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

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November 18, 1998

MEMORANDUM:

SUBJECT: **Errata Sheet** for EFED's Ethoprop RED Chapter Dated October 5, 1998.

TO: Kathryn Boyle, CRM
Betty Shackelford, Acting Chief
Reregistration Branch III
Special Review and Reregistration Division

FROM: N.E. Federoff, Wildlife Biologist
Dana Spatz, Team Leader
Environmental Risk Branch IV
Environmental Fate and Effects Division

THROUGH: Mah Shamim, Ph.D., Branch Chief
Environmental Risk Branch IV
Environmental Fate and Effects Division

As noted by Rhone Poulenc in their November 13 response to the EFED Preliminary Risk Assessment for Ethoprop, the Avian Acute Risk Quotient table on page 35 contained several calculational errors. The table attached to this memo is an update.

The risk conclusions remain the same.

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Avian Acute Risk Quotients for Granular Products (Banded or In Furrow).

Site/Method Band Width (feet)	oz. ai/1000 ft of Row	Bird Type and Body Weight (g)	% (decimal) of Pesticide Left on the Surface	Exposed mg/ft²	LD_{50} (mg/kg)	Acute RQ[1] (LD_{50}/ft^2)
Sugarcane/ 4 lbai/a Banded-Incorporated						
1	8.96	Songbird 20	0.15	38.10	4.21	452.49
1	8.96	Upland Gamebird 180	0.15	38.10	7.5	28.22
1	8.96	Waterfowl 1000	0.15	38.10	12.6	3.02
Tobacco/ 12 lbai/a Banded-incorporated						
2	15.36	Songbird 20	0.15	32.66	4.21	387.89
2	15.36	Upland Gamebird 180	0.15	32.66	7.5	24.20
2	15.36	Waterfowl 1000	0.15	32.66	12.6	2.59
Beans/ Potatoes/ Corn 3 lbai/a Banded-incorporated						
1	3.2	Songbird 20	0.15	13.61	4.21	161.64
1	3.2	Upland Gamebird 180	0.15	13.61	7.5	10.08
1	3.2	Waterfowl 1000	0.15	13.61	12.6	1.08
Cucumber/ 2 lbai/a Banded-incorporated						
1.25	5.12	Songbird 20	0.15	17.42	4.21	206.89
1.25	5.12	Upland Gamebird 180	0.15	17.42	7.5	12.90
1.25	5.12	Waterfowl 1000	0.15	17.42	12.6	1.38

[1] $RQ = \frac{\text{oz. ai per 1000 ft.} * 28349 \text{ mg/oz} * \text{\% Unincorporated / bandwidth (ft)} * 1000 \text{ ft}}{LD_{50}\text{(mg/kg)} * \text{Weight of the Animal (g)} * 1000 \text{ (g/kg)}}$

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D237118,D237119,D237120,D240089,D242567,D242881,D239731,D207807
D238996

MEMORANDUM

SUBJECT: Environmental Fate and Effects Division RED Chapter for **Ethoprop**

TO: Betty Shackelford, Acting Branch Chief
Reregistration Branch III
Special Review and Reregistration Division (7508W)

FROM: Sid Abel, Environmental Scientist
N.E. Federoff, Wildlife Biologist
Dana Spatz, Chemist, Branch Team Leader
Ann Stavola, Senior Biologist, Task Team Leader
Environmental Risk Branch IV Team for Ethoprop
Environmental Fate and Effects Division (7507C)

10/13/98

THROUGH: Mah T. Shamim, Ph.D., Chief
Environmental Risk Branch IV / EFED (7507C)

This memo summarizes the attached EFED Environmental Risk Assessment (science chapter) for the Ethoprop Reregistration Eligibility Decision document. It includes recommendations for labeling and mitigation measures and identifies gaps and uncertainties resulting from outstanding data requirements. **All uses at all labeled rates resulted in high risks to all terrestrial and aquatic animals, except for turf slit-placement uses.**

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SUMMARY OF CONCERNS

Avian Risk

- Acute high risk and chronic avian LOC's are exceeded for single broadcast applications of nongranular products at registered maximum application rates equal to or above 1 lb ai/A.

- Acute high risk and chronic avian LOC's are exceeded for multiple broadcast applications of nongranular products at registered maximum application rates equal to or above 6 lbs ai/A.

- Acute high risk avian LOC's are exceeded for broadcast applications of granular products at registered minimum application rates of 1.5 lbs ai/A.

- Acute high risk avian LOC's are exceeded for a range of avian species from banded/in-furrow applications of granular products at registered maximum application rates.

Mammalian Risk

- Acute high risk mammalian LOC's are exceeded for single broadcast applications of nongranular products for all feed items other than seeds at registered maximum application rates equal to or above 3 lbs ai/A.

- Mammalian chronic LOC's are exceeded for all feed items other than seeds (which are exceeded at or above 2 lbs ai/A) at registered maximum application rates equal to or above 1 lb ai/A.

- Acute high risk mammalian LOC's are exceeded for banded/in-furrow granular products at registered maximum application rates.

Risk to Freshwater Fish

- Acute high risk LOC's are exceeded for the cucumber, golf course broadcast, and potato (sweet) uses.

- The chronic risk LOC is exceeded for freshwater fish for all model uses other than peanuts and golf course slit placement uses.

Risk to Freshwater Invertebrates

- Acute high risk LOC's are exceeded for all uses except golf course turf slit and peanut uses.

- The chronic LOC is exceeded for all uses except golf course slit use.

Risk to Estuarine and Marine Animals

- Acute high risk LOC's are exceeded for estuarine fish and invertebrates for all uses other than golf course turf slit use.

- The chronic LOC is exceeded for estuarine fish and invertebrates for all uses other than golf course turf slit use.

Data Gaps

Environmental Fate: All environmental fate data requirements have been satisfied. However, submission of an Aerobic Aquatic Metabolism study could reduce the amount of uncertainty associated with this potential route of dissipation and hence, possibly lower the aquatic EEC's.

Ecological Effects: The environmental toxicity database for ethoprop technical is largely complete and adequate for the present risk assessment. However, valid avian reproduction studies are needed to properly assess chronic risk to avian species. The two avian reproduction studies that were submitted were deficient as they did not generate NOEC values, which are the regulatory endpoints needed to assess chronic risks to wildlife. Freshwater and estuarine fish life-cycle tests are also required. Ethoprop is highly persistent in water and is likely to adversely affect fish reproduction, which is not a measurement endpoint in the fish early life stage studies that were submitted.

Risk Reduction

Given the extent and magnitude of LOC exceedences, EFED does not believe the risks from the use of Ethoprop can be mitigated effectively.

Recommended Label Language

EFED recommends that the following language be included on the appropriate labels.

Statement to minimize the potential for surface water contamination for all end-use products:

This chemical can contaminate surface water through ground spray applications. Under some conditions, it may also have a high potential for runoff into surface water after application. These include poorly draining or wet soils with readily visible slopes toward adjacent surface waters, frequently flooded areas, areas overlaying extremely shallow ground water, areas with in-field canals or ditches that drain to surface water, areas not separated from adjacent surface waters with vegetated filter strips, and areas over-laying tile drainage systems that drain to surface water.

Label statements for toxicity to nontarget organisms:

Manufacturing Use Products

This pesticide is toxic to aquatic organisms (fish and invertebrates) and wildlife. Birds feeding in treated areas may be killed. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) 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.

End Use Products: Non-granular formulations

This pesticide is toxic to aquatic organisms (fish and invertebrates) and extremely toxic to birds. Cover or disc all spill areas. Birds feeding in treated areas may be killed. Do not apply directly to water or to areas where surface water is present or to intertidal areas below the mean high-water mark. Drift and runoff may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwater or rinsate.

End Use Products: Granular formulations

This pesticide is toxic to aquatic organisms (fish and invertebrates) and wildlife. Birds feeding in treated areas may be killed. Do not apply directly to water or to areas where surface water is present or to intertidal areas below the mean high-water mark. Runoff may be hazardous to aquatic organisms in neighboring areas. Cover, incorporate, or clean up spills. Do not contaminate water when disposing of equipment washwater or rinsate.

ENVIRONMENTAL RISK ASSESSMENT FOR ETHOPROP

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ENVIRONMENTAL RISK ASSESSMENT

USE CHARACTERIZATION

Ethoprop is a restricted use organophosphate pesticide developed for control of soil insects and includes granular (G) and spray formulations (EC and SC/L). Ethoprop has been registered since the late 1960s for use on a variety of crops and turf grasses and may be formulated with other pesticides and fertilizers. The pesticide may be applied by ground application methods only and one application per season is permitted (exceptions are peanuts, pineapples and golf course turf). There are no registered homeowner uses. Most use occurs in Florida (52%). Sugarcane accounts for 43% of the total active ingredient used, with potatoes (24%), tobacco (12%), other (15%), and corn (6%) accounting for the remainder (Doanes Market Research, 1996).

Crop	Product	lbs ai/A/season	# Apps	Application Methods
Potatoes	EC G	3-12 12	1 1	Band incorporated at plant; Broadcast incorporated before planting
Sugarcane	EC G	4 4-6	1 1	Band incorporated at plant Soil in-furrow
Tobacco	EC G SC/L	2-12 8-12 12	1 1 1	Band incorporated or broadcast incorporated
Peanut	EC G SC/L	2-4-6 3-6 6	1 1 1	Band incorporated at pegging; Band incorporated at plant or broadcast incorporated at preplant
Sweet Potatoes	EC G SC/L	3-8 8 8	1 1 1	Band or broadcast incorporated 2-3 weeks preplant
White/Irish Potatoes	EC G SC/L	12 3-12 12	1 1 1	Band incorporated
Beans	EC G SC/L	1-6-8 8 8	1 1 1	Band incorporated at plant or broadcast incorporated at preplant
Cabbage	EC G SC/L	2-4.5-5 5 5	1 1 1	Band incorporated at plant or broadcast incorporated at preplant
Cucumber	G SC/L	1.5-2 5	1 1	Band incorporated at or just prior to plant
Pineapple (Hawaii only)	EC G SC/L	3-48 1.2 6	multiple	Apply through drip irrigation at or post plant and every 2 months thereafter; soil band treatment (G)
Golf Turf	G	7.5-10-20	60 day min. Interval	Broadcast on turf and immediately incorporated with at least 0.1" of rainfall or irrigation; slit incorp 1.5" between slits
Banana/ Plantain	EC G	low use 0.01323	as needed	Soil broadcast
Citrus seedlings	EC	5	1	Soil band incorporated
Ornamentals	EC G SC/L	6 4 6	1 1 1	Soil band
Corn	EC G	2-6 3-6	1 1	Band incorporated at plant

EC= Emulsifiable concentrate
G= Granular
SC/L= Soluble concentrate/liquid

EXPOSURE CHARACTERIZATION

Chemical Name: O-ethyl S,S-dipropylphosphorodithioate

Physical/Chemical properties:

Molecular formula:	$C_8H_{19}O_2PS_2$
Molecular weight:	242.3
Physical state:	clear pale yellow liquid
Vapor pressure (26°C):	3.5×10^{-4} mmHg
Solubility (20°C):	843 mg/L water

Nomenclature for ethoprop degradates:

O-ethyl-S-methyl-S-propylphosphorodithioate (SME)
O-ethyl-O-methyl-S-propylphosphorothioate (OME)
O-ethyl-S-propylphosphorothioate (M1)
S,S-dipropylphosphorodithioate (M2)

a. *Environmental Fate Assessment*

Ethoprop is a soluble (aqueous solubility: 843 ppm) and somewhat volatile (vp: 3.5×10^{-4} mmHg at 26°C) insecticide. Laboratory studies have shown ethoprop to be fairly persistent. However, in the field ethoprop can dissipate rapidly, depending upon the moisture and temperature of the soil; with dissipation being more rapid under warm moist conditions. Based on mobility data, ethoprop can be expected to leach, though according to EPA's *Pesticides in Ground Water Database - 1992*, no ground water detections have been reported with over 1350 wells sampled. Because of its high solubility and low K_d's, ethoprop also has the potential to contaminate surface water through dissolved runoff. Ethoprop is however either mechanically incorporated or watered into the soil, which will in turn reduce the runoff potential.

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i. ***Degradation and Metabolism***

Chemical Degradation

Ethoprop is stable to hydrolysis at pH's 5, 7, and 9 and also does not undergo photodegradation in water or on soil. In the hydrolysis study, ethoprop comprised an average of 91.9% of the applied radioactivity in the pH 5 solution, 92.2% in the pH 7 solution, and 73.0% in the pH 9 solution. An extrapolated half-life of 83 days was estimated at pH 9. Two degradates were identified in the treated solutions: ethyl alcohol and S,S-dipropylphosphorodithioate. At 30 days, ethyl alcohol comprised an average of 4.3% of the applied in the pH 5 and 7 solutions and 21.2% in the pH 9 solution. S,S-dipropylphosphorodithioate, formed when ethyl alcohol cleaves from ethoprop, was present at less than 5% of applied radioactivity in the pH 9 study.

Ethoprop was stable to both direct and indirect (1% acetone) photolysis in water when continuously exposed to a xenon arc lamp for 30 days. No degradates were present at greater than 10% of applied. On sandy loam soil, ethoprop did not photodegrade when irradiated in a 12-hr exposed, 12-hr dark sequence by a filtered xenon arc lamp at 25°C for 30 days. After 30 days, the soil extracts had an average of 83.9% ethoprop, whereas 27% of the radioactivity was recovered from the 30 day exposed test system and tubing as volatile ethoprop. The degradates in the soil extracts comprised less than 10% of the applied radioactivity.

Microbial Degradation

An aerobic soil metabolism study established a half-life of 100 days in a loamy sand incubated at 25°C in the dark for 252 days. At 252 days posttreatment, 24.8% of the applied radioactivity was undegraded ethoprop. The major degradate was CO_2, which accounted for 53.9% of the applied radioactivity by the end of the study. The major nonvolatile degradates,

O-ethyl-S-methyl-S-propylphosphorodithioate (SME)
O-ethyl-O-methyl-S-propylphosphorodithioate (OME)
O-ethyl-S-propylphosphorothioate (M1)

each accounted for <4% of the applied at every sampling interval. Unextractable residues accounted for only 10.3% of the applied at 252 days posttreatment. Of the three soil metabolites, the one that accumulated to the greatest extent was M1, a product of microbially-mediated

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hydrolysis. The methylation of the hydroxylated M1 metabolite forming OME is a minor metabolic pathway. Another minor degradation pathway is the hydrolysis of ethoprop to M1 with subsequent methylation forming SME.

An anaerobic soil metabolism study showed a similar rate of degradation with a half-life of approximately 100 days. Ethoprop decreased from 79.2% to 58.2% of the applied radioactivity during 56 days of anaerobic incubation (flooded plus N_2 atmosphere) following 28 days of aerobic incubation in loamy sand soil maintained in the dark at 25°C. By day 56 of the anaerobic incubation, a total of 2.25% of the radioactivity had been evolved and 10.5% was unextractable. The degradates OME and M1 each accounted for <1% of the applied in both the flood water and soil extracts.

ii. Mobility

Ethoprop may be considered mobile in some soils. Freundlich K_d's were determined from a batch equilibrium study to be 1.08 in a sandy loam with 1.0% organic carbon, 1.24 in a sandy loam with 1.9% o.c., 2.10 in a silt loam (2.3% o.c.) and 3.78 in a silty clay (4.1% o.c.). Mobility information on the M1 degradate indicates that it is highly mobile with Freundlich adsorption values of 0.525 in a silt loam, 0.505 in a sandy loam, 0.527 in a loamy sand, 1.24 in a pond sediment, and 4.12 in a clay soil. K_{oc} values were 129, 109, 43, 50, and 1652, respectively. The mobility of the other degradates; S,S-dipropylphosphorodithioate, OME and SME is not known. However, the similarity in structure of these degradates with ethoprop and the M1 metabolite, suggests that the chemicals will all have similar K_{oc} values.

In a laboratory volatility study, volatiles comprised up to 7.1% of the applied dose; the mean value was 3.77%. Ethoprop comprised 21.3 - 52% of the volatile components on day 7, the last day of sampling. The vapor pressure of ethoprop is somewhat moderate at 3.49×10^{-4} mmHg and its Henry's Law Constant is also moderately low at 1.5×10^{-7} atm m^3/mol, indicating that it is not expected to volatilize from water to any great extent.

iii. Field Dissipation

Two registered formulations of ethoprop (MOCAP 10G and MOCAP EC), were applied and soil incorporated at the maximum label rate of 12 lbs ai./A. In a potato field in **Washington**, characterized by cool, sandy, low organic soils, ethoprop dissipated with a half-life of

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approximately 40 days. At a **North Carolina** site, characterized by wet soils as well as warm temperatures and moderately organic loamy soils, ethoprop dissipated rapidly with a half-life of approximately 10 days.

Dissipation followed first-order kinetics in all four plots and appeared to be independent of the formulation used. Ethoprop was found primarily in the 0.0 - 0.15 m and 0.15 - 0.3 m depth increments. However, significant residues were detected in the 0.3 - 0.6 m increment in North Carolina soil (0.43 µg/g at 1 month, EC formulation; 0.20 µg/g at 2 weeks, granular formulation). This leaching may have been exacerbated by the above average heavy rainfall at the site.

Ethoprop (MOCAP® 10G, 10% a.i.), broadcast applied at a nominal concentration of 20.0 lbs a.i./A, dissipated with calculated half-lives of 18 days and 13 days on turf and bareground sandy loam soil plots located in **Wilson County, North Carolina**. However, because the parent compound dissipated rapidly, but the calculated half-life values were based on data collected throughout the study period, the reported half-lives may have been overestimated. The observed DT_{50} was between 0 and 3 days posttreatment in both turf and bareground plots.

Following application to the **bareground plot**, the parent compound was detected in the 0- to 15-cm depth at 8.35 ppm at 0 days posttreatment, decreased to 3.22 ppm by 0.12 months (3 days) posttreatment and 1.19 ppm by 0.50 months (16 days) posttreatment, and was 0.02 ppm at 4 months posttreatment. The parent compound was detected in the 15- to 30-cm depth at 0.03-0.04 ppm (in only 2 of 4 replicates) at 0.25 months (7 days) posttreatment and at 0.06 ppm (1 replicate) at 0.50 months (16 days) posttreatment. The major degradate, O-ethyl-S-propylphosphorothioic acid (M1), was detected in the 0- to 15-cm depth at 0.015 ppm at 0 days posttreatment and was a maximum concentration of 0.04 ppm at 0.12 months (3 days) and 0.25 months (7 days) posttreatment, and was not detected by 0.50 months (16 days) posttreatment. The degradate M1 was not detected above the limit of quantitation at lower depths.

Following application to the **turf plot**, ethoprop was initially present in the thatch at 55.26 ppm, decreased to 19.63 ppm by 0.12 months (3 days) posttreatment and 4.17 ppm by 1 month posttreatment, and was present at 0.69 ppm at 4 months posttreatment. The parent compound was observed in soil samples from the 0- to 15-cm depth immediately after application at 0.66 ppm, decreased to 0.33 ppm by 0.12 months (3 days) posttreatment and 0.048 ppm by 0.50 months (16 days) posttreatment, and was below the limit of quantitation by 3 months posttreatment. The parent compound was observed in the 15- to 30-cm depth at 0.02-0.05 ppm (in two replicates) at 0.12 months (3 days) posttreatment, but was not detected above the limit of quantitation at any other sampling interval at that depth or at lower depths. The major degradate, O-ethyl-S-propylphosphorothioic acid (M1), was detected in the thatch at 0.14 ppm at 0 days posttreatment, decreased to 0.05 ppm by 0.50 months (16 days) posttreatment, and was below the limit of quantitation by 3 months posttreatment. The degradate M1 was not observed above the limit of quantitation in soil samples from the 0- to 15-cm depth other than in one replicate (0.02 ppm) at 0.12 months (3 days) posttreatment. The degradate M1 was not observed above the limit of quantitation at lower depths.

Ethoprop (MOCAP® 10G, 10% a.i.), broadcast applied at a nominal concentration of 20.0 lb a.i./A, dissipated with calculated half-lives of 9 days and 12 days on turf sand soil and bareground loamy sand soil plots in Jefferson County, Florida. However, because the parent compound dissipated rapidly, but the calculated half-life values were based on data collected throughout the study period, the reported half-lives may have been overestimated. The observed DT_{50} was between 0 and 3 days posttreatment in bareground plots and between 0 and 7 days in turf plots.

Following application to the **bareground plot**, ethoprop was detected in the 0- to 15-cm depth at 10.27 ppm at 0 days posttreatment, decreased to 2.55 ppm by 0.12 months (3 days) posttreatment and 0.06 ppm by 1 month posttreatment, and was present at 0.01-0.02 ppm (in two replicates only) at 4 months posttreatment. The parent compound was detected in the 15- to 30-cm depth at a maximum of 0.09 ppm at 0.12 months (3 days) posttreatment, decreased to 0.07 ppm by 0.25 months (7 days) and was not above the limit of quantitation by 1 month posttreatment. The parent compound was not detected in the 30- to 45-cm depth other than in one replicate (0.16 ppm) at 0.25 months (7 days) posttreatment. The parent compound was not detected above the limit of quantitation at lower depths. The major degradate, O-ethyl-S-propylphosphorothioic acid (M1), was detected in the 0- to 15-cm depth at 0.03 ppm at 0 days posttreatment, and was not detected above the limit of quantitation at any other sampling interval with the exception of 0.12 months (3 days) posttreatment (0.02 ppm in one replicate only). The degradate M1 was not detected above the limit of quantitation at lower depths.

Following application to the **turf plot**, ethoprop was initially present in the thatch at 103.30 ppm, decreased to 27.40 ppm by 0.12 months (3 days) posttreatment and 0.82 ppm by 1 month posttreatment, and was 0.06 ppm at 4 months posttreatment. The parent compound was detected in soil samples from the 0- to 15-cm depth at 1.43 ppm at 0 months posttreatment,

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decreased to 0.62 ppm by 0.25 months (7 days) and 0.06 ppm by 1 month posttreatment, and was not detected above the limit of quantitation by 2 months posttreatment. The parent compound was observed in the 15- to 30-cm depth at 0.14 ppm at 0.12 months (3 days) posttreatment, decreased to 0.03 ppm by 0.50 months (16 days) posttreatment and was below the limit of quantitation by 1 month posttreatment. In the 30- to 45-cm depth, the parent compound was detected at 0.03 ppm at 0.12 months (3 days) posttreatment and was not detected or was below the limit of quantitation by 0.50 months (16 days) posttreatment. Ethoprop was detected only sporadically in the 45- to 60-cm and lower depths. The major degradate, O-ethyl-S-propylphosphorothioic acid (M1), was detected in the thatch at 0.60 ppm at 0 days posttreatment, was a maximum of 0.69 at 0.12 months (3 days) posttreatment, decreased to 0.36-0.42 ppm by 0.25-0.50 months (7-16 days) posttreatment, and was below the limit of quantitation by 2 months posttreatment. Other than in sporadic observations, M1 was not detected above the limit of quantitation in the soil.

The differences between the half-lives in the laboratory studies versus the field studies may be due in part to leaching/runoff, as well as increased soil moisture and temperature in the field soils. Previous work with the organophosphate insecticides has shown that volatilization and microbial degradation increases as soil moisture content and temperature increases. The field dissipation rates are likely a result of microbial degradation, leaching, runoff, plus volatilization.

iv. Accumulation

The results of a dynamic 49-day study (35 days uptake; 14 days depuration) of the bioconcentration of ethoprop maintained at a water concentration of approximately 2.0 µg/L by bluegill sunfish indicated that uptake tissue concentrations ranged from 11 to 180 µg/kg for fillet, 31 to 290 µg/kg for whole fish, and 47 to 480 µg/kg for viscera. Calculated BCF's were 86x, 140x, and 230x for fillet, whole fish, and viscera, respectively. Radioanalysis on day 14 of the depuration period indicated 50%, 38%, and 56% depuration from fillet, whole fish, and viscera, respectively. The fillet concentration of ethoprop dropped from a day 35 uptake value of 180 µg/kg to 90 µg/kg by day 14 of depuration. Whole fish levels decreased from 290 µg/kg on day 35 to 180 µg/kg by day 14 of depuration; whereas, viscera concentrations dropped from 480 µg/kg on day 35 to 210 µg/kg by day 14 of depuration.

b. Terrestrial Exposure Assessment

Nongranular applications: The terrestrial exposure assessment is based on Hoerger and Kenaga (1972), as modified by Fletcher et al (1994)[1]. Terrestrial estimated environmental concentrations (EECs) for nongranular formulations were derived from maximum application rates incorporating dissipation rates for ethoprop. Uncertainties arise from a lack of data on interception and dissipation from foliar surfaces.

Granular applications: EECs for broadcast granular applications are calculated on the basis of mass (in mg) per area (square foot), corrected for the fraction of the pesticide left on the surface. For unincorporated broadcast applications, the entire fraction of the pesticide is assumed to remain on the surface.

EECs on Avian and Mammalian Food Items From Applications of 1 lb ai/A (from Hoerger & Kenaga, 1972, modified by Fletcher et al, 1994).

Food Items	*Max. EEC (ppm) 1 lb ai/A*	*Mean EEC (ppm) 1 lb ai/A*
Short grass	240	85
Tall grass	110	36
Broadleaf plants and small insects	135	45
Fruits, pods, seeds, and large insects	15	7

1 Hoerger, F., and E.E. Kenaga. 1972. Pesticide residues on plants: Correlation of representative data as a basis for estimation of their magnitude in the environment. In F. Coulston and F. Korte, eds., *Environmental Quality and Safety: Chemistry, Toxicology, and Technology,* Georg Thieme Publ, Stuttgart, West Germany, pp. 9-28.

Fletcher, J.S., J.E. Nellessen, and T.G. Pfleeger. 1994. Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, an instrument for estimating pesticide residues on plants. Environ. Tox. Chem. 13:1383-1391.

c. *Water Resource Assessment*

i. Ground Water Assessment

Based on the laboratory studies conducted, it appears that ethoprop and its degradates could pose a significant threat to ground water resources. The chemical is considered mobile in most soils (K_{ads}=1.08-3.78). Additionally, ethoprop is somewhat resistant to aerobic soil metabolism ($t_{1/2}$=100 days). However, terrestrial field dissipation studies, as well as monitoring data, suggest that parent ethoprop should not pose a significant ground water contamination problem.

A substantial amount of ground water monitoring data has been collected and reported to the STORET system, USGS National Water Quality Assessment[2] (NAWQA) study, and the *Pesticide in Ground Water Database*[3] on the occurrence of ethoprop between 1981 and 1995. These data are summarized as follows:

> More than 5300 well water samples were analyzed and reported to STORET between 1981 and 1997. Less than one-tenth of one percent of these samples were reported as above the level of detection (LOD)(range 0.003 to 2.5 ug/l). All samples above the LOD were less than 1.0 ug/l. The majority of well water samples were collected outside the major use areas (Florida, Washington, Georgia, North Carolina, and Oregon) for ethoprop (ca. >80%).
>
> One set of samples collected at public ground water drinking water wells located in the Umatilla Well Field, Umatilla, Oregon, reported results below detection limits (0.03 ug/l) to 0.19 ug/l. Of note here is that one set of samples taken on the same day ahead of and behind the chlorinator indicated that treatment by this method has little effect on ethoprop; the concentration ahead of chlorinator was 0.14 ug/l and 0.19 ug/l behind the chlorinator (i.e. after treatment).

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[2]National Water Quality Assessment, Pesticide National Synthesis Project, Pesticides in Surface and Ground Water of the United States: Preliminary Results of the National Water Quality Assessment Program (NAWQA), Provisional Data, August 1997.

[3]Pesticide in Ground Water Database: A Compilation of Monitoring Studies: 1971-1991 National Summary. Published in September 1992. USEPA 734-12-92-001.

The USGS NAWQA program reported 2549 samples collected between 1991-1995 from 20 of the Nation's major watersheds. The maximum reported concentration (0.009 ug/l) occurred in an agricultural watershed. All other samples were reported as below the LOD (LOD = 0.003 ug/l). It is important to note that sampling was not conducted to specifically identify concentrations of ethoprop in verified use areas. No information on the use patterns of ethoprop were available at well locations, although ethoprop is known to be used in most of the watersheds sampled.

The Pesticide in Ground Water Database reported 1368 samples collected from 1983-1991 from eight geographically diverse states. Several of the monitored states include major use areas. No measurable concentrations of ethoprop were reported.

ii. Surface Water Assessment

Ethoprop can contaminate surface water via runoff if runoff-producing rain events occur up to months after application. Ethoprop will enter surface waters via dissolution in runoff and sorbed to suspended and eroding materials as suggested by it water solubility (843 mg/l) and its partitioning (K_{des}=1.08-3.78), respectively. It appears that ethoprop will be persistent in surface water as indicated by its aerobic soil metabolism ($T_{1/2}$= 100 days) especially in water with low to moderate microbial activity or where abundant alternative energy (carbon) sources are available. In waters with short hydrological residence times (streams and rivers), its persistence is limited by the flow out of the system more so than metabolism. However, its persistence in waters with high residence times (lakes and reservoirs) will be greater and controlled more so by metabolism.

Surface water monitoring data collected and reported to the STORET system on the occurrence of ethoprop between 1978 and 1997 indicates its presence in surface water in association with known use areas. Additionally, the USGS NAWQA program has collected and reported ethoprop concentrations from 20 major U.S. watersheds from 1991-1995. A summary of the data follows:

More than 6000 surface water samples have been analyzed and reported to STORET between 1978 and 1997. Samples were collected from a variety of surface water sources (lakes, reservoirs, streams, and canals) in many of the major ethoprop use areas. Most samples (ca >90%) were below the detection limit (LOD ranged from 0.003 ug/l to 1 ug/l).

The highest measured concentration, 3.1 ug/l, was sampled on Mill Creek in Marion County, Oregon, October 31, 1994. Subsequent sampling (two) on November 4, 1994 at the same location, measured ethoprop at 1.7 ug/l and 1.9 ug/l. At locations on other streams in Marion County, ethoprop was measured at up to 1.95 ug/l. Nearly all samples collected from streams in Marion County measured ethoprop above the detection limit of 0.003 ug/l. Sampling relative to ethoprop application timing could not be ascertained from the reported data. Marion County is within the Willamette Valley watershed, a major agricultural region.

The USGS NAWQA program sampled 20 major watersheds for the presence of ethoprop and other pesticides during its 1991-1995 Pesticide National Synthesis Project. The location of the 20 major watersheds covered a wide geographical area of the U.S., including several of the ethoprop use areas (e.g., Oregon and Washington), but did not include the major use area of Florida where sugarcane is produced. The reported results of 5119 analyzed samples is a follows:

Minimum reported concentration:	0.003 ug/l;
Maximum reported concentration:	2.000 ug/l;
Average reported concentration:	0.004 ug/l.

The majority of samples above the LOD, including the highest measured concentration, were found in the Willamette Basin. The NAWQA data confirms concentrations reported to the STORET data base from other studies. Most samples in the Willamette basin were collected once per year at the various stations within the basin, therefore, long-term concentrations were not estimated. Additionally, many of the samples were not collected at or near the height of the hydrograph, thus peak concentrations may not have been captured.

The NAWQA results have not been corrected for recovery because the specific recovery for each sample was not available at the time of review. Insufficient samples were collected from any one NAWQA site in a given year to estimate time weighted annual means. The use of NAWQA data for exposure assessment purposes is limited by the absence of sample collection

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during peak runoff potential for any specific pesticide, no correlation with known use patterns, insufficient sample frequency at any given site, and sometimes poor analytical recoveries (note: ethoprop recovery was 84 percent with a standard deviation of 6).

The South Florida Water Management District (SFWMD), Water Quality Monitoring Division sampled surface waters for pesticide residues including ethoprop. Surface water samples collected and analyzed from November 1988 to November 1993 at 27 sites did not contain concentrations of ethoprop above the detection limits. Samples were collected at various times during the year, biannually to every 2 months. Detection limits (either practical or method) ranged from 0.06 ug/l (2 sampling events in 1988) to 0.731 ug/l. All sugarcane grown in Florida (approximately 428,000 acres) is within the SFWMD. Additionally, approximately 44,000 acres of golf courses and 155,000 acres of truck crops are also located in the SFWMD on which ethoprop may be applied. Approximately 40 tons/year of ethoprop were reported used in the SFWMD during the study period; Rhone-Poulenc reported 43 percent of its production volume is used on sugarcane (mainly in Florida) or approximately 215 tons.

Although the levels of ethoprop found in the various studies suggest that ethoprop does not appear to exceed concentrations above the very low ug/l range, the reported samples were not correlated with use patterns, were collected randomly throughout the year, and were of insufficient numbers to make definitive statements as to extent of contamination of surface waters. Additionally, information on the site characteristics within the monitored basins would be necessary to understand the relative vulnerability of the recipient surface waters.

d. Aquatic Exposure Assessment[4]

Estimated Environmental Concentrations (EECs) in aquatic environments, specifically, edge-of-field ponds, using PRZM-EXAMS are presented in Table 3. The Pesticide Root Zone Model (PRZM 3.1) simulates pesticide field runoff on daily time steps, incorporating runoff, infiltration, erosion, and evaporation. The model calculates foliar dissipation and runoff, plant uptake, microbial transformation, volatilization, and soil dispersion and retardation. The Exposure Analysis Modeling System (EXAMS 2.97.5) simulates pesticide fate and transport in an aquatic environment.

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[4]Abel, S. 1998. Ethoprop Tier II EEC's. DP Barcode 242567. Memorandum to Judith Loranger, OPP/SRRD and Kit Farwell, OPP/HED. May 26, 1998.

Estimated EECs for Florida cucumbers are considerably higher than other crop uses due to the characteristics of the modeled soil. The soil, a Riviera sand, is a very poorly draining soil that is often flooded for portions of the year. Crops, especially vegetable truck crops, that are grown on these soil are done so after intensive draining through the use of canals or tile drain networks. The PRZM-EXAMS simulation is not capable of factoring in artificial drainage networks directly. Although modification of runoff curve numbers could be used to account for these changes, data to support a change in these values were unavailable. Therefore, the simulation reflects unaltered soil characteristic for the modeled soil and the resulting surface water concentrations from those characteristics.

Surface water assessments for turf uses of pesticides, including home-owner lawn and golf course uses are limited to an initial screen using GENEEC. A PRZM-EXAMS simulation for golf courses was performed after obtaining information on the area of land necessary to construct an 18-hole course, estimates of amounts of water hazards, and percent of fairways and tees for courses in the U.S. Limited information was available for the specific region, however, the ratio of land area to water hazard volume of 5.0 used in the standard pond was characterized as lower than that for most golf courses (electronic communications with several golf course architects contacted on the GOLFWEB homepage (http://www.golfweb.com). Therefore, assuming that a treated golf course is at least as conservative as an agricultural field in terms of this ratio, the estimated concentrations from ethoprop use on golf courses will represent a high-end concentration (>90 percent exposure on the probable distribution), but not likely an upper-bound concentration.

Environmental fate studies indicate that ethoprop will tend to remain in the water column and persist.

e. *Estimated Water Concentrations For Drinking Water*

The estimated concentrations provided in Table 3 for drinking water are for the parent ethoprop only. Ethoprop degradates, which have been included in the tolerance expression, are not included in the modeling due to the absence of necessary fate information. Considering the limited presence of these degradates in the laboratory and field studies, ethoprop degradates will not add appreciably to the concentration of parent ethoprop in ground or surface water in most use areas. Should specific environmental concentrations of ethoprop and ethoprop degradation products become necessary because the margin of exposure leaves little room for uncertainties,

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then it may be necessary to perform additional laboratory studies on the degradates as well as a more intense review of the monitoring data.

i. Ground Water Sources

A preliminary ground water assessment was made using the Screening Ground Water model SCI-GROW[5] to estimate the "maximum" ground water concentrations from the application of a pesticide to crops. SCI-GROW is based on the fate properties of the pesticide, the annual application rate, and the existing body of data from small-scale ground water monitoring studies. The model assumes that the pesticide is applied at its maximum rate in areas where the ground water is particularly vulnerable to contamination. In most cases, a considerable portion of any use area will have ground water that is less vulnerable to contamination than the areas used to derive the SCI-GROW estimates. As such, the estimated maximum concentration derived using SCI-GROW should be considered a high-end to bounding estimate of "acute" exposure. The concentration for parent ethoprop estimated using SCI-GROW is approximately 25.0 ug/l using a maximum application rate of 20 lbs. per year, median Koc of 109, and a metabolism half-life of 100 days. The results of this model should be compared to available monitoring data when determining the potential for human exposure.

ii. Surface Water Sources

Tier II surface water drinking water EECs were calculated using PRZM 3.1 to simulate the agricultural field and EXAMS 2.97.5 for fate and transport in surface water. Spray drift was not simulated for ethoprop.

Environmental fate parameters used to estimate ethoprop EECs can be found in *Section a.* of the *Exposure Characterization.* The scenarios chosen for ethoprop and the application rates, numbers, and intervals are presented in Table 1. Scenarios were chosen to represent sites that were expected to produce runoff at greater than 90% of the sites where the appropriate crop is grown. Model simulation were made with the maximum application rates. Tier II one-in-ten year (upper tenth percentile) EECs are presented in Table 3 for all time intervals except the annual average. The annual average is reported as the overall mean concentration. The EECs have been

[5]Barrett, M. 1997. SCI-GROW; "A proposed method to determine screening concentration estimates for drinking water from ground water sources." Draft. USEPA/OPP/EFED, September 1997.

calculated so that in any given year there is a 10% probability that the maximum average concentration of that duration in that year will equal or exceed the EEC at the site.

TABLE 1. Crop Specific Inputs to PRZM/EXAMS for Ethoprop

CROP	App Rate (lbs)	App No	App. Interval (days)	App Method	Scenario Location
Beans	8	1	NA	Broadcast	Michigan
Cabbage, California	5	1	NA	Broadcast	California
Cabbage, New York	5	1	NA	Broadcast	New York
Corn	6	1	NA	Broadcast	Ohio
Cucumbers	2	1	NA	Broadcast	Florida
Golf Courses, Broadcast	20	2	60	Broadcast	Florida
Golf Courses, "Slit"	20	2	60	Incorporated at 1 inch	Florida
Peanuts	6	1	NA	Broadcast	Georgia
Potatoes, Irish, etc.	12	1	NA	Broadcast	Maine
Sugarcane	4	1	NA	Broadcast	Louisiana
Sweet Potatoes	8	1	NA	Broadcast	Louisiana
Tobacco	12	1	NA	Broadcast	North Carolina

TABLE 2. Fate Parameters Used for PRZM/EXAMS Modeling

Chemical Parameter	*Value*	*Model Input*
Molecular Weight	242.33	242.33
Vapor Pressure	3.49E-04	3.49E-04
Henry's Law Constant	1.49E-07	1.49E-07
Solubility	843 mg/L @ 21°C	843 mg/L @ 21°C
Hydrolysis	Stable	No Value
Photolysis	Stable	No Value
Aerobic Soil Metabolism	300 days (X3 for single study)	PRZM 0.0023 day^{-1} EXAMS 9.6E-05 hr^{-1}
Anaerobic Soil Metabolism	300 days (X3 for single study)	PRZM 0.0023 day^{-1} EXAMS 9.6E-05 hr^{-1}
Aerobic Aquatic Metabolism	No study conducted	EXAMS 4.8E-05 hr^{-1}
Adsorption (Kd)	2.10 (silt loam)	2.10

TABLE 3. PRZM/EXAMS Surface Water Concentrations for Ethoprop (ppb)

Crop	Peak	4-Day	21-Day	60-day	90-day	Overall Mean*
Beans	75.0	75.0	74.0	71.0	68.0	36.0
Cabbage California	17.0	17.0	16.0	16.0	15.0	8.0
Cabbage, New York	24.0	24.0	24.0	23.0	22.0	13.0
Corn	26.0	26.0	25.0	24.0	23.0	10.0
Cucumber	580.0	580.0	570.0	540.0	520.0	210.0
Golf Courses, Broadcast	650.0	640.0	630.0	600.0	580.0	290.0
Golf Courses, "Slit"	0.0	0.0	0.0	0.0	0.0	0.0
Peanuts	16.0	16.0	15.0	15.0	14.0	6.0
Potatoes, Irish, etc	29.0	29.0	28.0	27.0	26.0	12,0
Sugarcane	74.0	74.0	73.0	71.0	70.0	20.0
Sweet Potatoes	180.0	180.0	180.0	170.0	170.0	80.0
Tobacco	65.0	65.0	63.0	60.0	59.0	21.0

*The overall mean concentrations are the mean of means for all years simulated. These estimated concentrations are the requested values for use in all chronic non-cancer and carcinogenic risk assessments.

iii. Use of Screening Estimates for Drinking Water Assessments

EFED recommends that the EECs generated from SCI-GROW (for ground water sources) and from PRZM-EXAMS (for surface water sources) be used ***only*** for a screening drinking water risk assessment for the parent ethoprop. Additionally, the monitoring data reported here are not sufficiently reliable and of adequate quantity for use in a higher tiered drinking water assessment. All monitoring data that could be traced to its original owner could not be correlated with a specific use pattern or to drinking water intakes. Several studies were specifically targeted to drinking water sources and as such, can be used as evidence that under the conditions of use and site characteristics of the study unit, ethoprop concentrations are less than those estimated by the models; in some instances, e.g., Florida golf courses and cucumbers and Louisiana sweet potatoes, up to two orders of magnitude.

Model predictions provide a screen to eliminate those chemicals that are not likely to cause concerns in drinking water. Exceedances in drinking water risk assessments using the screening model estimates do not necessarily mean a risk actually exists but point to the need for better data (e.g., monitoring studies specific to use patterns and drinking water sources) on which to make a finding.

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ECOLOGICAL EFFECTS HAZARD ASSESSMENT

Toxicity testing reported in this section does not represent all species of birds, mammals, or aquatic organisms. Only two **surrogate species** for both freshwater fish and birds are used to represent all freshwater fish (2000+) and bird (680+) species in the United States. For mammals, acute studies are usually limited to Norway rat or the house mouse. Estuarine/marine testing is usually limited to a crustacean, a mollusk, and a fish. Also, neither reptiles nor amphibians are tested. The assessment of risk or hazard makes the assumption that avian and reptilian toxicity are similar. The same assumption is used for fish and amphibians.

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a. Toxicity to Terrestrial Animals

i. Birds, Acute and Subacute

Avian Acute Oral Toxicity

Species	% ai	LD_{50} (mg/kg)	Toxicity Category	Acc No. Author/Year	Study Classification[1]
Mallard duck *(Anas platyrhynchos)*	95.8	12.6	Highly toxic	00160000 FWS (Hudson et al. 1984)	Core
Mallard duck *(Anas platyrhynchos)*	94	61.0	Moderately toxic	00092147 Fink, 1978	Core
Mallard duck *(Anas platyrhynchos)*	95.8	12.6	Highly toxic	05008363 Hudson, 1979	supplemental
Coturnix quail (*Coturnix sp.*)	95.8	7.5	Very highly toxic	GS0106004 Schafer, 1979	supplemental
Grackle (*Quiscalus quiscula*)	95.8	10.0	Highly toxic	GS0106004 Schafer, 1979	supplemental
Rock dove (*Columba livia*)	95.8	13.3	Highly toxic	GS0106004 Schafer, 1979	supplemental
Starling (*Sturnus vulgaris*)	95.8	7.5	Very highly toxic	GS0106004 Schafer, 1979	supplemental
Domestic hen (*Gallus domesticus*)	technical	5.62	Very highly toxic	00078038 Hazelton labs, 1966	supplemental
House Sparrow (*Passer domesticus*)	95.8	4.21	Very highly toxic	GS0106004 Schafer, 1979	supplemental
Red winged Blackbird (*Agelaius phoeniceus*)	95.8	4.21	Very highly toxic	GS0106004 Schafer, 1979	supplemental
Ring-necked Pheasant *(Phasianus colchicus)*	95.8	4.21	Very highly toxic	00160000 FWS (Hudson et al. 1984)	supplemental

[1] Core (study satisfies guideline).

Since the LD_{50} falls in the range of 4.21 to 61.0 mg/kg, ethoprop is considered to be very highly to moderately toxic to avian species on an acute oral basis. Ethoprop is a Restricted Use pesticide (LD_{50}<50 mg/kg). The guideline (71-1) is fulfilled (ACC# 00160000 and 00092147).

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Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC_{50} (ppm)[1]	Toxicity Category	Acc No. Author/Year	Study Classification
Mallard duck (10 da old) *(Anas platyrhynchos)*	95.8	550	moderately toxic	00022923 Hill, 1975	core
Japanese quail *(Coturnix japonica)*	95.8	100	highly toxic	00022923 Hill, 1975	Supplemental
Northern bobwhite quail *(Colinus virginianus)*	95.8	33	very highly toxic	00022923 Hill, 1975	core
Ring-necked Pheasant *(Phasianus colchicus)*	95.8	118	highly toxic	00022923 Hill, 1975	core
Mallard duck (5 da old) *(Anas platyrhynchos)*	95.8	287	highly toxic	00022923 Hill, 1975	core

[1] Test organisms observed an additional three days while on untreated feed.

Since the LC_{50} falls in the range of 33 to 550 ppm, ethoprop is considered to be very highly to moderately toxic to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled. (ACC# 00022923). For formulated products containing ethoprop (10GR), LC_{50}'s ranged from 86 to 340 ppm, which classifies 10GR as highly toxic (Acc# 0078041 and 091295).

ii. Birds, Chronic

Avian reproduction studies using the TGAI are required for ethoprop because birds may be subject to repeated or continuous exposure to the pesticide, especially preceding or during the breeding season.

Avian Reproduction

Species/ Study Duration	% ai	NOEC/LOEC (ppm)	LOEC Endpoints	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	96.8	ND/7.5	Reductions in viable and live embryos, eggs set of eggs laid, and female body wts.	443127-01 Taliaferro and Miller (1997)	Supplemental (not repairable)
Mallard duck *(Anas platyrhynchos)*	96.8	ND/40	Reductions in eggs laid, eggs set, viable and live 3 wk embryos, normal hatchlings, 14 da survivors, eggs set	443127-02 Taliaferro and Miller (1997)	Supplemental (not repairable)

The guideline (71-4) is not fulfilled as the studies did not generate NOEC values.

iii. Mammals, Acute and Chronic

Wild mammal testing is required on a case-by-case basis, depending on the results of lower tier laboratory mammalian studies, intended use pattern and pertinent environmental fate characteristics. In most cases, rat or mouse toxicity values obtained from the Agency's Health Effects Division (HED) substitute for wild mammal testing. These toxicity values are reported below.

Mammalian Toxicity: Acute

Species	% ai	Test Type	Toxicity Value (mg/kg)	Author/year	Acc No.
laboratory rat *(Rattus rattus)*	technical	LD_{50}	32.8 (highly toxic)	Hazelton labs (1965)	00078035
	metabolite				
	SME	LD_{50}	50.0 (highly toxic)	Weiler (1997)	
	OME	LD_{50}	22.4 (highly toxic)	Weiler (1997)	444725-01
	M1	LD_{50}	1608 (slightly toxic)	Weiler (1997)	
	technical	dermal	8.5 (highly toxic)	1987	429795-02

The results suggest that technical ethoprop is highly toxic to mammals from acute oral and dermal routes of exposure. Also the metabolites (letter concerning metabolites to HED from M. Weiler, Covance Labs, 11/12/97) are highly to slightly toxic to mammals on an acute oral basis.

Mammalian Toxicity: Chronic

Rat 2-generation reproduction study (MRID 419212-01):Supplemental

NOEL= 2.3 mg/kg/da (30 ppm)

LOEL= 13 mg/kg/da (150 ppm)

Effects= Decrease in Body wt. Both in P1 and offspring

P1 (parental) PB ChE NOEL/LOEL= 1.0/30 ppm

P1 (parental) R ChE NOEL/LOEL= 150/>150 ppm

iv. Insects

Nontarget Insect Acute Contact Toxicity

Species	% ai	LD_{50} (μg/bee)	Toxicity Category	ACC No. Author/Year	Study Classification
Honey bee *(Apis mellifera)*	technical	2.58	Moderately toxic	00066220 Atkins et al. 1976	core
Honey bee *(Apis mellifera)*	technical	5.6	Moderately toxic	00043714 Atkins et al. 1975	core

The results indicate that ethoprop is moderately toxic to bees on an acute contact basis. The guideline (141-1) is fulfilled. (ACC# 00066220 and 00043714).

b. Toxicity to Freshwater Aquatic Animals

i. Freshwater Fish, Acute

Freshwater Fish Acute Toxicity

Species	% ai	96-hour LC_{50} (ppm)	Toxicity Category	MRID/ Acc No.	Study Classification
Goldfish (*Carassius auratus*)	Technical	13.6	Slightly toxic	0078042	Supplemental
Rainbow trout *(Oncorhynchus mykiss)*	92	1.02	Moderately toxic	ZUOETH01	Supplemental
Rainbow trout *(Oncorhynchus mykiss)*	92	1.15	Moderately toxic	GS0106001	Supplemental
Bluegill sunfish *(Lepomis macrochirus)*	99.7	0.3	Highly toxic	00160187	Core
Rainbow Trout *(Onchoryhncus mykiss)*	92	1.85	Moderately toxic	ZUOETH01	Supplemental
Rainbow trout (*Onchoryhncus mykiss*)	technical	13.8	Slightly toxic	0078042	Supplemental
Bluegill sunfish (*Lepomis macrochirus*)	technical	2.07	Moderately toxic	0078042	Supplemental

Because the 96-hour LC_{50} for the technical grade material falls in the range of 0.3 to 13.8 ppm, ethoprop is considered to be highly to slightly toxic to freshwater fish on an acute basis. The guideline (72-1) is fulfilled (Acc# 00160187 for the warmwater fish study requirement; and

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0078042, ZUOETH01 and GS0106001 taken together as a unit to satisfy the coldwater fish study requirement). For formulated products containing ethoprop (10GR and 15GR), the static 96-hour LC_{50} falls in the range of 1.1 and 10.3 ppm and are considered to be moderately to slightly toxic to freshwater fish on an acute basis. (Acc# 0092123, 0078042 and GS0106002).

ii. Freshwater Fish, Chronic

Freshwater Fish Early Life-Stage Toxicity Under Flow-through Conditions

Species	% ai	NOEC/LOEC (ppm)	MATC[1] (ppm)	Endpoints Affected	MRID No.	Study Classification
Fathead Minnow *(Pimephales promelus)*	technical	0.024/0.054	0.037	Larval growth	406501-02	Supplemental

[1] MATC = Maximum Allowed Toxic Concentration, defined as the geometric mean of the NOEC and LOEC.

The guideline (72-4) is fulfilled (MRID# 406501-02). The data indicate that ethoprop significantly affected larval growth at concentrations greater than 0.024 ppm.

A freshwater fish life-cycle test using the TGAI (guideline 72-5) is required for ethoprop because the end-use product is expected to be transported to water from the intended use site; the EECs from the exposure modeling are greater than 0.1 the NOEC from the early life stage study and the reproductive physiology of freshwater fish may be affected. The guideline is not fulfilled.

iii. Freshwater Invertebrates, Acute

Freshwater Invertebrate Acute Toxicity

Species	% ai	48-hour LC_{50}/ EC_{50} (ppm)	Toxicity Category	Acc No.	Study Classification
Waterflea a h ia ag a	99.7	0.093 (static)	very highly toxic	00160188/ 263478 (1986)	Core
Waterflea (aphnia magna)	technical	0.044 (static)	very highly toxic	00068325	Supplemental

Because the LC_{50}/EC_{50} of the TGAI falls in the range of 0.044 to 0.093 ppm, ethoprop is considered to be very highly toxic to aquatic invertebrates on an acute basis. The guideline (72-2) is fulfilled (Acc# 00160188). Testing using the 10GR formulated product resulted in a static 48hr EC_{50} of 690 ppm.

iv. *Freshwater Invertebrate, Chronic*

Freshwater Aquatic Invertebrate Life-Cycle Toxicity

Species	% ai	21-day NOEC/LOEC (ppb)	MATC[1] (ppb)	Endpoints Affected	MRID No.	Study Classification
Waterflea *(Daphnia magna)*	96.8	0.8/2.4	1.4	Growth	438774-01	Core
Waterflea *(Daphnia magna)*	96.5	2.4/5.4	3.6	Reproduction	406501-01	Supplemental

[1] Maximum Allowed Toxic Concentration, defined as the geometric mean of the NOEC and LOEC.

The data indicate that ethoprop significantly reduced growth and reproduction at concentrations greater than 0.8 and 2.4 ppb, respectively. Guideline (72-4) is fulfilled. (MRID# 438774-01).

c. *Toxicity to Estuarine and Marine Animals*

i. *Estuarine and Marine Fish, Acute*

Estuarine/Marine Fish Acute Toxicity

Species	% ai	96-hour LC_{50} (ppm)	Toxicity Category	MRID No.	Study Classification
Pinfish (*Lagodon rhomboides*)	95	0.0063 (flow-through)	very highly toxic	402284-01	Core
Sheepshead minnow *(Cyprinodon variegatus)*	96.8	0.958 (flow-through)	highly toxic	436863-01	Core
Spot (*Leiostomus xanthurus*)	95	0.033 (static)	very highly toxic	402284-01	supplemental
Sheepshead minnow *(Cyprinodon variegatus)*	95	0.180 (flow-through)	highly toxic	402284-01	supplemental

Since the LC_{50} ranges from 0.0063 to 0.958 ppm ethoprop is considered to be very highly to highly toxic to estuarine/marine fish on an acute basis. The guideline (72-3a) is fulfilled (MRID# 402284-01 and 436863-01).

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ii. *Estuarine and Marine Fish, Chronic*

Estuarine/Marine Fish Early Life-Stage Toxicity Under Flow-through Conditions

Species	% ai	NOEC/LOEC (ppm)	MATC[1] (ppm)	Endpoints Affected	MRID/acc No.	Study Classification
Sheepshead minnow	96.8	0.0059/0.011	0.0081	growth (length and wet wt.)	444721-01	Core
Sheepshead minnow	95	0.012/0.021	0.016	mortality in embryos and juveniles (survival)	Acc# 0066341	Supplemental

[1] MATC = Maximum Allowed Toxic Concentration, defined as the geometric mean of the NOEC and LOEC.

The guideline (72-4) is fulfilled (MRID# 444721-01). The data indicate that ethoprop significantly affected growth (length and wet weight) at concentrations above 5.9 ppb and juvenile and embryo survival at concentrations above 12 ppb.

An estuarine/marine fish life-cycle test using the TGAI (guideline 72-5) is required for ethoprop. The preferred test species is sheepshead minnow.The reasons are: the end-use product is expected to be transported to water from the intended use site; the EECs from the exposure modeling are greater than 0.1 the NOEC from the early life stage study and the reproductive physiology of freshwater fish may be affected. The guideline is not fulfilled.

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iii. *Estuarine and Marine Invertebrates, Acute*

Estuarine/Marine Invertebrate Acute Toxicity

Species	**% ai.**	**96-hour LC_{50}/EC_{50} (ppm)**	**Toxicity Category**	**MRID/Acc No.**	**Study Classification**
Eastern oyster (shell deposition) *(Crassostrea virginica)*	98.7	3.7 (measured)	moderately toxic	436863-02	Core
Eastern oyster (Larval) *(Crassostrea virginica)*	95	14.9 (48hrEC_{50}) (static)	Slightly toxic	0066341	Core
Mysid *(Mysidopsis bahia)*	95	0.0075 (flow-through)	very highly toxic	402284-01	Supplemental
Mysid *(Mysidopsis bahia)*	96.7	0.02 (measured)	very highly toxic	436863-03	Core
Grass shrimp *(Palaemonetes vulgaris)*	Technical	0.0564 (static)	very highly toxic	0048779	Supplemental
Fiddler crab *(Uce pugilator)*	Technical	1.6 (static)	moderately toxic	0044779	Supplemental
White Shrimp (*Penaeus stylirostris*)	95	0.0064 (static)	very highly toxic	402284-01	Supplemental
Sand shrimp (*Crangon septemspinosa*)	98.9	0.025 (62 hr LC_{50}) (static)	very highly toxic	00092111	Supplemental
Sand shrimp (*Crangon septemspinosa*)	98.9	<1.0 (3 hr LC_{50}) (static)	highly toxic	00092111	Supplemental
Pink Shrimp (*Penaeus duorarum*)	95	0.013 (flow-through)	Very highly toxic	402284-01	Supplemental
Blue crab *(Callinectes sapidus)*	98.9	<1.0 (23 hr LC_{50}) (static)	≥Highly toxic	00092111	Supplemental

Because the LC_{50} ranges from 14.9 to 0.0064 ppm, the TGAI of ethoprop is considered slightly to very highly toxic to estuarine/marine invertebrates on an acute basis. The guideline (72-3b and 72-3c) is fulfilled (MRID/Acc#s 436863-02, 436863-03 and 0066341).

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iv. ***Estuarine and Marine Invertebrate, Chronic***

Estuarine/Marine Aquatic Invertebrate Early Life-Stage Toxicity

Species	% ai	28-day NOEC/LOEC (ppb)	MATC[1] (ppb)	Endpoints Affected	Acc/MRID No.	Study Classification
Mysid (*Mysidopsis bahia*)	96.8	1.4/2.7 (flow-through)	1.9	Growth (male length and dry wt.)	444575-01	Core
Mysid (*Mysidopsis bahia*)	95	0.36/0.62 (static)	0.47	Survival	0066341	supplemental

[1] Maximum Allowed Toxic Concentration, defined as the geometric mean of the NOEC and LOEC.

The data (0066341) indicate that ethoprop significantly reduced survival at concentrations greater than 0.36 ppb. This was considered a partial life-cycle study because the F1 generation was not exposed until reproductive maturity. The number of offspring produced per female was significantly reduced at 1.4 ppb. A more recent study (444575-01) indicated that ethoprop significantly reduced growth (male length and dry wt.) at concentrations greater than 1.4 ppb. The guideline (72-4) is fulfilled (MRID 444575-01).

d. ***Toxicity to Plants***

Currently, plant testing is not required for pesticides other than herbicides and fungicides except on a case-by-case basis (e.g., labeling bears phytotoxicity warnings, incident data or literature that demonstrates phytotoxicity). However, some data has been provided (MRID# 402284-01) below:

Aquatic Plant Toxicity

Species	% ai	96-hour EC_{50} (ppm)	CI	MRID No.	Study Classification
Marine Diatom (*Skeletonema costatum*)	95	8.4 (static)	7.6-9.0	402284-01	Supplemental

ECOLOGICAL RISK ASSESSMENT

To evaluate the potential risk to nontarget organisms from the use of ethoprop products, risk quotients (RQs) are calculated from the ratio of estimated environmental concentrations (EECs) to ecotoxicity values. RQs are then compared to levels of concern (LOCs) for determination of potential ecorisk and the consideration of regulatory action.

SUMMARY

Acute and chronic avian and mammalian LOC's were exceeded for single and multiple applications of spray and granular products. Acute high risk levels of concern are exceeded for freshwater fish for the cucumber, golf course broadcast, and potato (sweet) uses. Restricted use, and endangered species levels of concern are exceeded for freshwater fish for the cucumber, golf course broadcast, potato (Irish and sweet), tobacco, bean and sugarcane uses. Endangered species levels of concern are exceeded for freshwater fish for the all uses except golf course slit use. The chronic risk level of concern is exceeded for freshwater fish for all model uses other than for peanuts and golf course slit placement uses. Freshwater invertebrate, estuarine fish and estuarine invertebrate acute and chronic LOC's were exceeded for all modeled use patterns other than for peanuts (only for freshwater invertebrates) and golf course turf uses (slit placement application). As Ethoprop is moderately toxic to honeybees, precautions with respect to spray drift to flowering plants should be followed. No apparent risks to aquatic plants are associated with the current uses and rates of ethoprop.

a. *Exposure and Risk to Nontarget Terrestrial Animals*

For pesticides applied as a liquid product, the estimated environmental concentrations (EECs) on food items following product application are compared to LC_{50} values to assess risk. The predicted 0-day maximum residues of a pesticide that may be expected to occur on selected avian or mammalian food items immediately following a direct single application at 1 lb ai/A are tabulated below.

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Estimated Environmental Concentrations (EECs) on Avian and Mammalian Food Items (ppm) Following a Single Application at 1 lb ai/A

Food Items	EEC (ppm)[1]
Short grass	240
Tall grass	110
Broadleaf/forage plants, and small insects	135
Fruits, pods, seeds, and large insects	15

[1] Maximum EEC are for a 1 lb ai/A application rate and are based on Fletcher et al. (1994).

<u>Environmental Residue Values</u>

The value of 240 ppm residues on short rangegrass is a screen to cover all routes of exposure, not just ingestion of pesticide contaminated food items. Ingestion can also occur from drinking contaminated water, through preening of feathers, licking of fur containing pesticide residues or when animals dust themselves in fields treated with pesticides. Examples of other routes of exposure include dermal absorption and inhalation of pesticide particles suspended in the air. All these routes together contribute to the total exposure an animal faces when it is present in a treated field or adjacent habitat sprayed with a toxic chemical. As the exact contribution of each exposure component has not been determined, the use of the risk index calculated by 240 ppm/LC_{50} is not conservative, but may actually underestimate total risk.

The index does not account for the differences between dry/wet weight measurements, but it assumes safety factors, such as using the range of EECs from Fletcher (Hoerger and Kenaga as modified by Fletcher, 1994) which will help compensate for these differences. That is, laboratory birds are fed a mash that contains little water, about 10 percent by weight, while most of the residue data are reported as ppm wet weight. Estimates of avian dietary exposure may be understated when toxicity values based on dry laboratory diet values are compared to wet weight residue levels. This is because birds eating their natural diet in the field need to eat a higher portion of their body weight compared to birds eating laboratory food with a low moisture content to obtain the same amount of food energy. In doing so, birds in the field will consume greater quantities of pesticide than birds on laboratory diets. Therefore, the use of 240 ppm may underestimate the risk.

Toxicity Values

The LC_{50} toxicity value has a great deal of uncertainty. This index of toxicity denotes the concentration that killed 50 percent of the laboratory test population. Although the LC_{50} value has long been accepted in the field of toxicology as a reliable indicator of hazard, it may not be a good predictor of mortality to wildlife in the field. Although 50 percent mortality may be acceptable for comparisons of toxicity among several pesticides, this level of mortality may too high for a natural population to maintain itself. Therefore lower toxicity values calculated from the dose-response curve may be better predictors of risk. Two alternative approaches are: 1) to use the confidence interval around the LC_{50} value, particularly the lower value which provides a greater degree of safety in the risk calculation and 2) use of LC_{10} or LC_5 values as more realistic indices of hazard in the field. Using either of these alternatives will produce risk estimates greater than that used in this risk assessment.

Other Factors Affecting Risk

Only two bird species are tested--one waterfowl species and one upland gamebird species--under the Fish and Wildlife Data Requirements listed in CFR 158. There is a great deal of uncertainty associated with extrapolating from the acute oral and subacute dietary data from two species to the large numbers of bird species associated with agricultural areas. Field surveys indicate that a large variety of birds are associated with these areas, including a multitude of songbirds and many others. Waterfowl are also likely to be present in these regions. As the EFED ecological database indicates that songbirds tend to be more sensitive than the two required test species, using the maximum estimated environmental concentration to calculate risk helps to compensate for this uncertainty in the toxicity data.

Birds and mammals use agricultural fields and adjacent habitat for a number of purposes including feeding, resting and nesting. There is a misconception that wildlife in the adjacent edge habitat are not exposed to the pesticide at the levels present in the treated fields and consequently are not at risk. However, edge habitat around treated fields receives the same amount of pesticide residues; the reduction in residue levels from spray applications occurs a distance from the treated fields. Therefore wildlife occupying edge habitat and those in the treated field are equally at risk.

Furthermore, a review of over 40 terrestrial field studies conducted as part of registration requirements (Guideline 71-5) for a number of highly toxic pesticides showed that field mortality of wildlife nearly always occurred when the risk index indicated high risk calculated by the risk index of 240 ppm residues/dietary LC_{50} value for that pesticide. Therefore, use of this index is reasonable for predicting wildlife kills.

The lack or small number of reported incidents involving birds or mammals does not prove that animals are not dying from pesticide exposure. Finding dead animals in the field is difficult, even when experienced field biologists are searching treated fields. Reporting of incident data is still rather accidental, and only carefully designed field studies can confidently indicate the likelihood of field kill incidents occurring. As the Agency no longer requires field studies for organophosphate pesticides, the conclusion that use of these pesticides presents a high acute and chronic risk to birds and high acute risk to mammals remains unchanged.

i. Birds

a. Non-granular Products

The acute and chronic risk quotients for broadcast applications of nongranular products are tabulated below. As the chronic risk quotients are calculated with the LOEC value and not the NOEC value, due to a deficiency in the study design, these quotients underestimate the long-term risk ethoprop presents to birds.

Avian Acute and Chronic Risk Quotients for Single Application of Nongranular Products (Broadcast) Based on a quail LC_{50} of 33 and a quail LOEC of 7.5 ppm (studies did not provide an NOEC).

Site/App. Method	App. Rate (lbs ai/A)	Food Items	Maximum EEC (ppm)	LC_{50} (ppm)	LOEC (ppm)	Acute RQ (EEC/ LC_{50})	Chronic RQ (EEC/ NOEC)
	1	Short grass	240	33	7.5	7.27	32.00
		Tall grass	110	33	7.5	3.33	14.67
		Broadleaf plants/Insects	135	33	7.5	4.09	18.00
		Seeds	15	33	7.5	0.50	2.00
Potatoes/tobacco	12	Short grass	2,880	33	7.5	87.27	384.00
		Tall grass	1,320	33	7.5	40.00	176.00
		Broadleaf plants/Insects	1,620	33	7.5	49.09	216.00
		Seeds	180	33	7.5	5.45	24.00

An analysis of the results indicate that for a single broadcast application of nongranular products, avian acute high, restricted use, and endangered species levels of concern are exceeded at registered maximum application rates equal to or above 1 lb ai/A. The avian chronic level of concern is exceeded at a registered maximum application rate equal to or above 1 lb ai/A.

Avian Acute and Chronic Risk Quotients for Multiple Applications of Nongranular Products (Broadcast) Based on a quail LC_{50} of 33ppm and a quail LOEC of 7.5 ppm (studies did not provide an NOEC).

Site/App. Method	App.Rate (lbs ai/A) No. of Apps.	Food Items	Maximum EEC[1] /Time weighted Ave. (ppm)	LC_{50} (ppm)	LOEC (ppm)	Acute RQ (EEC/ LC_{50})	Chronic RQ (EEC/ NOEC)
turf ground and Pineapple ground	6/2	Short grass	2391/1169	33	7.5	73/35	319/156
		Tall grass	1095/536	33	7.5	33/16	146/71
		Broadleaf plants/Insects	1344/658	33	7.5	41/20	179/88
		Seeds	149/73	33	7.5	5/2	20/10

1 Assumes degradation using FATE program.

The residues expected on avian food items after multiple applications of nongranular ethoprop products were calculated for 300 days. The simulations were based on the initial residue concentrations immediately after application (Fletcher, 1994); chemical half-life of 100 days; and 2 applications at 6 lb a.i./A 60 days apart. The results indicate that avian acute high, restricted use and endangered species and chronic levels of concern are exceeded for peak as well as time-weighted averages.

b. Granular Products

Birds may be exposed to granular pesticides ingesting granules when foraging for food or grit. They also may be exposed by other routes, such as by walking on exposed granules or drinking water contaminated by granules. The number of lethal doses (LD_{50}s) that are available within one square foot immediately after application ($LD_{50}s/ft^2$) is used as the risk quotient for granular/bait products. Risk quotients are calculated for three separate weight classes of birds: 1000 g (*e.g.*, waterfowl), 180 g (*e.g.*, upland gamebird), and 20 g (*e.g.*, songbird).

The minimum acute risk quotients for broadcast applications of granular products are tabulated below.

Avian Risk Quotients for Granular Products (Broadcast) Based on the lowest application rate of 1.5 lbs ai/A.

Site/ Application Method/Rate in lbs ai/A	% (decimal) of Pesticide Left on the Surface	Body Weight (g)	LD_{50} (mg/kg)	Acute RQ[1] (LD_{50}/ft^2)
low G rate/incorporated cucumber				
1.5	.15	20	4.21	27.79
1.5	.15	180	7.5	1.73
1.5	.15	1000	12.6	0.19

[1] $RQ = \frac{\text{App. Rate (lbs ai/A)} * (453{,}590 \text{ mg/Lbs}/43{,}560 \text{ ft}^2/\text{A})}{\text{LD50mg/kg} * \text{Weight of Animal (g)} * 1000 \text{ g/kg}}$

An analysis of the results indicate that for broadcast incorporated applications of granular products, avian acute high risk, restricted use, and endangered species levels of concern are exceeded for all species at registered minimum application rates of 1.5 lbs ai/A..

The maximum acute risk quotients for broadcast applications of granular products are tabulated below.

Avian Risk Quotients for Granular Products (Broadcast) Based on the highest application rate of 12 lbs ai/A.

Application Method/Rate in lbs ai/A	% (decimal) of Pesticide Left on the Surface	Body Weight (g)	LD_{50} (mg/kg)	Acute RQ[1] (LD_{50}/ft^2)
High G rate/incorporated Tobacco/potatoes				
12	.15	20	4.21	222.33
12	.15	180	7.5	13.87
12	.15	1000	12.6	1.49

[1] RQ = App. Rate (lbs ai/A) * (453,590 mg/Lbs/43,560 ft^2/A)
LD50mg/kg * Weight of Animal (g) * 1000 g/kg

An analysis of the results indicate that for broadcast applications of granular products, avian acute high risk, restricted use, and endangered species levels of concern are exceeded at registered maximum application rates of 12 lbs ai/A.

The acute risk quotients for banded or in-furrow applications of granular products are tabulated below.

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Avian Acute Risk Quotients for Granular Products (Banded or In Furrow).

Site/Method Band Width (feet)	oz. ai/1000 ft of Row	Bird Type and Body Weight (g)	% (decimal) of Pesticide Left on the Surface	Exposed mg/ft²	LD_{50}(mg/kg)	Acute RQ[1] (LD_{50}/ft²)
Sugarcane/ 4 lbai/a Banded-Incorporated						
1	8.96	Songbird 20	0.15	38.10	4.21	452.49
1	8.96	Upland Gamebird 180	0.15	38.10	7.5	28.22
1	8.96	Waterfowl 1000	0.15	38.10	12.6	3.02
Tobacco/ 12 lbai/a Banded-incorporated						
2	15.36	Songbird 20	0.15	65.32	4.21	775.77
2	15.36	Upland Gamebird 180	0.15	65.32	7.5	48.39
2	15.36	Waterfowl 1000	0.15	65.32	12.6	5.18
Beans/ Potatoes/ Corn 3 lbai/a Banded-incorporated						
1	3.2	Songbird 20	0.15	13.61	4.21	161.64
1	3.2	Upland Gamebird 180	0.15	13.61	7.5	10.08
1	3.2	Waterfowl 1000	0.15	13.61	12.6	1.08
Cucumber/ 2 lbai/a Banded-incorporated						
1.25	5.12	Songbird 20	0.15	21.77	4.21	258.55
1.25	5.12	Upland Gamebird 180	0.15	21.77	7.5	16.13
1.25	5.12	Waterfowl	0.15	21.77	12.6	1.73

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[1] $$RQ = \frac{\text{oz. ai per 1000 ft.} * 28349\ \text{mg/oz} * \%\ \text{Unincorporated / bandwidth (ft)} * 1000\ \text{ft}}{LD_{50}(\text{mg/kg}) * \text{Weight of the Animal (g)} * 1000\ (\text{g/kg})}$$

An analysis of the results indicate that avian acute high, restricted use, and endangered species levels of concern are exceeded for a range of avian species from banded/in-furrow applications of granular products at registered maximum application rates.

ii. Mammals-Acute Risks

a. Nongranular Products

To assess acute risk to mammals from the use of non-granular products, an LC_{50} value calculated from the LD_{50} value is used (LD_{50}/% body wt consumed). The EEC is then divided by this value to determine mammalian RQ's.

The mammalian acute and chronic risk quotients for broadcast applications of nongranular products are tabulated below.

Mammalian Acute and Chronic Risk Quotients for Single Application of Nongranular Products (Broadcast) Based on a rat LD_{50} of 32.8 mg/kg (calculated LC_{50}=656 ppm) and a rat NOEC of 30 ppm.

Site/App. Method	App. Rate (lbs ai/A)	Food Items	Maximum EEC (ppm)	Calculated LC_{50} (ppm)	NOEC (ppm)	Acute RQ (EEC/ LC_{50})	Chronic RQ (EEC/ NOEC)
	1	Short grass	240	656	30	0.37	8.00
		Tall grass	110	656	30	0.17	3.67
		Broadleaf plants/Insects	135	656	30	0.21	4.50
		Seeds	15	656	30	0.02	0.50
	3	Short grass	720	656	30	1.10	24.00
		Tall grass	330	656	30	0.50	11.00
		Broadleaf plants/Insects	405	656	30	0.62	13.50
		Seeds	45	656	30	0.07	1.50

An analysis of the results indicate that for a single broadcast application of nongranular products, mammalian acute high, restricted use, and endangered species levels of concern are exceeded for all feed items other than seeds at registered maximum application rates equal to or above 3 lb ai/A. The mammalian chronic level of concern is exceeded for all feed items other than seeds (which would exceed at or above 2 lbs ai/A) at a registered maximum application rate equal to or above 1 lb ai/A.

b. Granular Products:

The acute risk quotients for banded or in-furrow applications of granular products are tabulated below.

Mammalian Acute Risk Quotients for Granular Products (Banded or In-furrow) Based on a rat LD_{50} of 32.8 mg/kg.

Site/Method Band Width (feet)	oz. ai.1000 ft of row	Body Weight (kg)	% (decimal) of Pesticide Left on the Surface	Exposed mg/ft²	Rat LD_{50} (mg/kg)	Acute RQ[1] (LD_{50}/ft²)
Sugarcane/ 4 lbai/a Banded-Incorporated						
1	8.96	0.015	0.15	38.10	32.8	77.44
1	8.96	0.035	0.15	38.10	32.8	33.19
1	8.96	1.0	0.15	38.10	32.8	1.16
Tobacco/ 12 lbai/a Banded-incorporated						
2	15.36	0.015	0.15	32.66	32.8	66.38
2	15.36	0.035	0.15	32.66	32.8	28.45
2	15.36	1.0	0.15	32.66	32.8	1.00
Beans/ Potatoes/ Corn 3 lbai/a Banded-incorporated						
1	3.2	0.015	0.15	13.61	32.8	27.66
1	3.2	0.035	0.15	13.61	32.8	11.86
1	3.2	1.0	0.15	13.61	32.8	0.41
Cucumber/ 2 lbai/a Banded-incorporated						
1.25	5.12	0.015	0.15	17.42	32.8	35.41
1.25	5.12	0.035	0.15	17.42	32.8	15.17
1.25	5.12	1.0	0.15	17.42	32.8	0.53

[1]RQ = $\frac{\text{oz. ai per 1000 ft.} * 28349 \text{ mg/oz} * \text{\% Unincorporated / bandwidth (ft)} * 1000 \text{ ft}}{LD_{50}(\text{mg/kg}) * \text{Weight of the Animal (g)} * 1000 \text{ g/kg}}$

An analysis of the results indicate that for banded/in-furrow granular products, mammalian acute high risk, restricted use, and endangered species levels of concern are exceeded at registered maximum application rates.

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iii. Insects

Currently, EFED does not assess risk to nontarget insects. Results of acceptable studies are used for recommending appropriate label precautions. As Ethoprop is moderately toxic to honeybees, precautions in respect to spray drift to flowering plants should be followed.

iv. Plants

No apparent risks to aquatic plants are associated with the current uses and rates of ethoprop.

PRZM2 Maximum Peak EEC/toxicity=RQ
0.65ppm/8.4ppm=0.08 (RQ<LOC of 1.0)

b. Exposure and Risk to Nontarget Freshwater Aquatic Animals

EFED calculated EEC's in aquatic environments, specifically edge-of-field ponds, using PRZM-EXAMS. The Pesticide Root Zone Model (PRZM 3.1) simulates pesticide field runoff on daily time steps, incorporating runoff, infiltration, erosion, and evaporation. The model calculates foliar dissipation and runoff, plant uptake, microbial transformation, volatilization, and soil dispersion and retardation. The Exposure Analysis Modeling System (EXAMS 2.97.5) simulates pesticide fate and transport in an aquatic environment.

Environmental fate studies indicate that ethoprop will tend to remain in the water column and persist.

Estimated Environmental Concentrations (EECs) For Aquatic Exposure

Site	Application Method	Application Rate (lbs ai/A)	# of Apps./ Interval Between Apps.	Initial (PEAK) EEC (ppm)	21-day average EEC (ppm)	60-day average EEC (ppm)
Beans	Broadcast	8	1	0.075	0.074	0.071
Cabbage	Broadcast	5	1	0.024	0.024	0.023
Corn	Broadcast	6	1	0.026	0.025	0.024
Cucumbers	Banded	2	1	0.585	0.570	0.546
Golf course	Broadcast	20	2/60	0.650	0.636	0.605
Golf course	Slit placement	20	2/60	0.000	0.000	0.000
Peanuts	Broadcast	6	1	0.016	0.015	0.015
Potatoes	Broadcast	12	1	0.029	0.028	0.027
Sugarcane	Banded	4	1	0.074	0.073	0.071
Sweet potatoes	Broadcast	8	1	0.182	0.180	0.174
Tobacco	Broadcast	12	1	0.065	0.063	0.061

The 10 listed crops/commodities comprise approximately 98 percent of the total active ingredient (a.i.) applied annually. Additionally, four major crops, sugarcane, potatoes, tobacco, and corn make up approximately 85 percent of the total a.i. applied.

Fate Parameters Used for PRZM/EXAMS Modeling

Chemical Parameter	*Value*	*Model Input*
Molecular Weight	242.33	242.33
Vapor Pressure	3.49E-04	3.49E-04
Henry's Law Constant	1.49E-07	1.49E-07
Solubility	843 mg/L @ 21°C	843 mg/L @ 21°C
Hydrolysis	Stable	No Value
Photolysis	Stable	No Value
Aerobic Soil Metabolism	300 days (X3 for single study)	PRZM 0.0023 day^{-1} EXAMS 9.6E-05 hr^{-1}
Anaerobic Soil Metabolism	300 days (X3 for single study)	PRZM 0.0023 day^{-1} EXAMS 9.6E-05 hr^{-1}
Aerobic Aquatic Metabolism	No study conducted	EXAMS 4.8E-05 hr^{-1}
Adsorption (Kd)	2.10 (silt loam)	2.10

i. *Freshwater Fish*

Acute and chronic risk quotients are tabulated below.

Risk Quotients for Freshwater Fish Based On a bluegill LC_{50} of 0.3 ppm and a fathead minnow NOEC of 0.024 ppm.

Site	LC_{50} (ppm)	NOEC (ppm)	EEC Initial/Peak (ppm)	EEC 21-Day Ave. (ppm)	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC)
Beans	0.3	0.024	0.075	0.074	0.25	3.08
Cabbage	0.3	0.024	0.024	0.024	0.08	1.00
Corn	0.3	0.024	0.026	0.025	0.09	1.04
Cucumbers	0.3	0.024	0.585	0.570	1.95	23.75
Golf course/ broadcast	0.3	0.024	0.650	0.636	2.17	26.50
Golf course/slit	0.3	0.024	0.000	0.000	0.00	0.00
Peanuts	0.3	0.024	0.016	0.015	0.05	0.63
Potatoes	0.3	0.024	0.029	0.028	0.10	1.17
Sugarcane	0.3	0.024	0.074	0.073	0.25	3.04
Sweet potatoes	0.3	0.024	0.182	0.180	0.61	7.50
Tobacco	0.3	0.024	0.065	0.063	0.22	2.63

An analysis of the results indicate that acute high risk levels of concern are exceeded for freshwater fish for the cucumber, golf course broadcast, and potato (sweet) uses. Restricted use, and endangered species levels of concern are exceeded for freshwater fish for the cucumber, golf course broadcast, potato (Irish and sweet), tobacco, bean and sugarcane uses. Endangered species levels of concern are exceeded for freshwater fish for the all uses except golf course slit use. The chronic risk level of concern is exceeded for freshwater fish for all model uses other than for peanuts and golf course slit placement uses. No aquatic acute or chronic levels of concern are exceeded for freshwater fish for the golf course slit placement use.

ii. Freshwater Invertebrates

The acute and chronic risk quotients are tabulated below.

Risk Quotients for Freshwater Invertebrates Based On a daphnia EC_{50}/LC_{50} of 0.044 ppm and a daphnia NOEC of 0.8 ppb.

Site	LC_{50} (ppm)	NOEC (ppm)	EEC Initial/Peak (ppm)	EEC 21-Day Average	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC)
Beans	0.044	0.0008	0.075	0.074	1.70	92.50
Cabbage	0.044	0.0008	0.024	0.024	0.55	30.00
Corn	0.044	0.0008	0.026	0.025	0.59	31.25
Cucumbers	0.044	0.0008	0.585	0.570	13.30	712.50
Golf course/broadcast	0.044	0.0008	0.650	0.636	14.77	795.00
Golf course/slit	0.044	0.0008	0.000	0.000	0.00	0.00
Peanuts	0.044	0.0008	0.016	0.015	0.36	18.75
Potatoes	0.044	0.0008	0.029	0.028	0.66	35.00
Sugarcane	0.044	0.0008	0.074	0.073	1.68	91.25
Sweet potatoes	0.044	0.0008	0.182	0.180	4.14	225.00
Tobacco	0.044	0.0008	0.065	0.063	1.48	78.75

An analysis of the results indicate that acute high risk levels of concern are exceeded for freshwater invertebrates for all uses except golf course turf slit and peanut uses. Restricted use, and endangered species levels of concern are exceeded for all uses other than golf course turf slit use. The chronic level of concern is exceeded for all uses except golf course slit use.

c. *Exposure and Risk to Estuarine and Marine Animals*

Fish

The acute and chronic risk quotients are tabulated below.

Risk Quotients for Estuarine/Marine Fish Based on a pinfish LC_{50} of 0.0063 ppm and a sheepshead minow NOEC of 0.0059 ppm.

Site	LC_{50} (ppm)	NOEC (ppm)	EEC Initial/ Peak (ppm)	EEC 60-Day Average	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC or MATC)
Beans	0.0063	0.0059	0.075	0.071	11.90	12.03
Cabbage	0.0063	0.0059	0.024	0.023	3.81	3.90
Corn	0.0063	0.0059	0.026	0.024	4.13	4.07
Cucumber	0.0063	0.0059	0.585	0.546	92.86	92.54
Golf course/ broadcast	0.0063	0.0059	0.650	0.605	103.17	102.54
Golf course/slit	0.0063	0.0059	0.000	0.000	0.00	0.00
Peanuts	0.0063	0.0059	0.016	0.015	2.54	2.54
Potato	0.0063	0.0059	0.029	0.027	4.60	4.58
Sugarcane	0.0063	0.0059	0.074	0.071	11.75	12.03
Sweet potato	0.0063	0.0059	0.182	0.174	28.90	29.49
Tobacco	0.0063	0.0059	0.065	0.061	10.32	10.34

An analysis of the results indicate that aquatic acute high risk, restricted use, and endangered species levels of concern are exceeded for estuarine fish for all uses other than golf course turf slit use. The chronic level of concern is exceeded for estuarine fish for all uses other than golf course turf slit use.

Invertebrates

Risk Quotients for Estuarine/Marine Aquatic Invertebrates Based on a white shrimp LC_{50}/EC_{50} of 0.0064 ppm and a mysid NOEC of 0.00036 ppm .

Site/ Application Method	LC_{50} (ppm)	NOEC (ppm)	EEC Initial/ Peak (ppm)	EEC 21-Day Average	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC)
Beans	0.0064	0.00036	0.075	0.074	11.72	205.56
Cabbage	0.0064	0.00036	0.024	0.023	3.75	66.70
Corn	0.0064	0.00036	0.026	0.025	4.06	69.44
Cucumber	0.0064	0.00036	0.585	0.570	91.41	1,583.33
Golf course/ broadcast	0.0064	0.00036	0.650	0.636	101.56	1,766.66
Golf course/slit	0.0064	0.00036	0.000	0.000	0.00	0.00
Peanuts	0.0064	0.00036	0.016	0.015	2.50	41.66
Potatoes	0.0064	0.00036	0.029	0.028	4.53	77.78
Sugarcane	0.0064	0.00036	0.074	0.073	11.56	202.77
Sweet potatoes	0.0064	0.00036	0.182	0.180	28.44	500.00
Tobacco	0.0064	0.00036	0.065	0.063	10.16	175.00

An analysis of the results indicate that aquatic acute high risk, restricted use, and endangered species levels of concern are exceeded for estuarine invertebrates for all uses other than golf course turf slit use. The chronic level of concern is exceeded for estuarine invertebrates for all uses other than golf course turf slit use.

d. Exposure and Risk to Endangered Species

The Agency has developed a program (the "Endangered Species Protection Program") to identify pesticides whose use may cause adverse impacts on endangered and threatened species, and to implement mitigation measures that will eliminate the adverse impacts. At present, the program is being implemented on an interim basis as described in a Federal Register notice (54 FR 27984-28008, July 3, 1989), and is providing information to pesticide users to help them protect these species on a voluntary basis. As currently planned, the final program will call for label modifications referring to required limitations on pesticide uses, typically as depicted in county-specific bulletins or by other site-specific mechanisms as specified by state partners. A final program, which may be altered from the interim program, will be

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described in a future Federal Register notice. The Agency is not imposing label modifications at this time through the RED. Rather, any requirements for product use modifications will occur in the future under the Endangered Species Protection Program.

RISK CHARACTERIZATION

Ethoprop is a Restricted Use pesticide and is a known cholinesterase inhibitor. Ethoprop is very highly toxic to avian species (LD50=4.21 mg/kg; LC50=33 ppm) on an acute basis and causes reproductive effects (LOEC =7.5 ppm). It is highly toxic to mammals (LD50= 32.8 mg/kg) on an acute basis and causes reproductive effects in this group of animals as well (NOEL =30 ppm). Ethoprop is moderately toxic to honeybees (LD50 =2.58 ug/bee). Ethoprop is highly acutely toxic to freshwater and estuarine fish (LC50 values of 0.3 ppm and 6.3 ppb, respectively), and it affected larval fish growth at low concentrations (NOEC values of 24 ppb for freshwater fish and 5.9 ppb for estuarine fish). It is very highly toxic to freshwater and estuarine invertebrates (LC50 values of 44 ppb and 6.4 ppb, respectively). It also caused chronic effects in this group of organisms. Growth was reduced in freshwater invertebrates (NOEC of 0.8 ppb), and survival was reduced in estuarine invertebrates (NOEC of 0.36 ppb).

Ethoprop is applied by ground application methods only and is formulated as a granular (G) or spray formulation (EC and SC/L). Only one application per season is permitted (exceptions are peanuts, pineapple and golf course turf). Ethoprop may be applied to numerous crops, but its primary use occurs on sugarcane in Florida (52% of ethoprop's annual use). Other major uses are: potatoes, tobacco and corn. The variety of use sites implies that diverse wildlife habitats and species associated with these habitats, both aquatic and terrestrial, are regularly exposed to ethoprop.

Based on laboratory data, ethoprop appears to be fairly persistent. However, in the field, dissipation was more rapid than expected. The differences between the half-lives in the laboratory studies versus the field studies may be due in part to leaching/runoff, as well as increased soil moisture and temperature in the field soils. Previous work with the organophosphate insecticides has shown that volatilization and microbial degradation increases as soil moisture content and temperature increases. The field dissipation rates are likely a result of microbial degradation, leaching, runoff, plus volatilization.

The persistence and mobility seen in the laboratory studies would indicate that ethoprop and its degradates could pose a significant threat to ground water resources. The chemical is considered mobile in most soils (K_{ads}=1.08-3.78). Additionally, ethoprop is somewhat resistant to aerobic soil metabolism ($t_{1/2}$=100 days). However, terrestrial field dissipation studies, as well as monitoring data, suggest that parent ethoprop should not pose a ground water contamination problem. According to EPA's *Pesticides in Ground Water Database -1992*, no ground water detections have been reported with over 1350 wells sampled.

The risk quotient (RQ) analysis defines the acute and chronic risks of ethoprop to terrestrial and aquatic animals as very high for most use patterns even at the lower labeled application rate of 1 lb a.i./A. Contributing reasons for the high RQs include: ethoprop's very high toxicity, high solubility in water and resistance to hydrolytic, photolytic and metabolic degradation in water and soil.

Very high acute and chronic risks to freshwater and estuarine invertebrates may produce food chain effects which may impact fish and other organisms that depend on invertebrates as a significant portion of their diet. As ethoprop is more toxic to invertebrates than to fish, and as ethoprop caused several fish kill incidents (discussed below), it is not unreasonable to assume that large numbers of invertebrates are, likewise, impacted.

The likelihood of adverse effects on aquatic organisms is increased by the fact that ethoprop can contaminate surface water via runoff for up to several months after application. Ethoprop will enter surface waters in both the dissolved form as well as bound to suspended and eroding materials as suggested by its water solubility and its partitioning, respectively. One mitigating aspect however is that ethoprop is either mechanically incorporated or watered into the soil, which will in turn reduce the runoff potential. It appears that ethoprop will be persistent in surface water as indicated by its aerobic soil metabolism especially in water with low to moderate microbial activity or where abundant alternative energy (carbon) sources are available. In waters with short hydrological residence times (streams and rivers), its persistence is limited by the flow out of the system more so than by metabolism. However, its persistence in waters with high residence times (lakes and reservoirs) will be greater and controlled more so by metabolism.

Incidents have been reported from the use of ethoprop and are in the EPA incident database. All reported incidents involved fish, though it is likely that incidents have occurred involving waterfowl, upland gamebirds, and songbirds (Stone, 1980). The predicted high risks to

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fish are corroborated by the following fish kill incident data:

State	*Organism*	*# Affected*	*Pesticide*	*Use Site*	*Certainty*
LA	Shad	200	Mocap	Golf course	Highly probable
LA	Fishkill	Not reported	Mocap	Golf course	Probable
NC	Bluegill, bass	>200	Mocap EC	Tobacco/ corn	Unlikely
NC*	Bream, bass, crappie	>300	Mocap	Tobacco	Unlikely
NC	Fishkill	400	Mocap	Tobacco	Possible
SC	Bass, Mullet, Eels	Not reported	Chipco Mocap 10G	Golf course	Probable

Concentrations of ethoprop in water, measured at the time the fish kills were discovered, ranged from 3-241 ppb (SC incident), 10-26 ppb (LA probable incident), and 0.140 ppb (*NC unlikely incident). Laboratory tests showed that ethoprop (Mocap) was the cause of the highly probable shad fishkill incident in LA due to rain runoff into a golf course pond (though no numerical data were provided by the LSU School of Veterinary Medicine which performed the analysis). The incidents are not described in detail, but the kills apparently occurred under routine application conditions where pesticide drift and/or runoff caused contamination of water adjacent to aquatic sites. Unfortunately the database does not indicate how soon the fish were killed after ethoprop was applied. It is reasonable to assume that the concentrations of ethoprop that caused the kills were higher than those eventually measured at the sites. Fish kills at golf course sites are generally easier to document than in flowing open water systems which are typical of estuaries, due to the ease of close, oftentimes daily, monitoring. Recurring fish kills, even though these kills do not significantly reduce fish populations as a whole or even locally, are still in themselves an unreasonable adverse effect.

Aquatic EECs are higher in the coastal regions possibly due to greater rainfall in those areas. Florida, where 52% of ethoprop is applied yearly, receives ~ 50" of rainfall per year. Therefore, estuarine organisms, which are more sensitive than freshwater organisms to ethoprop, are likely to be exposed more often to surface runoff of the chemical. These factors are likely to produce greater impacts on aquatic communities situated along the coasts than in inland regions with drier climates. This is particularly important in terms of the commercial value of several estuarine species as penaeid shrimp and sport fisheries. It is not unreasonable to assume that fish kills are also occurring in estuarine regions; however, they are more difficult to document in these areas than in inland locations.

Ethoprop is applied on a wide variety of crops during critical periods for avian and mammalian species in the spring resulting in high acute and chronic (reproductive) risks from ingestion of granules or contaminated food items or through dermal absorption of the chemical. Chronic reproductive risk quotients (RQ's) were high for avian species. These risks were calculated using an LOEC due to the fact that the study did not an establish an NOEC. Risks would be even greater if an NOEC was used. In the summer, during extremely hot weather, stress, including these extreme temperatures, can exacerbate the toxicity of anti-cholinesterase (AChE) compounds (Rattner 1982). It is evident from the toxicity data that songbirds and upland gamebird species are slightly differentially more sensitive and susceptible to the acute and chronic effects of ethoprop than are waterfowl species, and, therefore they are more likely than are waterfowl to suffer direct effects from exposure to ethoprop.

However, when ethoprop enters aquatic habitats, un-natural alterations in the food chain may occur, thus having impacts on ducklings. Swanson et al. (1985) and Reinecke (1979) have suggested that macroinvertebrates may represent a very high percentage of the diet of waterfowl species and especially their young. The importance of aquatic invertebrates for the young of several species of dabbling (Anatini) and diving (Aythyini) ducks has been established (Bartonek and Hickey, 1969; Sugden, 1973). If ducklings are present, competition for limited invertebrate food items may occur, thus reducing growth rates and increasing energy expenditures searching for food (Hunter et al., 1984; Hunter et al., 1986). While it is has been suggested (Swanson et al., 1985) that waterfowl will adapt to natural limitations and variability in food resources, ethoprop entering an aquatic habitat would not be considered a natural phenomenon. Also, since most waterfowl species have extended nesting strategies, which may involve moving overland to find other non-affected areas, higher predation rates on ducklings may be a result.

Birds and small mammals actively probe the soil while searching for food. While foraging they are known to ingest soil, both intentionally and incidentally. Beyer, et al. (1994) estimated the soil content of the diet of a number of bird and mammal species to range from <2.0% to 30%. If this foraging occurs in ethoprop-contaminated fields, wildlife could be exposed to levels of ethoprop high enough to cause ecological effects. The RQS may not accurately quantify the amount of risk wildlife may encounter, but this scenario is realistic and represents another route of exposure to ethoprop.

There are several use patterns for which the standard risk assessment methodologies are not appropriate. Ethoprop can be applied on pineapples in Hawaii several times each year through a drip irrigation system (an application every 2 months but no more than 8 applications per year for a total seasonal rate of 48 lbs ai/acre.) The label states that all irrigation lines should be placed under plastic sheeting or at least 4 inches below the soil surface. Exposure from 1 application of 6 lbs ai/A may produce soil residues of 132.3 ppm to 25.5 ppm in the top 0.1 ppm to 0.5 inches. US EPA, 1986). Using the avian LC50 of 33 ppm, RQS for contaminated soil range from 4.0 to 0.8, which is in the "high acute risk" category.

Hawaii is rich with a diverse and rare bird community as many endangered species inhabit these islands. If any tend to frequent the pineapple plantations and forage in the top 0.5 inch of soil overlaying the irrigation lines, the species may be placed into jeopardy.

Additionally, effects to aquatic organisms from the use of ethoprop in Hawaii could not be determined as there are no scenarios for the PRZM/EXAMS models which can account for the volcanic soils of Hawaii. Therefore, there is high uncertainty as to the impact this use has on water resources and aquatic life in this state.

The slit-placement method for application to turf significantly reduces exposure of ethoprop to terrestrial and aquatic animals at levels below turf fields treated with broadcast applications of ethoprop. With this method the turf is slit open, the granules are placed under the thatch, the thatch is replaced and pressed down to its original position. Therefore, the risks from this method of application are considered to be acceptable.

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Appendix A: Summary of Submitted Environmental Fate Studies

1. Degradation Studies

161-1 Hydrolysis (MRID# 41270703)

1-Ethyl-labeled [14C]ethoprop, at approximately 10 ppm, was relatively stable to hydrolysis in sterile aqueous pH 5 and 7 buffered solutions that were incubated in the dark at 25 ± 1°C for 30 days. In similarly treated pH 9 buffered solutions, ethoprop degraded with an estimated half-life of 83 days. Immediately posttreatment, [14C]ethoprop comprised 92.3-94.0% of the applied radioactivity in the three solutions; at 30 days posttreatment, [14C]ethoprop comprised an average of 91.9% of the applied in the pH 5 solution, 92.2% in the pH 7 solution, and 73.0% in the pH 9 solution. Two degradates were identified in the treated solutions: ethyl alcohol and S,S-dipropyl phosphorodithioate. At 30 days posttreatment, ethyl alcohol comprised an average of 4.3% of the applied in the pH 5 and 7 solutions and 21.2% in the pH 9 solution.

161-2 Aqueous Photolysis (MRID# 41270702, 43833502)

The photolysis half-life in pH 7 buffer was estimated to be 122 days in the exposed system and 416 days in the dark control. In the previous study, values of 736 days and 603 days were calculated. The photolysis half-life in the sensitized (1% acetone) pH 7 buffer was estimated to be 104 days in the exposed system and 2079 days in the dark control. Values of 277 and 1460 days were found in the previous study. Because the current study only involved one sampling interval (30 days), the half-lives determined in the previous study are believed to be more reliable. However, the previously determined half-lives still involve a large amount of extrapolation. In any case, it is clear that photodegradation in water is not a significant route of dissipation for ethoprop.

HPLC analysis of the non-sensitized day 30 samples showed peaks with retention times of 3 minutes (2.60%), 5 minutes (9.97%), and 19 minutes (1.75%). These peaks were not further identified. Ethoprop was the major peak comprising 83% of the applied radioactivity in the exposed sensitized samples and 85% of applied radioactivity in the exposed non-sensitized samples.

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In the non-sensitized system, ethoprop comprised an average of 100.02% on day 0 and 84.92% on day 30 in the exposed samples and 95.71% on day 30 in the dark control.

In the sensitized system, ethoprop comprised an average of 99.98% on day 0 and 82.59% on day 30 in the exposed samples and 99.69% on day 30 in the dark control.

161-3 Photolysis on Soil (MRID# 41270704, 43833501)

After 30 days of exposure, the soil extracts had an average of 83.9% ^{14}C-ethoprop by HPLC. Approximately 27% of the radioactivity was recovered as volatile residues from extracting the 30 day exposed test system and tubing. The ^{14}C-volatile radioactivity was found to be ethoprop. The identity of ethoprop was confirmed by 2D-TLC. The degradates in the soil extracts comprised <10% of the applied radioactivity. No degradation was apparent in the dark controls. This supplemental study confirmed the original study conclusion that Ethoprop is photolytically stable on soil.

Based on the original Carpenter study (41270704), extrapolated half-lives were 308 days and 2090 days for the exposed and dark control samples, respectively.

2. Metabolism Studies

162-1 Aerobic Soil Metabolism study (Acc. # 00160171)

[1-^{14}C]Ethoprop at 11.9 ppm degraded with a half-life of 100 days in aerobic loamy sand soil incubated at 25°C in the dark for 252 days. At 252 days posttreatment, 24.84% of the applied radioactivity was undegraded [^{14}C]ethoprop. $^{14}CO_2$ was the major degradate; CO_2 accounted for 54% of the applied at 252 days posttreatment. The major nonvolatile degradates, O-ethyl-S-methyl-S-propylphosphorodithioate, O-ethyl-O-methyl-S-propylphosphorodithioate, and O-ethyl-S-propylphosphorothioate, each accounted for <4% of the applied at every sampling interval. Unextractable [^{14}C]residues accounted for 10.28% of the applied at 252 days posttreatment.

162-2 Anaerobic Soil Metabolism study (Acc.# 00160171)

[1-^{14}C]Ethoprop decreased from 79.18 to 58.17% of the applied radioactivity during 56 days of anaerobic incubation (flooded plus N_2 atmosphere) following 28 days of aerobic incubation in loamy sand soil maintained in the dark at 25°C. By day 56 of the anaerobic incubation, a total of 2.25% of the radioactivity had been evolved and 10.48% was unextractable. The degradates O-ethyl-O-methyl-S-propylphosphorothioate, and O-ethyl-S-propylphosphorothioate each accounted for <1% of the applied in both the flood water and soil extracts.

3. Mobility

163-1 Mobility - Adsorption/Desorption

Ethoprop may be considered mobile in some soils. Freundlich K_d's were determined from a batch equilibrium study to be 1.08 in a sandy loam with 1.0% organic carbon, 1.24 in a sandy loam with 1.9% o.c., 2.10 in a silt loam (2.3% o.c.) and 3.78 in a silty clay (4.1% o.c.). Mobility information on the M1 degradate indicates that it is highly mobile with Freundlich adsorption values of 0.525 in a silt loam, 0.505 in a sandy loam, 0.527 in a loamy sand, 1.24 in a pond sediment, and 4.12 in a clay soil. K_{oc} values were 129, 109, 43, 50, and 1652, respectively.

163-1 Mobility - Aged Leaching (MRID# 43778601)

Based on batch equilibrium experiments, [^{14}C] O-ethyl-S-propyl phosphorothioic acid-S-propyl phosphorothioic acid at nominal concentrations of 0.043, 0.415, 2.057, and 4.067 ppm, showed very high mobility in silt loam, sandy loam, pond sediment, and loamy sand soil:solution slurries equilibrated for 3 hours at 26 ± 1°C. Mobility was less in a clay soil:solution slurry equilibrated for 8 hours. Freundlich K_{ads} values were 0.525 for silt loam soil, 0.505 for sandy loam soil, 0.527 for loamy sand soil, 1.24 for pond sediment, and 4.12 for clay soil; respective K_{oc} values were 129, 109, 43, 50, and 1652.

Freundlich K_{des} values (desorption cycle 1) were 1.0 for the silt loam soil, 1.1 for the sandy loam soil, 1.4 for the loamy sand soil, 1.7 for the pond sediment, and 11.4 for the clay soil. All the soils showed increasing values of K_{des} between the first, second, and third cycles, indicating increased binding to soils during the desorption cycles.

163-2 Laboratory Volatility (MRID# 41211201)

In a laboratory volatility study, volatiles comprised up to 7.1% of the applied dose; the mean value was 3.77%. Ethoprop comprised 21.3 - 52% of the volatile components on day 7, the last day of sampling.

At 50% FMC and a flow rate of 100 ml/minute, soil vapor concentrations ranged from 0.26 to 1.96 $\mu g/m^3$. At 300 ml/min., soil vapor concentrations ranged from 0.038 to 0.49 $\mu g/m^3$. At 75% FMC and a flow rate of 100 ml/minute, soil vapor concentrations ranged from 0.93 to 3.2 $\mu g/m^3$. At 300 ml/min., soil vapor concentrations ranged from 0.06 to 0.99 $\mu g/m^3$.

4. Dissipation Studies

164-1 Terrestrial Field Dissipation (MRID# 41712401)

Two registered formulations of ethoprop, (MOCAP 10%G and MOCAP EC), were applied and soil incorporated into potato fields at two separate locations at the maximum label rate of 12 lb ai/A. The field dissipation studies were conducted in Washington and North Carolina. At the Washington site, characterized by cool, sandy, low organic soils, ethoprop dissipated with a half-life of approximately 40 days. The dissipation rate appeared to be independent of the formulation used. At the North Carolina site, characterized by wet soils as well as warm temperatures and moderately organic loamy soils, ethoprop dissipated rapidly with a half-life of approximately 10 days. Again, the dissipation rate did not appear to be affected by the formulation used. Dissipation followed first-order kinetics at all four plots. Ethoprop was found primarily in the 0.0-0.15 m and 0.15-0.3 m depth increments, however, significant residues were detected in the 0.3-0.6 m increment in the North Carolina soil (0.43 $\mu g/g$ at 1 month, EC formulation; 0.20 $\mu g/g$ at 2 weeks, granular formulation). This leaching may have been exacerbated by the above average heavy rainfall at the site.

164-1 Terrestrial Field Dissipation (MRID# 443980-01)

Ethoprop (MOCAP® 10G, 10% a.i.), broadcast applied at a nominal concentration of 20.0 lbs a.i./A, dissipated with calculated half-lives of 18 days and 13 days on turf and bareground sandy loam soil plots located in **Wilson County, North Carolina**. However, because the parent compound dissipated rapidly, but the calculated half-life values were based on data collected throughout the study period, the reported half-lives may have been overestimated. The observed half-life was between 0 and 3 days posttreatment in both turf and bareground plots.

Following application to the **bareground plot**, the parent compound was detected in the 0- to 15-cm depth at 8.35 ppm at 0 days posttreatment, decreased to 3.22 ppm by 0.12 months (3 days) posttreatment and 1.19 ppm by 0.50 months (16 days) posttreatment, and was 0.02 ppm at 4 months posttreatment. The parent compound was detected in the 15- to 30-cm depth at 0.03-0.04 ppm (in only 2 of 4 replicates) at 0.25 months (7 days) posttreatment and at 0.06 ppm (1 replicate) at 0.50 months (16 days) posttreatment. The major degradate, O-ethyl-S-propylphosphorothioic acid (M1), was detected in the 0- to 15-cm depth at 0.015 ppm at 0 days posttreatment and was a maximum concentration of 0.04 ppm at 0.12 months (3 days) and 0.25 months (7 days) posttreatment, and was not detected by 0.50 months (16 days) posttreatment. The degradate M1 was not detected above the limit of quantitation at lower depths.

Following application to the **turf plot**, ethoprop was initially present in the thatch at 55.26 ppm, decreased to 19.63 ppm by 0.12 months (3 days) posttreatment and 4.17 ppm by 1 month posttreatment, and was present at 0.69 ppm at 4 months posttreatment. The parent compound was observed in soil samples from the 0- to 15-cm depth immediately after application at 0.66 ppm, decreased to 0.33 ppm by 0.12 months (3 days) posttreatment and 0.048 ppm by 0.50 months (16 days) posttreatment, and was below the limit of quantitation by 3 months posttreatment. The parent compound was observed in the 15- to 30-cm depth at 0.02-0.05 ppm (in two replicates) at 0.12 months (3 days) posttreatment, but was not detected above the limit of quantitation at any other sampling interval at that depth or at lower depths. The major degradate, O-ethyl-S-propylphosphorothioic acid (M1), was detected in the thatch at 0.14 ppm at 0 days posttreatment, decreased to 0.05 ppm by 0.50 months (16 days) posttreatment, and was below the limit of quantitation by 3 months posttreatment. The degradate M1 was not observed above the limit of quantitation in soil samples from the 0- to 15-cm depth other than in one replicate (0.02 ppm) at 0.12 months (3 days) posttreatment. The degradate M1 was not observed above the limit of quantitation at lower depths.

Ethoprop (MOCAP® 10G, 10% a.i.), broadcast applied at a nominal concentration of 20.0 lb a.i./A, dissipated with calculated half-lives of 9 days and 12 days on turf sand soil and bareground loamy sand soil plots in **Jefferson County, Florida**. However, because the parent compound dissipated rapidly, but the calculated half-life values were based on data collected throughout the study period, the reported half-lives may have been overestimated. The observed half-life was between 0 and 3 days posttreatment in bareground plots and between 0 and 7 days in turf plots.

Following application to the **bareground plot**, ethoprop was detected in the 0- to 15-cm depth at 10.27 ppm at 0 days posttreatment, decreased to 2.55 ppm by 0.12 months (3 days) posttreatment and 0.06 ppm by 1 month posttreatment, and was present at 0.01-0.02 ppm (in two replicates only) at 4 months posttreatment. The parent compound was detected in the 15- to 30-cm depth at a maximum of 0.09 ppm at 0.12 months (3 days) posttreatment, decreased to 0.07 ppm by 0.25 months (7 days) and was not above the limit of quantitation by 1 month posttreatment. The parent compound was not detected in the 30- to 45-cm depth other than in one replicate (0.16 ppm) at 0.25 months (7 days) posttreatment. The parent compound was not detected above the limit of quantitation at lower depths. The major degradate, O-ethyl-S-propylphosphorothioic acid (M1), was detected in the 0- to 15-cm depth at 0.03 ppm at 0 days posttreatment, and was not detected above the limit of quantitation at any other sampling interval with the exception of 0.12 months (3 days) posttreatment (0.02 ppm in one replicate only). The degradate M1 was not detected above the limit of quantitation at lower depths.

Following application to the **turf plot**, ethoprop was initially present in the thatch at 103.30 ppm, decreased to 27.40 ppm by 0.12 months (3 days) posttreatment and 0.82 ppm by 1 month posttreatment, and was 0.06 ppm at 4 months posttreatment. The parent compound was detected in soil samples from the 0- to 15-cm depth at 1.43 ppm at 0 months posttreatment, decreased to 0.62 ppm by 0.25 months (7 days) and 0.06 ppm by 1 month posttreatment, and was not detected above the limit of quantitation by 2 months posttreatment. The parent compound was observed in the 15- to 30-cm depth at 0.14 ppm at 0.12 months (3 days) posttreatment, decreased to 0.03 ppm by 0.50 months (16 days) posttreatment and was below the limit of quantitation by 1 month posttreatment. In the 30- to 45-cm depth, the parent compound was detected at 0.03 ppm at 0.12 months (3 days) posttreatment and was not detected or was below the limit of quantitation by 0.50 months (16 days) posttreatment. Ethoprop was detected only sporadically in the 45- to

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60-cm and lower depths. The major degradate, O-ethyl-S-propylphosphorothioic acid (M1), was detected in the thatch at 0.60 ppm at 0 days posttreatment, was a maximum of 0.69 at 0.12 months (3 days) posttreatment, decreased to 0.36-0.42 ppm by 0.25-0.50 months (7-16 days) posttreatment, and was below the limit of quantitation by 2 months posttreatment. Other than in sporadic observations, M1 was not detected above the limit of quantitation in the soil.

5. Accumulation Studies

165-4 Bioaccumulation in Fish (MRID# 414256-01, -02, 430384-01, -02)

Ethoprop is accumulated in bluegill under the conditions of a flow-through accumulation study. Measured BCF's were 230x for viscera and 86x for fillet. The HPLC analysis of the water, fillet and viscera stability samples indicated that there was no significant degradation of parent or metabolites under freezer storage conditions. Solvent extraction released approximately 25-30% of the total ^{14}C as organic-extractable. Approximately 50% was tissue unextractable. The organic-extractable fractions of viscera and fillet samples contained similar profiles of parent and degradates. Ethoprop represented an average of 0.005 and 0.017 ppm of the fillet and viscera residue, respectively. Base hydrolysis released approximately 50% of the tissue unextractable. However, of the radioactivity which was released by base hydrolysis, no parent was found. Enzyme hydrolysis released <15% of the total ^{14}C as organic-extractable.

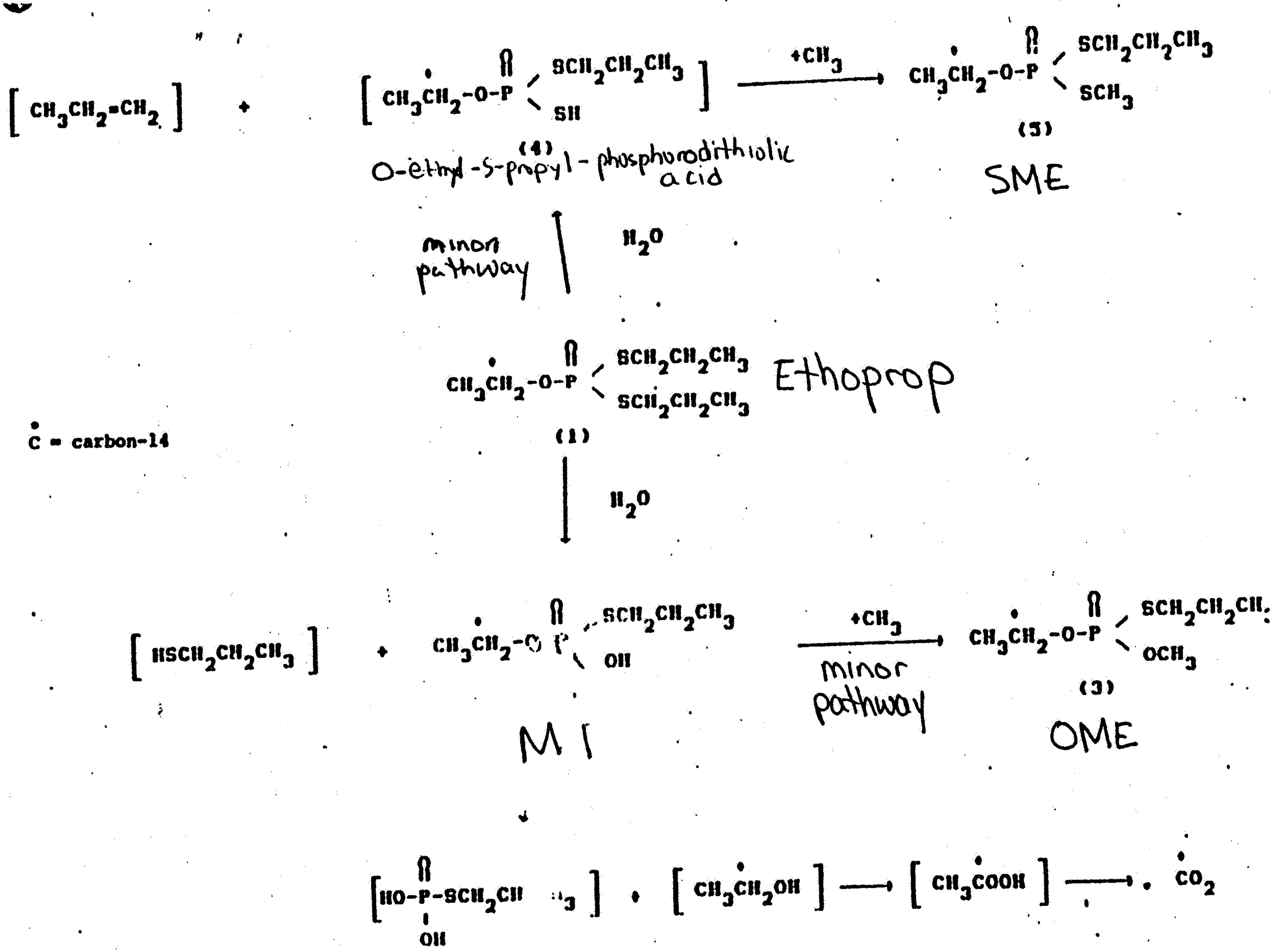

Figure 7. Proposed degradation pathway of ethoprop in soil.

Appendix C: Risk Quotients

A means of integrating the results of exposure and ecotoxicity data is called the quotient method. For this method, risk quotients (RQs) are calculated by dividing exposure estimates by ecotoxicity values, both acute and chronic:

RQ = EXPOSURE/TOXICITY

RQs are then compared to OPP's levels of concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to nontarget organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories: (1) **acute high** - potential for acute risk is high, regulatory action may be warranted in addition to restricted use classification (2) **acute restricted use** - the potential for acute risk is high, but this may be mitigated through restricted use classification (3) **acute endangered species** - the potential for acute risk to endangered species is high, regulatory action may be warranted, and (4) **chronic risk** - the potential for chronic risk is high, regulatory action may be warranted. EFED does not perform assessments for chronic risk to plants, acute or chronic risks to nontarget insects, or chronic risk from granular/bait formulations to mammalian or avian species.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic risk quotients are derived from the results of required studies. Examples of ecotoxicity values derived from the results of short-term laboratory studies that assess acute effects are: (1) LC_{50} (fish and birds) (2) LD_{50} (birds and mammals (3) EC_{50} (aquatic plants and aquatic invertebrates) and (4) EC_{25} (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic effects are: (1) LOEC (birds, fish, and aquatic invertebrates) (2) NOEC (birds, fish and aquatic invertebrates) and (3) MATC (fish and aquatic invertebrates). For birds and mammals, the NOEC value is used as the ecotoxicity test value in assessing chronic effects. Other values may be used when justified. Generally, the MATC (defined as the geometric mean of the NOEC and LOEC) is used as the ecotoxicity test value in assessing chronic effects to fish and aquatic invertebrates. However, the NOEC is used if the measurement end point is production of offspring or survival.

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Risk Presumptions for Non-Target Organisms, with Corresponding RQs and LOCs.

Risk Presumption	RQ	LOC
	Birds	
Acute High Risk	EEC[1]/LC_{50} or LD_{50}/sqft[2] or LD_{50}/day[3]	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOEC	1
	Wild Mammals	
Acute High Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOEC	1
	Aquatic Animals	
Acute High Risk	EEC[3]/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Endangered Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/MATC or NOEC	1
	Terrestrial and Semi-Aquatic Plants	
Acute High Risk	EEC[4]/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1
	Aquatic Plants	
Acute High Risk	EEC[5]/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1

[1] abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items

[2] $\frac{mg/ft^2}{LD_{50} * \text{wt. of bird}}$ [3] $\frac{\text{mg of toxicant consumed/day}}{LD_{50} * \text{wt. of bird}}$

[3] EEC = (ppm or ppb) in water [4] EEC = lbs ai/A [5] EEC = (ppb/ppm) in water

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