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OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

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MEMORANDUM

SUBJECT: Revised Environmental Fate and Effects Division Preliminary Risk Assessment for the **Oxyfluorfen** Reregistration Eligibility Decision Document.

TO: Deanna Scher, Chemical Review Manager
Susan Lewis, Branch Chief
Reregistration Branch I
Special Review and Reregistration Division (7508C)

FROM: Christine Hartless, Wildlife Biologist, Environmental Risk Branch I
Amer Al-Mudallal, Chemist, Environmental Risk Branch I
Norman Birchfield, Biologist, on detail to Environmental Risk Branch IV
Environmental Fate and Effects Division (7507C)

THRU: Dana Spatz, Acting Branch Chief
Environmental Risk Branch I
Environmental Fate and Effects Division (7507C)

Attached is the EFED preliminary risk assessment for oxyfluorfen (revised based on Dow AgroSciences 30-error correction comments). EFED believes oxyfluorfen presents the greatest risks to: (1) terrestrial plants through spray drift of liquid formulations and (2) aquatic organisms through spray drift of liquid formulations and runoff of dissolved and soil entrained oxyfluorfen. In addition, the potential of oxyfluorfen (as a light-dependent peroxidizing herbicide) to be more toxic in the presence of intense sunlight may lead to the occurrence of environmental effects that are not predicted by standard guideline toxicity tests.

Data Gaps

Environmental Fate and Transport: The environmental fate database is adequate. Although not required, the submission of the following additional studies would provide further refinement in the characterization of the fate of oxyfluorfen and in the drinking water estimates:

1. Anaerobic Aquatic Metabolism, Guideline 162-3

2. Aerobic Aquatic Metabolism, Guideline 162-4

Ecological Effects. The ecological toxicity data base is fairly complete. The following studies are required:

1. Avian Reproduction, Guideline 71-4. Bobwhite quail and mallard duck. The submitted studies (MRID 4153012-05 and -06) were classified as supplemental. A definitive NOEC was not established in the bobwhite quail study, and only one treatment group was exposed in the mallard duck study. There is uncertainty in the avian chronic RQs calculated in the attached EFED chapter since no definitive NOEC was established. In addition, the change in the purity of the technical grade of oxyfluorfen (from 70-82% ai to 99% ai) may impact the toxicity of the chemical, and no avian studies have been conducted with this new technical.

2. Aquatic Invertebrate Life-Cycle, Guideline 72-4(b). Raw data for this supplemental study (MRID 921361-06) must be submitted and satisfactorily reviewed, or a new study must be submitted. Because the Agency has not been able to review these raw data, there is uncertainty in the NOEC value used for the chronic risk assessment for freshwater invertebrates.

3. Seed Germination/Seedling Emergence, Guideline 123-1(a). Seedling emergence toxicity study using the TEP is requested. The submitted study (MRID 416440-01) is classified as "supplemental" because the percent recovery was unacceptably high for two treatment levels (273% [nominal concentration = 0.80 lbs ai/acre] and 319% [nominal concentration = 0.05 lbs ai/acre]). EFED is requesting a repeat of this entire study be conducted using the TEP, in accordance with our current policy. Toxicity tests conducted with the TEP would allow for the development of a more realistic description of the actual risk to non-target terrestrial plants.

4. Vegetative Vigor, Guideline 123-1(b).Vegetative vigor toxicity study using the TEP is required. In this supplemental study (MRID 416440-01), the NOEC and EC25 values obtained from cabbage are unacceptable and must be repeated. Also, the percent recovery was unacceptably low for two treatment levels (29.6% [nominal concentration = 1.6 lbs ai/acre] and <10% [non-detect in nominal concentration = 0.0040 lbs ai/acre]) and the solvent control was contaminated with the test substance. EFED is requesting a repeat of this entire study be conducted using the TEP, in accordance with our current policy.

Toxicity tests conducted with the TEP would allow for the development of a more realistic description of the actual risk to non-target terrestrial plants.

5. Aquatic Plant Growth, Guideline 123-2. Toxicity studies for *Anabaena flos-aquae*, *Navicula pelliculosa*, *Skeletonema costatum*, and *Lemna gibba* are also required for this Guideline to be fulfilled. These studies will allow for a more complete characterization of the risks to aquatic plants. Also, the toxicity study for *Lemna gibba* will allow for an assessment of risks to endangered aquatic vascular plants. With the currently submitted study, the risks to aquatic vascular plants cannot be assessed.

6. Phototoxicity study: Protoporphyrinogen oxidase in plants and animals shows similar sensitivity to many light-dependent peroxidizing herbicides (LDPHs) including oxyfluorfen. In order to determine if animals may have similar sensitivity to intense light after exposure to LDPHs, EFED is requesting that registrants of herbicides with this mode of action submit phototoxicity studies (see memo in Appendix D of attached RED document).

7. 10-day survival and growth toxicity test for sediments using one of the suggested freshwater sediment toxicity organisms, as outlined in Section 12, Test Method 100.2, USEPA (2000). In addition to the guidance provided in USEPA (2000), pore water concentrations of oxyfluorfen must be measured (see OPPTS Draft Guideline 850.1735 and consult with EFED for additional study protocols). There is potential for exposure of sediment-dwelling organisms to oxyfluorfen as concentrations in sampled sediments (San Joaquin River and Columbia River Valley waters) did reach high levels (at least one sample > 500 ppb). In a submitted sediment-dwelling midge larvae toxicity study (MRID 420480-01, supplemental non-guideline), the organisms were not observed for 10 days and the pore water concentration of oxyfluorfen was not measured.

8. 10-day survival and growth toxicity test for sediments using one of the suggested estuarine sediment toxicity organisms. In addition to the guidance provided in OPPTS Draft Guideline 850.1740, consult with EFED for additional study protocols. The justification for this study is the same as outlined above for the freshwater sediment-dwelling organism toxicity test. In addition, the likelihood that oxyfluorfen could reach estuarine systems is high due to its heavy use in coastal California and along the lower Mississippi River.

9. Estuarine/marine fish early-life stage [Guideline 72-4(a)] and aquatic invertebrate life-cycle [Guideline 72-4(b)] toxicity tests. Acute toxicity testing demonstrated that the estuarine/marine invertebrate test species were more sensitive to oxyfluorfen than freshwater invertebrate test species. Based on the limited data, EFED concluded that acute sensitivity of freshwater fish and estuarine/marine fish to oxyfluorfen is similar, but cannot make any conclusions regarding chronic risks to estuarine/marine fish. It is important to assess the chronic risks to estuarine/marine organisms since they may be more sensitive to oxyfluorfen than freshwater fish and invertebrates. Also, the likelihood

that oxyfluorfen could reach estuarine systems is high due to its heavy use in coastal California and along the lower Mississippi River.

Endangered Species Statement

The Agency has developed 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 address these impacts. The Endangered Species Act requires federal agencies to ensure that their actions are not likely to jeopardize listed species or adversely modify designated critical habitat. To analyze the potential of registered pesticide uses to affect any particular species, EPA puts basic toxicity and exposure data developed for REDs into context for individual listed species and their locations by evaluating important ecological parameters, pesticide use information, the geographic relationship between specific pesticides uses and species locations, and biological requirements and behavioral aspects of the particular species. This analysis will include consideration of the regulatory changes recommended in this RED. A determination that there is a likelihood of potential impact to a listed species may result in limitations on use of the pesticide, other measures to mitigate any potential impact, or consultations with the Fish and Wildlife Service and/or the National Marine Fisheries Service as necessary.

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). A final program, which may be altered from the interim program, will be proposed in a Federal Register notice scheduled for publication in autumn of 2001.

Label Information

The following should be included on oxyfluorfen labels:

Environmental hazards for terrestrial and residential uses:

1. “This product may contaminate water through drift of spray in wind. This product has a high potential for runoff for several days after application. Poorly draining soils and soils with shallow water tables are more prone to produce runoff that contains this product.

Household Labels - Avoid applying this product to ditches, swales, and drainage ways. Runoff of this product will be reduced by avoiding applications when rainfall is forecasted to occur within 48 hours.

Agricultural Label - A level, well maintained vegetative buffer strip between areas to which this product is applied and surface water features such as ponds, streams, and springs will reduce the potential for contamination of water from rainfall-runoff. Runoff of this product will be reduced by avoiding applications when rainfall is forecasted to occur within 48 hours.”

2. To appear on all end-use products:

"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."

3. To appear on end-use products:

Granular End-Use Products

This pesticide is toxic to fish and aquatic invertebrates. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwaters or rinsate.

Non-granular End-Use Products

This pesticide is toxic to fish and aquatic invertebrates. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwaters or rinsate.

4. Warnings regarding spray drift effects and establishment of buffer zones should follow current label language (Draft PR Notice available at: http://www.epa.gov/opppmsd1/PR_Notices/prdraft-spraydrift801.htm).

Application Rates and Timing

Reported use rates on all crops are typically much lower than the maximum labeled rates. Often the average reported use rate (BEAD QUA report and Crop Profiles) is less than ½ the maximum labeled rate. To aid in mitigating risk to the environment, we propose a reduction in the maximum use rates. This is critical as the use of oxyfluorfen has been drastically increased over the past decade. One of the geographic regions with the largest increase is the agricultural regions surrounding the lower Mississippi river (mostly cotton fallow bed use). Several California crops also showed large increase in the use of oxyfluorfen, due to increase in crop acreage and/or the end of production of DCPA (a pre-emergence herbicide). If this increasing trend continues, the likelihood of surface water contamination of oxyfluorfen will increase as well. Use at less than the maximum labeled rate appears to be efficacious and frequent; therefore, the proposed reduction in maximum labeled rates may not affect the usage patterns of oxyfluorfen products. Although a reduction in the maximum labeled rate may not remove all risks, it will help to minimize them.

The language for application timing on non-bearing citrus should be more specific. Currently there are no restrictions on the timing other than a maximum of 2 lbs ai/acre/application, a maximum of 6 lbs ai/acre/year, and applications should not occur during periods of new growth.

EFED also requests that the label language for the time interval of the total chemical applied be clarified. The time interval is inconsistent and unclear on some labels (may be referred to as year, season, or growing season). This may be misleading as some labeled crops are perennials or annuals, and some may be planted multiple times in the same field during a calendar year. For some uses, the maximum poundage to be applied per year or the maximum number of applications per year is not specified (e.g., right-of-way). EFED requests that the maximum poundage of chemical applied per acre be given on a calendar year basis for all uses. If not, the terms season and growing season must be clearly defined on the label. In the attached risk assessment, EFED considered maximum rates supplied on the label to apply to a calendar year.

Environmental Fate and Effects Division's Preliminary Risk Assessment for the Reregistration Eligibility Document for Oxyfluorfen

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I. Environmental Risk Conclusions

Usage Summary

Oxyfluorfen is a diphenyl ether contact herbicide used for pre- or post-emergence to control monocotyledonous and broad-leaved weeds. It is an ingredient in several agricultural and home use products, either as a sole active ingredient or in conjunction with other active ingredients. From 1992 to 1997 the use of oxyfluorfen increased by 54%, from an estimated 458,000 pounds active ingredient in 1992 to an estimated 705,000 lbs active ingredient in 1997. Oxyfluorfen is most frequently used in a liquid formulation (emulsifiable concentrate) as either a ground or aerial spray. The most common uses are as a ground spray on tree fruit, nut, and grape crops and as either an aerial or ground spray on fallow fields prior to planting for a wide range of crops (e.g., broccoli, cabbage, cauliflower, garlic, onion, cotton, soybeans). Oxyfluorfen is also available in a granular formulation, with labeled uses focusing on ornamental nursery crops. There are also several ready-to-use products and a liquid concentrate available for residential use.

Environmental Risks Summary

EFED has considered available information on oxyfluorfen's toxicity, use areas, usage, fate properties, and application methods and formulations in characterizing ecological risks related to normal use. Upon review and synthesis of this information, EFED believes oxyfluorfen presents the greatest risks to: (1) terrestrial plants through spray drift of liquid formulations and (2) aquatic organisms through spray drift of liquid formulations and runoff of dissolved and soil entrained oxyfluorfen. In addition, the potential of oxyfluorfen (as a light-dependent peroxidizing herbicide) to be more toxic in the presence of intense light may lead to the occurrence of environmental effects that are not predicted by standard guideline toxicity tests.

Oxyfluorfen is classified as a very highly toxic and very persistent herbicide and is a concern for terrestrial plants and aquatic organisms. Oxyfluorfen can contaminate surface water through spray drift and runoff. Oxyfluorfen is unlikely to contaminate ground water because it is relatively immobile in the soil column; therefore, the likelihood of leaching is small.

Drinking Water Summary

The proposed surface water-derived drinking water concentrations are:

> **23.4** µg /L for the 1 in 10 year annual peak concentration (acute)
> **7.1** µg /L for the 1 in 10 year annual mean concentration (chronic) and
> **5.7** µg /L for the 36 year annual mean concentration.

These concentrations were derived from modeling oxyfluorfen use on Oregon apples with an application rate of 2.0 lb ai/acre.

The recommended scenario is neither the highest labeled application rate nor the highest expected water concentration of the modeled scenarios. The modeled surface water-derived drinking water concentrations will vary depending on regional climate, soil, environmental characteristics. Some uses with higher application rates have traditionally represented a small percentage of the total annual poundage of oxyfluorfen usage (e.g., non-bearing citrus, coffee, cacao, ornamentals).

The SCI-GROW model concentration estimate of oxyfluorfen in drinking water from shallow groundwater sources is **0.08** µg/L, using the highest annual application rate of 8.0 lbs ai/acre for ornamentals. This concentration can be considered as both the acute and chronic value.

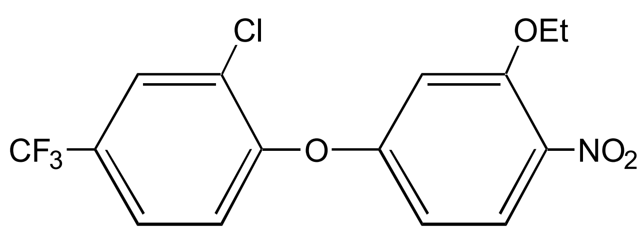
The estimated oxyfluorfen concentrations in drinking water presented above were derived from modeling (PRZM/EXAMS and SCI-GROW). The limited monitoring data were used qualitatively in the drinking water assessment.

II. Introduction

<u>Physical and Chemical Properties</u>

Common name:	Oxyfluorfen
Chemical name:	2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene
Molecular formula:	$C_{15}H_{11}ClF_3NO_4$
Molecular weight:	361.7
Physical state:	Orange crystalline solid
Melting point:	65-84 °C
Vapor pressure (25°C):	0.0267 mPa (2.5 x 10^{-7} Torr)
Solubility (25°C):	0.116 mg/L water; 725 g/kg acetone;500-550 g/kg chloroform; 615 g/kg cyclohexanone; >500 g/kg dimethylformamide
Octanol/water:	2.94 x 10^4 at 25ºC
Log K_{ow}:	4.46

Chemical structure of oxyfluorfen:



Mode of Action

Oxyfluorfen is a light-dependent peroxidizing herbicide (LDPH) used for pre- and post-emergence control of monocotyledonous and broad leaf weeds. LDPHs target a specific enzyme, protoporphyrinogen oxidase, in the heme and chlorophyll biosynthetic pathway. Inhibiting protoporphyringen oxidase in plants leads to an accumulation of phototoxic heme and chlorophyll precursors which, in the presence of light, produce activated oxygen species which rapidly disrupt cell membrane integrity.

Oxyfluorfen is applied as a spray or granule that must contact plant foliage to cause effects. Oxyfluorfen is not translocated in plants, thus damage is normally limited to the areas it contacts. Visible signs of oxyfluorfen toxicity to plants include localized chlorosis (yellowing or whitening) and necrosis. Plants that are actively growing are most susceptible to oxyfluorfen. By forming a chemical barrier on the soil surface, oxyfluorfen affects plants at emergence. This barrier is formed with adequate spray coverage or irrigation following granule application (to partially dissolve granules and promote dispersion of oxyfluorfen over the soil surface). Because of the length of oxyfluorfen soil half-life, this barrier may last up to three months (Rout label, EPA Reg.# 58185-27). All plants attempting to emerge through the soil surface will be affected through contact. Oxyfluorfen also affects plants through direct contact of spray or granules to exposed tissues. If the plant is able to recover from a partial injury to the contacted tissues, death may not occur.

Protoporphyrinogen oxidase in plants and animals shows similar sensitivity to many LDPHs including oxyfluorfen. In order to determine if animals may have similar sensitivity to intense light after exposure to LDPHs, EFED is requesting that registrants of herbicides with this mode of action submit phototoxicity studies (see Appendix D).

Oxyfluorfen Formulations and Use Characterization

Oxyfluorfen is an ingredient in several agricultural and home use products, as a sole active ingredient and in conjunction with other active ingredients (Table 1).

Table 1: Oxyfluorfen Formulations						
Company	Trade Name	EPA REG #	Percent Oxyfluorfen	Other AIs	Form	Intended Use
Dow AgroSciences	Goal Technical	62719-399	99	None	Tech Grade	a
Dow AgroSciences	Goal 4F	62719-447	41	None	EC	b
Dow AgroSciences	Goal 2XL	62719-424	23	None	EC	b
Dow AgroSciences	Goal 2E	62719-395	23.5	None	EC	b
Dow AgroSciences	Goal 1.6E	62719-400	19.4	None	EC	b
Agan	Galigan Technical	11603-29	97.4	None	Tech Grade	a
Agan	Galigan 2E	66222-28	22	None	EC	b
Monsanto	Mon 78095 Herbicide	00524-520	2.5	Glyphosate (40%)	EC	b
Regal Chemical	Regal 0-0 Herbicide	48234-10	2	Oxadiazon (1.0%)	Granular	c
Grace/Sierra	Rout Ornamental Herbicide	58185-27	2	Oryzalin (1.0%)	Granular	c
Scotts	8918/2 Ornamental Herbicide II	00538-172	2	Pendimethalin (1.0%)	Granular	c
Platte Chemical	Kleenup Super Edger	34704-775	0.25	Glyphosate (0.25%)	RTU Liquid	d
Monsanto-Solaris Group	Ortho GroundClear SuperEdger	00239-2516	0.25	Glyphosate (0.25%)	RTU Liquid	d
Monsanto-Solaris Group	Ortho GroundClear Triox	00239-2622	0.7	Imazapyr, Isopropylamine salt (0.08%)	Liquid Concentrate	d

[a] Technical grade of oxyfluorfen, not intended for any agricultural or home use.

[b] Emulsifiable concentrate, agricultural use as a ground or aerial spray. Intended for a wide range of crops over a large geographic area. Maximum application rates vary for crops and cropping practices; highest labeled usage is 2 lbs oxyfluorfen/acre/application with a maximum of 6 lbs oxyfluorfen/acre/year (for coffee and cacao). See labels for specific usage rates and instructions.

[c] Granular form, ornamental nursery use. Recommended application rates and timings vary for nursery crops and target weeds; highest labeled usage is 2 lbs oxyfluorfen/acre/application with a maximum of 8 lbs oxyfluorfen/acre/year. See labels for specific usage rates and instructions.

[d] Ready-to-use liquid (in trigger spray bottle or use in tank sprayer) or liquid concentrate (dilute in a watering can). Labels geared to home use on driveways, sidewalks, fencerows, etc. Maximum application rate is approximately 8 lbs oxyfluorfen/acre/application, and no minimum interval between applications is specified. See labels for specific usage rates and instructions.

Based on pesticide survey usage information for the years of 1990 through 1999 available to BEAD (QUA dated 5 June 2001), an annual estimate of oxyfluorfen's total domestic usage averaged approximately 743,000 pounds active ingredient (a.i.) for 1,167,000 acres treated. Most of the acreage is treated with one pound ai/acre or less per application and one pound ai/acre or less per year. Oxyfluorfen is a broad spectrum herbicide with its largest markets in terms of total pounds active ingredient allocated to wine grapes (32%), almonds (23%), cotton (7%), walnuts (6%), and table grapes (4%). The remaining usage is primarily on apples, corn, raisin grapes, mint, dry onion, ornamentals, peaches, pistachios, prunes, and artichokes. Crops with a high percentage of the total U.S. planted acres treated include wine grapes (54%), artichokes (53%), pistachios (44%), almonds (43%), table grapes and nectarines (35% each), and figs (33%). Most of the usage is in California, Oregon, Washington, and the cotton growing regions along the Mississippi River (Figure 1).

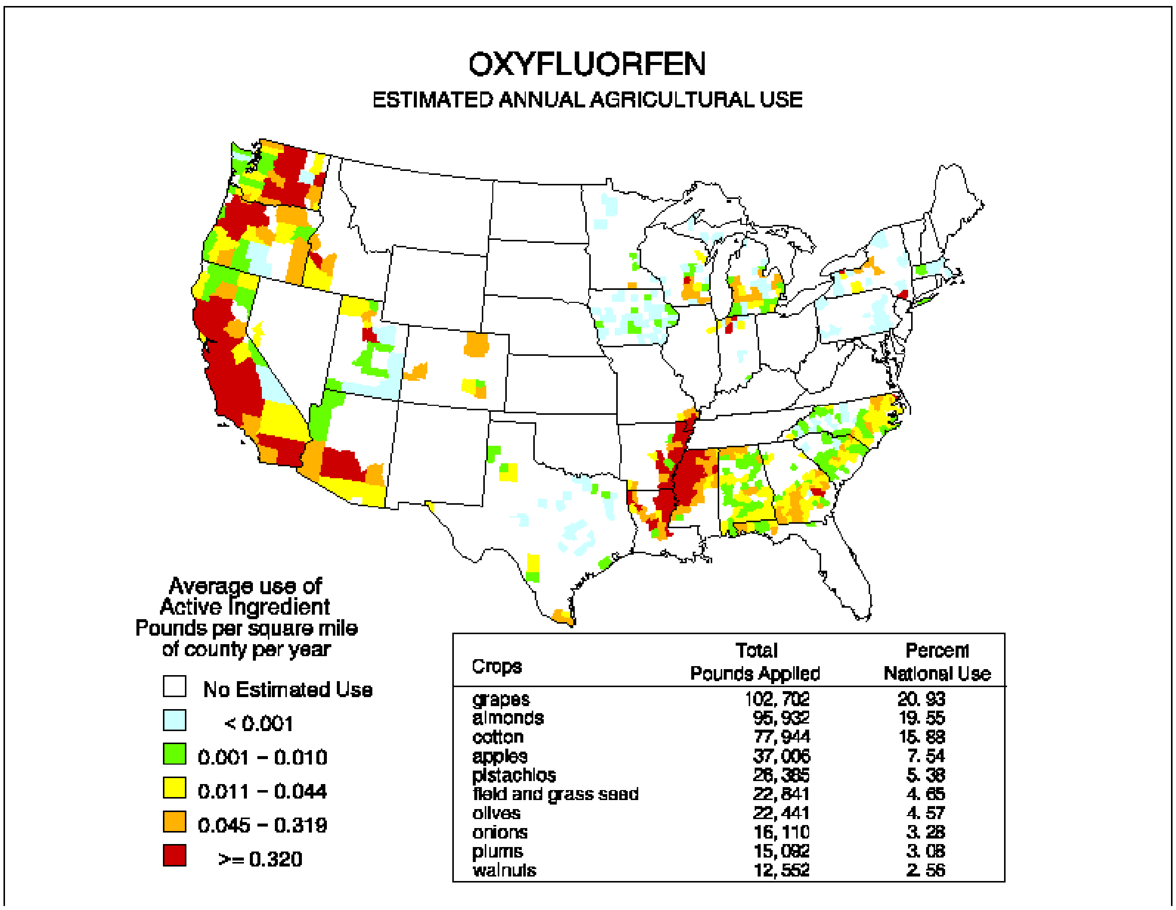


Figure 1. Estimated oxyfluorfen usage (lbs ai/square mile of county/year). The estimates are based on pesticide use rates compiled by the National Center for Food and Agricultural Policy (NCFAP) from pesticide use information collected by state and federal agencies between 1990 and 1993 and during 1995, and on crop acreage data obtained from the 1992 Census of Agriculture (source: US Geological Survey website, http://ca.water.usgs.gov/pnsp/use92/).

Although oxyfluorfen is labeled for a large number of crops, most use patterns can be described by a few broad categories. One of the most typical uses of oxyfluorfen is in tree fruit, nut, and grape crops; it is applied as a ground spray herbicide at a maximum of 2.0 lbs ai/acre/year and restricted to dormant season application. One exception is non-bearing citrus which has higher annual application rates (maximum of 4.0 lbs ai/acre/year) and multiple applications per year are common; however, this is a limited use since total acreage in non-bearing citrus is limited. Another frequent use of oxyfluorfen is as a “burndown” herbicide in fallow fields pre-plant or pre-transplant for a wide range of crops (e.g., broccoli, cabbage, cauliflower, garlic, onion, cotton, soybeans). Oxyfluorfen can be applied as an aerial or a ground spray at a maximum application rate of 0.5 lbs ai/acre. The highest labeled rate for aerial applications is 0.5 lbs ai/acre.

From 1992 to 1997 the use of oxyfluorfen increased by 54%, from an estimated 458,000 pounds active ingredient in 1992 to an estimated 705,000 lbs active ingredient in 1997 (Gianessi and Silvers, 2000). Much of this increase was driven by changes in usage on four agricultural crops. An estimated 2% of broccoli acreage in California was treated with oxyfluorfen in 1992; that estimate increased to 15% of broccoli acreage in California in 1997. Treated acreage of Texas onions increased from 15% to 100% and treated acreage of California onions increased from 55% to 67% between 1992 to 1997. Much of this increase in treated broccoli and onion acreage was due to the end of production of DCPA (a pre-emergence herbicide). An estimated 12% of cotton acreage in Louisiana was treated with oxyfluorfen in 1992; that estimate increased to 20% of cotton acreage in Louisiana in 1997. This change was attributed to the adoption of planting a “stale” seedbed (similar to conventional planting, except a “burndown” herbicide, such as oxyfluorfen, is required to remove weeds). Use on California pistachio acreage increased from an estimated 44% to 62% between 1992 and 1997. During this time interval, the total acreage in pistachios increased by 78%, thus resulting in a large total poundage increase in oxyfluorfen usage.

Risk Assessment Approach and Scenarios

This document includes an assessment of risks to aquatic and terrestrial organisms resulting from the use of oxyfluorfen. Specific uses chosen for modeling include non-bearing citrus, apples, grapes, walnuts, cotton, and cole crops (Table 2). Although this only represents a portion of the crops for which oxyfluorfen has a labeled use, it does represent crops with higher application rates and crops which have a large percentage of their total acreage treated with oxyfluorfen. Some crops with large increases in total acreage treated were also included as modeled scenarios. These crops were also chosen to represent a wide geographic area, thus encompassing a variety of environmental conditions. By encompassing crops with large percentages of acreage treated with oxyfluorfen and a large geographic area, some crops with lower maximum application rates were also included in the set of scenarios. Risks to aquatic organisms (fish, invertebrates, and plants) and terrestrial organisms (birds, mammals, and plants) are assessed based on modeled Expected Environmental Concentrations (EECs). This document also includes an assessment of potential oxyfluorfen residues in drinking water.

Table 2: Exposure Scenarios for Oxyfluorfen Risk Assessment				
Crop (location)	**Application Rate (lbs ai/acre)**	**Application number/type**	**Application dates**	**Reference**
Citrus[a] (Florida)	2.0	2 ground	07/01/xx 07/31/xx	label maximum (Goal 2XL[b])
Citrus (Florida)	1.2	3 ground	04/01/xx 08/01/xx 12/01/xx	typical rates (S. Futch, personal communication; Singh et al. 1990)
Citrus (Florida)	0.8	3 ground	04/01/xx 08/01/xx 12/01/xx	typical rates (S. Futch, personal communication; Singh et al. 1990)
Apples (Oregon)	2.0	1 ground	01/07/xx	label maximum (Goal 2XL)
Apples (Oregon)	1.0	1 ground	01/07/xx	average rates (QUA[c])
Grapes (New York)	2.0	1 ground	01/07/xx	label maximum (Goal 2XL)
Grapes (New York)	0.9	1 ground	01/07/xx	average rates (QUA)
Walnut (California)	2.0	1 ground	01/07/xx	label maximum (Goal 2XL)
Walnut (California)	0.8	1 ground	01/07/xx	average rates (QUA)
Cotton (Mississippi)	0.5	1 aerial	01/07/xx	label maximum (Goal 2XL)
Cotton (Mississippi)	0.5	1 ground	01/07/xx	label maximum (Goal 2XL)
Cole crops (California)	0.5	1 aerial	01/07/xx	label maximum (Goal 2XL) with 30-day wait to transplant
Cole crops (California)	0.25	1 aerial	01/07/xx	label maximum (Goal 2XL) with 0-day wait to transplant
Cole crops (California)	0.25	1 ground	01/07/xx	label maximum (Goal 2XL) with 0-day wait to transplant

[a] Oxyfluorfen is labeled for use only on non-bearing citrus.
[b] Goal 2XL - EPA Reg. No.62719-424.
[c] Typical rates provided in the Quantitative Usage Analysis for Oxyfluorfen prepared by BEAD.

For **non-bearing Florida citrus**, three application scenarios were explored. The label for oxyfluorfen (Goal 2XL EPA Reg. No. 62719-424) stated that the product is to be applied using a ground spray with a maximum application rate of 2.0 lbs ai/acre/application and a maximum of 4.0 lbs ai/acre/year. A conservative scenario was used with two applications at the maximum rate in a short time frame (one month apart). Since there are no timing restrictions on the label, July 1 and July 31 were chosen to represent higher exposure conditions during the rainy season when more runoff is likely. This scenario is not likely to commonly occur, so two more typical scenarios were also utilized. These scenarios consisted of three ground applications applied in April, August, and December at rates of 1.2 or 0.8 lbs ai/acre/application (S. Futch, personal communication; Singh et al. 1990).

For **apples** (Washington County, Oregon), **walnuts** (Kern County, California [Sacramento and San Joaquin Valleys]), and **grapes** (Chautauga County, New York), the ground spray scenarios had a single application date of January 7. For all treefruit, nut, and vine crops, the GOAL 2XL label states this is to be a dormant application: "Do not apply GOAL 2XL herbicide during the period between bud swell and completion of final harvest or when fruit/nuts are present. GOAL 2XL can be applied upon completion of final harvest." There are additional timing restrictions in Arizona and California: "IN ARIZONA AND CALIFORNIA, GOAL 2XL can be applied during the period following completion of final harvest up to February 15 (February 1 in the Coachella Valley, California)." The application rates for the apple, walnut, and grape scenarios represent the maximum labeled rate (2.0 lbs ai/acre/app with one application/year) and average rates based on the QUA. The results and inferences obtained from the California walnut scenario can be used as a surrogate for California almonds, a similar crop with high usage of oxyfluorfen.

Two Mississippi (Yazoo County) **cotton (fallow bed)** scenarios were modeled. Both utilized the maximum labeled rate (0.5 lbs ai/acre/app with 1 application/year) with an application date of January 7; however, one was an aerial application and one was a ground spray application. January 7 was chosen as oxyfluorfen is typically applied as a dormant winter herbicide to fallow cotton fields.

Two application rates were used for the California (Coastal Valley) **cole crop** (broccoli, cauliflower, and cabbage) scenarios. They are the maximum labeled rate (0.5 lb ai/app) with a 30-day wait to transplant seedlings and the maximum labeled rate (0.25 lb ai/app) with no wait to transplant seedlings. Since most cole crops are planted year-round in the Coastal Valley, January 7 was chosen as a conservative application date (during the rainy season, more runoff is likely). Both rates were modeled with an aerial application method, and the lower rate (0.25 lbs ai/acre) was also modeled with a ground application method. Most application of Goal 2XL to California cole crops is done using a ground spray (R. Smith, personal communication). Note that oxyfluorfen is not labeled for usage on brussels sprouts (also a cole crop).

The modeled scenarios do not represent the highest registered use rate for oxyfluorfen. Label use rates for coffee and cacao (2.0 lbs ai/acre/application with a maximum of 6.0 lbs ai/acre/year, Goal 2XL label) exceed the rate allowed for non-bearing citrus. Other than the Kona region of Hawaii, EFED is not aware of coffee or cacao growing areas in the US or its territories that contain large tracts of land devoted to coffee or cacao agriculture. The potential impact of these higher application rates on ecological risks are discussed qualitatively in the risk assessment.

The highest labeled use rate for ornamentals also exceeds the maximum use rate for non-bearing citrus. The granular forms of oxyfluorfen end-use products have a maximum label rate of 2.0 lbs ai/acre/application with a maximum of 8.0 lbs ai/acre/year. Based on pesticide survey usage information for the years of 1990 through 1999 available to BEAD (QUA dated 5 June 2001), only 2% of the total oxyfluorfen poundage was used for ornamental crops. Also, the average application rate on ornamental crops (2.0 lbs ai/acre/year) was much less than the label maximum rates. The potential impact of these higher label maximum application rates on ecological risks will be discussed qualitatively in the risk assessment.

III. Integrated Environmental Risk Characterization

EFED has considered available information on oxyfluorfen's toxicity, use areas, usage, fate properties, and application methods and formulations in characterizing ecological risks related to normal use. Upon review and synthesis of this information, EFED believes oxyfluorfen presents the greatest risks to: (1) terrestrial plants through spray drift of liquid formulations and (2) aquatic organisms through spray drift of liquid formulations and runoff of dissolved and soil entrained oxyfluorfen. In addition, the potential of oxyfluorfen (as a light-dependent peroxidizing herbicide) to be more toxic in the presence of intense light may lead to the occurrence of environmental effects that are not predicted by standard guideline toxicity tests.

Oxyfluorfen is classified as a very highly toxic and very persistent herbicide and is a concern for terrestrial plants and aquatic organisms. Oxyfluorfen contaminates surface water through spray drift and runoff. Oxyfluorfen is unlikely to contaminate ground water because it is relatively immobile in the soil column; therefore, the likelihood of leaching is small.

Spray Drift Risks to Non-target Terrestrial Plants

Effects on non-target terrestrial plants are most likely to occur as a result of spray drift from aerial and ground applications of the liquid formulation. Oxyfluorfen applied according to label directions as a liquid spray for ground or aerial applications may impact non-target plants far from the application site. Oxyfluorfen product labels do not specify a required or recommended droplet size for spray applications. Oxyfluorfen applied as a fine or medium spray has the potential to damage off-target plants. Coarse sprays may also damage non-target plants through drift, but to a lesser extent. The available terrestrial plant toxicity studies are expected to underestimate the toxicity of Goal (and other oxyfluorfen products) to plants because these toxicity studies were not conducted with formulated herbicide. Typically, herbicides are more toxic to plants when tests are conducted using a formulation. Oxyfluorfen toxicity to plants would be expected to be greater in the presence of additives that improve its ability to penetrate into plants.

EFED recognizes that label directions for use (Goal 2XL and Galigan 2E) currently include restrictions on aerial application in high wind conditions and include buffer zones to reduce drift damage to other crops and desirable vegetation. However, several incidents of drift damage have been reported in the EIIS database. Since both Roundup and Goal were applied simultaneously in all three reported incidences, the negative effects cannot be confidently attributed to either of the herbicides. Based on likely drift distance shown by studies conducted by the Spray Drift Task Force (SDTF), additional incidents of spray drift effects using Goal or Galigan could have occurred but were not reported to the Agency.

Risks to Aquatic Organisms

The results of the risk assessment suggest concern for aquatic acute and chronic risks to endangered and non-endangered species. Oxyfluorfen has the potential to affect aquatic ecological systems at all trophic levels, as it is toxic to plants, invertebrates, and fish, and exceeds the Levels of Concern based on modeled EECs [acute RQs range from 4.59 to 171.59 (aquatic plants), 0.01 to 0.25 (freshwater fish), 0.02 to 0.62 (freshwater invertebrates), and 0.04 to 1.56 (estuarine invertebrates)]. Based on the available data, oxyfluorfen acute toxicity and RQs for estuarine/marine fish were assumed to be similar to that of freshwater fish.

Exceedences of the Acute Risk LOCs may also be expected based on limited field studies. Using oxyfluorfen concentrations in containment pond water one day after application of Rout (granular formulation) at a rate of 2 lbs ai/acre in a nearby nursery field (Keese et al. 1994), exceedences of the Acute Risk LOCs for aquatic plants (RQ = 507), freshwater fish (RQ = 0.74) and invertebrates (RQ = 1.84), and estuarine/marine invertebrates (RQ = 4.59) are expected. Based on the available data, oxyfluorfen acute toxicity and RQs for estuarine/marine fish were assumed to be similar to that of freshwater fish. The initial measured concentrations in the pond water also exceeded the chronic toxicity endpoints for freshwater fish and invertebrates; however, levels of oxyfluorfen decreased below detection limits between 14 and 28 days.

Limited monitoring data also provide further information to the evaluation of environmental risk to aquatic organisms. Based on sampling during February 1992 in the San Joaquin River (at Vernalis, California), oxyfluorfen concentrations in suspended sediment ranged from 11.8 to 82.2 µg/L (Bergamaschi et al. 1997). Using a partitioning factor of 100 (see Appendix C), dissolved water concentrations are estimated to be between 0.12 and .82 µg/L. Using 0.82 µg/L as an EEC, the Acute Risk LOC was exceeded for aquatic plants (RQ = 2.8), but there were no acute LOC exceedences for freshwater and estuarine/marine fish (RQ < 0.01), freshwater invertebrates (RQ < 0.01), and estuarine invertebrates (RQ = 0.02). These concentrations of oxyfluorfen in water are comparable to concentrations expected in the standard farm pond based on PRZM/EXAMS modeling for California cole crops; however, they are lower than those expected based on PRZM/EXAMS modeling for California walnuts. Long term sampling at four sites in the San Joaquin River had estimated average concentrations in water ranging from 0.01 to 0.27 µg/L (Bergamaschi et al. 1997 and Appendix C), indicating a lower risk to aquatic organisms on average.

Localized high concentrations of oxyfluorfen have been observed. As a result of the Goal 2XL spill in the Columbia River Basin (Fifteen Mile Creek) on 22 August 2000 (Incident# I010844-01, I010949-001 and Appendix C), focused sediment and water sampling was conducted. Water and sediment samples were collected as background measures from areas thought not to be impacted by the spill. The few background water samples did not have detectable amounts of oxyfluorfen, but 2 of the 35 background sediment samples did have detectible amounts of oxyfluorfen (the highest was 541 ppb). It is important to note that these background samples were collected seven months after most oxyfluorfen applications would have occurred (oxyfluorfen is primarily applied during the dormant winter season).

Aquatic Risks Specific to the Benthic Environment

The benthic environment (aquatic soil environment) provides habitat to many invertebrates that provide important food sources to fish and other aquatic organisms. Based on toxicity data to invertebrates, oxyfluorfen may pose long term effects to benthic organisms; however, data on persistence and toxicity in the benthic environment is poor. Dissolved oxyfluorfen concentrations are expected to be relatively low in runoff water. However, because of oxyfluorfen's high affinity to soil, soil eroding from application areas is likely to carry bound oxyfluorfen to aquatic areas. Guideline studies for aerobic and anaerobic soil metabolism suggest oxyfluorfen is highly persistent on soil and would likely accumulate in depositing sediments. This information, combined with oxyfluorfen measurements in river suspended sediment (see Section VI) and aquatic toxicity data, suggests benthic organisms may be impacted and aquatic habitat degraded as a result of oxyfluorfen usage.

In a sediment-dwelling midge larvae toxicity study (MRID 420480-01, supplemental non-guideline), after addition of water (that did not contain oxyfluorfen) to Goal-treated soil, a decline in the concentrations of oxyfluorfen in the soil was observed, and measurable amounts of oxyfluorfen were detected in the overlying water at 24 and 120 hours. The LC_{50} from this study was greater than the maximum tested concentration of oxyfluorfen (5.1 mg ai/kg-dry soil). EFED is requesting 10-day survival and growth tests for sediment-dwelling both freshwater and estuarine invertebrates be submitted to the Agency to enable further characterization of the risk to sediment-dwelling invertebrates.

Phototoxicity

Oxyfluorfen may pose risks to animals not conveyed by standard guideline toxicity studies because oxyfluorfen's mode of action suggests it may be more toxic in the presence of light (phototoxic). Oxyfluorfen, and other light-dependent peroxidizing herbicides, act in plants by producing phototoxic compounds. Toxicity studies with oxyfluorfen and other similar herbicides suggest the same phototoxic compounds may occur in animals as a result of herbicide exposure. Because guideline toxicity studies are normally conducted under relatively low, artificial light conditions, the effects of being exposed simultaneously to oxyfluorfen and sunlight are not known. To provide information on the magnitude of this effect, EFED is currently requesting fish phototoxicity studies be conducted for light-dependent peroxidizing herbicides (Appendix D).

Phototoxicity is a concern for terrestrial organisms as well. Although oxyfluorfen inhibits heme synthesis, the anemia described in all but one of the mammalian sub-chronic studies was generally mild, with varying hematologic abnormalities. The anemia described one subchronic study with rats (MRID 449331-01) was more severe. The red blood cell count was normal, but the red blood cell mass was decreased because of the small size of the red blood cells, presumably because of inhibition of the protoporphyrinogen oxidase enzyme. In wild mammal populations, these hematologic effects have the potential to magnify since the lack of natural sunlight in the laboratory does reduce the likelihood of activating the phototoxic effects of oxyfluorfen.

Risks to Terrestrial Organisms

The results of the risk assessment do not suggest concern for acute risks to birds or mammals.

Sub-chronic and chronic risks to terrestrial birds and mammals present a serious concern. These toxic effects may be manifested as reproductive, developmental, and hemolytic consequences. The chronic LOC was exceeded for birds in all crop scenarios and for mammals in scenarios with the highest application rate (2 lbs ai/application). In the bobwhite quail reproduction study, reduced chick weights were observed, which would reduce fitness if experienced in the wild. In the 2-generation rat reproduction study, toxic effects in adults were mortality, decreased body weight, and liver and kidney histopathology, and toxic effects observed in the pups were decreased body weight and a decreased number of live pups/litter. In three of the four developmental toxicity studies, increases in spontaneous abortions, fetal resorptions, and fetal bone deformities as well as decreases in litter size were observed. Any of these effects would have an effect on the fitness of individuals, and may have an effect on the overall fitness of wild mammal populations exposed to oxyfluorfen.

As discussed above and in Section VII, the potential for phototoxic effects is a serious concern for this chemical. Anemia and other hematologic consequences were observed in the developmental studies in mammals. In wild mammal populations, these hematologic effects have the potential to magnify since the lack of natural sunlight in the laboratory does reduce the likelihood of activating the phototoxic effects of oxyfluorfen. Although no phototoxic effects were described in the avian reproduction studies, the likelihood that they would be observed in the wild does exist.

The toxic effects of oxyfluorfen on beneficial insects appears to vary depending on species and/or form of the chemical used in the study. Oxyfluorfen was classified as “practically non-toxic” to bees; however, a non-guideline study demonstrated that an oxyfluorfen TEP caused 98% mortality of predaceous mites at an application rate less than the maximum labeled rate. With only two species tested (and the two tests did not use the same form of the chemical), it is impossible to determine which species, if either, is more representative of the level of sensitivity to oxyfluorfen across the insect class. It is important to note that this particular TEP [Goal 4F (41% ai)] was recently registered in the United States (3 August 2001).

Increase in Purity of TEP

Several oxyfluorfen toxicity studies have been submitted to the Agency using a technical grade of the chemical with 97.4% or 99% purity, as opposed to older studies using a technical grade with 71% to 85% purity. The newer technical material has similar profiles of impurities when compared to the older material, but in reduced concentrations. HED noted a reduced toxicity with the current 98% product (see Toxicology Chapter, this document), and utilized newer studies with the 98% product to identify toxicological endpoints when studies with newer and older technical material were available. Within the suite of environmental toxicology studies reviewed by EFED, comparisons in toxic effects between the 'old' and 'new' technical are not possible. Based on these conclusions from HED, it is possible that the newer technical material, will have a reduced toxic effect on the species evaluated in the environmental assessment; however, no data have been submitted to the Agency to confirm that extrapolation. However, animals in one developmental mammal study with the 98% technical experienced the most severe anemia and related hematologic effects of any of the mammalian studies, suggesting the possibility that phototoxic effects may be more severe with a more pure form of oxyfluorfen.

Endangered Species Assessment

The preliminary risk assessment for endangered species indicates that oxyfluorfen exceeds the endangered species LOCs for the following combinations of analyzed uses and species:

- terrestrial plants for all uses;
- avian chronic for non-bearing citrus and all applications with rates greater than 0.5 lb ai/acre/application (such as rights-of-way, apples, walnuts and grapes) based on both maximum and mean residue levels;
- mammalian chronic for non-bearing citrus, and applications with rates of 2 lbs ai/acre (such as rights-of-way, apples, walnuts and grapes) based on maximum residues;
- freshwater fish for non-bearing citrus and grapes (of those scenarios modeled); and
- freshwater invertebrates for non-bearing citrus, apples, grapes and cotton (of those scenarios modeled).

Based on the available data, oxyfluorfen acute toxicity, RQs, and LOC exceedences for estuarine/marine fish were assumed to be similar to that of freshwater fish. Although the endangered species LOC for estuarine invertebrates has been exceeded, there are no federally listed species in this group. Risks to endangered aquatic vascular plants cannot be assessed at this time since no acceptable toxicity test for *Lemna gibba* has been submitted to the Agency.

Further analysis regarding the overlap of individual species and their behavior with each use site is required prior to determining the likelihood of potential impact to listed species.

The Agency had a consultation in 1985 (amended in 1986) with the US Fish and Wildlife Service (FWS or the Service) on oxyfluorfen (Goal 1.6E and Goal 2E) regarding its use on noncrop areas including rights-of ways, fence rows, roadsides, levee banks. The Service found jeopardy to 76 species of endangered plants, 54 species of endangered fish, 23 species of endangered mussels (clams), two species of snails, eleven species of endangered insects, four endangered amphibians and one endangered bird (piping plover). The Service proposed a Reasonable and Prudent Alternatives (RPA) to avoid jeopardy to these species. The RPA prohibited the application of Goal within a quarter mile of the habitat of the listed plants and terrestrial invertebrates and within a quarter mile of the streams or bodies of water where the aquatic species occur.

Oxyfluorfen was included in the corn cluster consultation in 1983, and it's uses on crops and forests were also included in the "reinitiation" of clusters in 1988. The resulting 1989 opinion found jeopardy to one amphibian (the Wyoming toad which is extirpated in the wild except on FWS refuges), five fish species, two species of crustaceans and one bird species (the wood stork). The Service proposed Reasonable and Prudent Alternatives (RPA) for each of these jeopardized species. In addition, the Service had Reasonable and Prudent Measures (RPM) to reduce incidental take of 34 aquatic and three bird species. The details of the RPM recommendations are provided in the FWS 1989 biological opinion.

Acute risks to endangered birds is no longer a concern for oxyfluorfen, as the study used as the basis for the earlier findings of jeopardy to birds has since been determined to be invalid. However, many additional species, especially aquatic species, have been federally listed as endangered/threatened since the biological opinion of 1989 was written, and determination of potential effect to these species has not been assessed for oxyfluorfen. In addition, endangered plants, which were considered in the 1985 and 1986 biological opinions for the rights-of-way uses, were not considered in the 1989 opinion and need to be addressed. Finally, not only are more refined methods to define ecological risks of pesticides being used but also new data, such as that for spray drift, are now available that did not exist in 1989. The RPAs and RPMs in the 1989 opinion may need to be reassessed and modified based on these new approaches.

The Agency is currently engaged in a Proactive Conservation Review with FWS and the National Marine Fisheries Service under section 7(a)(1) of the Endangered Species Act to clarify and develop consistent processes for endangered species risk assessments and consultations. Subsequent to the completion of this process, the Agency will reassess both those species listed since the completion of the biological opinion and those not considered in the opinion. The Agency will also consider regulatory changes recommended in this RED when we undertake this reassessment.

IV. Environmental Fate Assessment

Except for the photolysis in water study (which indicates relatively rapid degradation), laboratory data indicate that oxyfluorfen is moderately to very persistent. Adsorption/desorption studies suggest oxyfluorfen is relatively immobile, except perhaps when used on very sandy soils. The most likely route of dissipation is soil binding. Conversely, the guideline field dissipation study data indicate that the compound and its metabolites are only moderately persistent.

Except for photolysis, oxyfluorfen is persistent in laboratory studies (hydrolysis, >97% parent after 30 days at pH 4, 7 and 10; aerobic soil metabolism half-lives of 291 and 294 days in a clay loam soil and 556 and 596 days in a sandy loam soil; and anaerobic soil metabolism half-lives between 554 and 603 days). The compound is readily degraded by sunlight when dissolved in water (half-lives = 2 and 7.5 days), and is moderately degraded by sunlight when on the soil surface (half-life = 28 days, a minor route of dissipation). Since oxyfluorfen tightly adsorbs to soil from runoff into surface water, this soil-bound oxyfluorfen may be less susceptible to photolysis and, therefore, even more persistent than guideline studies and modeling indicates. Additional studies on oxyfluorfen degradation under anaerobic conditions and soil binding kinetics would help provide a more refined fate assessment.

Oxyfluorfen is slightly mobile in sandy soils and immobile in sandy loam, clay loam and silty clay loam soils (K_ds = 8.5. 62, 99, 228). Laboratory data suggest that once the soil-bound oxyfluorfen reaches deep or turbid surface water it will persist since it is stable to hydrolysis and since light penetration would be limited; however it may degrade by photolysis in clear, shallow water.

The major degradate found in the environmental fate studies was MW-332 [2-chloro-1-(3-ethoxy-4-hydroxyphenol)-4-(trifluoromethyl) benzene] which was identified in the aqueous photolysis study (MRID 42129101) at $\geq$ 10 % of the applied radioactivity. Other degradates identified in the aqueous photolysis study but not quantified include RH-3467, RH-34860, RH-34800, RH-45469, MW-327, and MW-180. In the hydrolysis study (MRID 00096882), RH-34670 [(2-chloro-1-(3-hydroxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene] was identified at a maximum concentration of 1.2-1.7% of the applied radioactivity. RH-34800 was the only degradate identified in the aerobic soil metabolism study (MRID 42142309) at a maximum concentration of 2.9% of the applied radioactivity. There were no degradates identified in the anaerobic soil metabolism, leaching adsorption/desorption and soil photolysis studies.

A summary of the input parameters used for modeling oxyfluorfen’s fate in surface water using PRZM/EXAMS and oxyfluorfen’s fate in ground water using SCI-GROW are provided in Tables 3 and 4. A detailed assessment of oxyfluorfen’s environmental fate is given in Appendix A.

Table 3: PRZM/EXAMS Input Parameters for Oxyfluorfen			
Model parameter	**Value**	**Comments**	**Source**
Application Rate	depends on scenario	see Table 2 for values for each scenario	Label (Goal 2XL EPA Reg. No. 62719-424)
Number of Applications	depends on scenario	see Table 2 for values for each scenario	Label (Goal 2XL EPA Reg. No. 62719-424)
Aerobic Soil Metabolism $t_{½}$	870.5 days	estimated 90 th upper percentile	MRID #s 92136110, 92136097
Anaerobic Soil Metabolism $t_{½}$	653.9 days	estimated 90 th upper percentile	MRID # 92136111
Aerobic Aquatic Degradation Rate (KBACW)	1.66 x10-5 $(cfu/mL)^{-1}$ $hour^{-1}$ ($t_{½}$ 1741 days)	half the aerobic soil metabolism degradation rate	MRID #s 92136110, 92136097
Anaerobic Aquatic Degradation Rate (KBACS)	$2.21x10^{-5}$ $(cfu/mL)^{-1}$ $hour^{-1}$ ($t_{½}$ 1308 days)	half the anaerobic soil metabolism degradation rate	MRID # 92136111
Aqueous Photolysis $t_{½}$	7.5 days		MRID # 42129101
Hydrolysis $t_{½}$	Stable		MRID #00096882
K_{OC}	5585 ml/g	Lowest non sand	MRID #s 92136112, 92136099
Molecular Weight	361.7		Product Chemistry
Water Solubility	1.16 mg/l	10 x solubility	Product Chemistry
Vapor Pressure	2.0 E-5 torr		Product Chemistry

Table 4: SCI-GROW Input Parameters for Oxyfluorfen			
Model Input Parameters	**Input Value**	**Comments**	**Source**
Aerobic Soil Metabolism $t_{1/2}$	434 days	Average value	MRID #s 92136110, 92136097
K_{OC}	6831	Median value	MRID #s 92136112, 92136099
Application Rate	2.0 lbs ai/acre		Label (Rout Ornamental Herbicide, EPA Reg. No. 58185-27)
Max. Number of Application Per Season	4 applications		Label (Rout Ornamental Herbicide, EPA Reg. No. 58185-27)

V. Drinking Water Assessment Summary

Oxyfluorfen in the environment is expected to be persistent with low mobility. In general oxyfluorfen degrades very slowly in both soil and water and adsorbs strongly to soil containing sediment or organic matter. Modeling results generally predict low concentrations in surface and groundwater but when oxyfluorfen reaches water it is likely to persist for long periods if the chemical has adsorbed to the available suspended sediment.

Modeling results are the source of the proposed drinking water concentration. Three different crop scenarios; citrus in Florida, apples in Oregon, and cotton in Mississippi were chosen to estimate the concentration of oxyfluorfen in surface drinking water. These scenarios were chosen to represent a geographically dispersed range of modeled surface water concentrations in areas representative of where oxyfluorfen is heavily used (west coast states and the Mississippi delta region) or has the potential for heavy use and a higher annual application rate (Florida).

The proposed surface water-derived drinking water concentrations are:

23.4 μg /L for the 1 in 10 year annual peak concentration (acute)
7.1 μg /L for the 1 in 10 year annual mean concentration (chronic) and
5.7 μg /L for the 36 year annual mean concentration.

These concentrations were derived from modeling oxyfluorfen use on Oregon apples with an application rate of 2.0 lb ai/acre. Although citrus had a higher application rate and the modeled oxyfluorfen concentrations were higher, its use is restricted to non-bearing citrus (trees 1-2 years after planting) which represent a small portion of Florida citrus agriculture.

The SCI-GROW model concentration estimate of oxyfluorfen in drinking water from shallow groundwater sources is **0.08** μg/L (using an application rate of 8 lbs ai/acre/year as from the Rout label). This concentration can be considered as both the acute and chronic value.

There are limited surface water monitoring data available for oxyfluorfen; however, these data are not adequate to perform a quantitative drinking water assessment. The USGS has conducted monitoring of oxyfluorfen bound to suspended sediment in central California (Bergamaschi et al 1997, Bergamaschi et al 1999). Average concentrations of oxyfluorfen associated with suspended sediment at four sites ranged from 1.0 to 27.2 ppb (Bergamaschi et al 1997). Since sediment is removed from water during the water treatment process, dissolved phase concentrations are more useful for estimating drinking water exposure. If oxyfluorfen partitioning between water and sediment is assumed to be reversible and at equilibrium upon entering the drinking water facility intake, an estimated 0.01 to 0.27 μg/L of oxyfluorfen was present in the water in the dissolved phase.

Water and sediment sampling was performed following the oxyfluorfen spill into Fifteen Mile Creek near the Dalles Dam in Oregon (22 August 2000, Incident# I010844-01, I010949-001). Excluding the two weeks immediately following the spill, only seven of approximately 300 water samples collected in the Columbia contained any detectable levels of oxyfluorfen. The detections were at relatively high levels and were most likely a result of leakage from the spill site.

Oxyfluorfen was included in the 1992 *Pesticides in Ground Water Database* (U.S. EPA/EFED/EFGWB). Among 188 wells sampled in the state of Texas between 1987 and 1988, no detections of oxyfluorfen were reported; however, the reported use of oxyfluorfen in Texas is relatively low.

A detailed discussion of available data and modeling for drinking water sources is in Appendix C.

VI. Aquatic Exposure and Risk Assessment

Hazard Summary

Toxicity to Fish

In general, toxicity tests show oxyfluorfen is highly toxic to fish exposed for short or extended periods of time. The freshwater and estuarine/marine fish acute toxicity summary data and requirement status for oxyfluorfen are presented in Table E-1.

The LC_{50}'s for three species of freshwater fish range from 200 µg/L to 410 µg/L, classifying oxyfluorfen as "highly toxic" on an acute basis. The core studies, MRID 421298-01, MRID 421298-02, and Acc# 95583, satisfy Guideline 72-1.

The single estuarine/marine acute fish acute toxicity study (MRID 416988-01) did not provide a point estimate of the LC_{50}, as no mortality was observed at the highest mean-measured concentration (170 µg/L). This core study, MRID 416988-01, satisfies Guideline 72-3(a).

One fish early life-stage toxicity study was conducted for oxyfluorfen. The study on fathead minnows (MRID 921360-57, also reviewed as Acc# 99270) indicated a NOEC of 38 µg/L and a LOEC of 74 µg/L. Survival, total length, and average weight were the most sensitive parameters (Table E-2). Guideline 72-4(a) is fulfilled by this core study.

Toxicity to Invertebrates

In general, toxicity tests show oxyfluorfen is "very highly toxic" to "moderately toxic" to aquatic invertebrates exposed for short or extended periods of time. The freshwater and estuarine/marine invertebrate acute toxicity summary data and status of requirements for oxyfluorfen are presented in Table E-3.

For freshwater invertebrates, the toxicity endpoints (LC_{50} or EC_{50}) range between 80 µg/L and 1500 µg/L, classifying oxyfluorfen as "very highly toxic" to "moderately toxic". The lowest

LC_{50} (80 μg/L) was obtained in a toxicity test using Goal 2XL on daphnids. In the study with high values for the toxicity endpoints, 48-hr LC_{50} = 1500 μg/L for daphnids (Acc# 96881), oxyfluorfen concentration was recorded as nominal levels. The actual exposure concentrations experienced by these invertebrates are likely to have been much less because these nominal levels were well in excess of the compound solubility limit (oxyfluorfen solubility = 100 μg/L). Guideline 72-3(b) is fulfilled by the core study Acc# 96881 (supplemental study was submitted under MRID 452713-01).

One supplemental non-guideline study submitted to the Agency (MRID 420480-01) evaluated the acute toxicity of Goal 1.6E (a TEP of oxyfluorfen, 19.5% a.i.) to a sediment-dwelling midge larvae (*Chironomus tentans*) in a soil and water test system. The 96-hr LC_{50} was > 5.1 mg ai/kg-soil(dry weight). After addition of "flood" water (which did not contain oxyfluorfen) to the test system, there was a decline in the concentrations of oxyfluorfen in the soil, and small amounts of oxyfluorfen (<50 μg/L) were detected in the flood water at the test concentrations of 1.28 and 5.1 mg ai/kg-soil(dry weight). Concentrations of oxyfluorfen in pore water were not measured, and this study was not conducted following the current draft guidelines (850.1735).

For estuarine invertebrates, the LC_{50}'s range between 32 μg/L and 69 μg/L, classifying oxyfluorfen as "very highly toxic". Guideline 72-3(c) is fulfilled (MRID 4232789-01 [core], MRID 309701-17 [supplemental], and Acc# 96811 [supplemental]) .

One invertebrate life-cycle toxicity study was conducted for oxyfluorfen (Table E-4). The life-cycle study on *Daphnia magna* (reviewed under MRID 921361-06 and under MRID 421423-05) indicated a NOEC of 13 μg/L and a LOEC of 28 μg/L. Guideline 72-4(b) is not fulfilled by this study. The study may be upgraded from supplemental to core if raw data (biological, physical, and chemical) are submitted to the Agency and the review is satisfactory.

Toxicity to Aquatic Plants

Based on limited data, toxicity tests show oxyfluorfen is highly toxic to aquatic plants.

A core aquatic plant toxicity study was conducted for one species (Table E-5). The plant growth study on *Selenastrum capricornutum* (MRID 452713-02) with Goal 2XL indicated a 96-hr EC_{50} of 0.29 μg/L and a NOEC of 0.10 μg/L. Guideline 123-2 is not fulfilled by this single study, as core growth studies also are required on the species: *Anabaena flos-aquae*, *Navicula pelliculosa*, *Skeletonema costatum*, and *Lemna gibba*.

Reported Aquatic Incidents

There is one reported incident in the EIIS database with an aquatic organism effect. On 22 August 2000, Fifteen Mile Creek near the Dalles Dam in Oregon was the site of an oxyfluorfen spill (Incident# I010844-01, I010949-001). A truck carrying formulated oxyfluorfen (Goal 2XL) crashed on a bridge spilling approximately 20,000 pounds (2600 gallons) of herbicide into the creek yards from where the creek enters the Columbia River. Two weeks after the spill, samples of filtered (8-micron filter) and unfiltered water near the spill site contained an average of 32 μg/L and 340 μg/L, respectively. This spill was estimated to cause a 35% decrease in the numbers of adult chinook salmon and a 26% decrease in the numbers of steelhead passing over the Dalles Dam the day immediately following the spill, relative to the day prior to the spill. The spill was also reported to kill thousands of young lampreys. An extensive cleanup operation (removal of water and sediment) removed a majority of the chemical, and the estimated quantity of oxyfluorfen not recovered was less than 1000 gallons.

The lack of reported incidents cannot be considered as evidence of lack of hazard. Incident reporting is a voluntary process. No attempt has been made to actively investigate if mortality of wildlife and non-target plants is occurring on fields treated with oxyfluorfen, and there are many reasons why incidents would not get reported by growers who use oxyfluorfen. In addition, the Agency is aware of many reports of pesticide incidents that are in the files of State agencies, and which have not been submitted to the Agency. Therefore, at the present time, the lack of wildlife mortality incidents in the EIIS database cannot be considered as evidence of a lack of hazard to terrestrial organisms.

Exposure

EFED uses environmental fate and transport simulation models to calculate refined Expected Environmental Concentrations (EECs). The Pesticide Root Zone Model (PRZM) simulates field runoff from a 10 hectare field while the Exposure Analysis Modeling System (EXAMS) simulates pesticide fate and transport in an aquatic environment (one hectare body of water, two meters deep). PRZM/EXAMS is used in a Tier II assessment and incorporates historical weather data to predict water concentrations for each year over a 30-year time interval. Input values (Table 3) used for the PRZM/EXAMS modeling are discussed in Appendix A, and input files for PRZM/EXAMS are listed in Appendix B. Acute risk assessments are performed using peak EEC values for single and multiple applications. Chronic risk assessments for invertebrates and fish are performed using the average 21-day and 60-day EECs, respectively. EECs for each of the modeled scenarios are listed in Table 5.

Table 5: Modeled Aquatic Exposure Concentrations of Oxyfluorfen						
Crop (location)	Application Rate (lbs ai/acre)	Application number and type	Application dates	Concentrations (µg/L)		
				Peak	21-day	60-day
Citrus (Florida)	2.0	2 ground	07/01/xx 07/31/xx	49.76	31.51	26.75
Citrus (Florida)	1.2	3 ground	04/01/xx 08/01/xx 12/01/xx	40.04	25.52	19.79
Citrus (Florida)	0.8	3 ground	04/01/xx 08/01/xx 12/01/xx	26.89	17.14	13.30
Apples (Oregon)	2.0	1 ground	01/07/xx	8.07	4.96	3.90
Apples (Oregon)	1.0	1 ground	01/07/xx	4.04	2.48	1.95
Grapes (New York)	2.0	1 ground	01/07/xx	19.60	14.49	12.41
Grapes (New York)	0.9	1 ground	01/07/xx	8.82	6.52	5.58
Walnut (California)	2.0	1 ground	01/07/xx	12.97	10.66	9.71
Walnut (California)	0.8	1 ground	01/07/xx	5.19	4.26	3.88
Cotton (Mississippi)	0.5	1 aerial	01/07/xx	4.85	3.81	3.30
Cotton (Mississippi)	0.5	1 ground	01/07/xx	4.44	3.54	3.20
Cole crops (California)	0.5	1 aerial	01/07/xx	3.15	1.98	1.48
Cole crops (California)	0.25	1 aerial	01/07/xx	1.58	0.99	0.74
Cole crops (California)	0.25	1 ground	01/07/xx	1.33	0.78	0.59

Risk Quotients

Fish and Invertebrates

An analysis of the results indicates that aquatic Acute Restricted Use and Endangered Species LOCs are exceeded for fish depending on the application rate and frequency, cropping practice, and geographic location. For invertebrates, aquatic Acute Risk, Acute Restricted Use, Endangered Species, and Chronic LOCs are exceeded depending on the application rate and frequency, cropping practice, and geographic location. The summarized acute and chronic risk quotients for fish and invertebrates are presented in Tables 6 and 7. The general approach to risk quotient (RQ) calculation and detailed calculations are presented in Appendix F and in Tables G-1 and G-2.

For the modeled scenarios with an application rate of 1.0 lbs ai/acre/year or less, no Acute Risk, Acute Restricted Use, or Endangered Species LOCs were exceeded for freshwater fish. Acute Restricted Use and Endangered Species LOCs were exceeded for freshwater for all three modeled Florida citrus scenarios. For the three modeled single-application scenarios with application rates greater than 1.0 lbs ai/acre/year, the acute risk LOC was exceeded only in New York grapes (Table 6). No Acute Risk LOCs were exceeded for freshwater fish in the modeled scenarios. Since a point estimate of an LC_{50} for estuarine/marine fish was not available (LC_{50} > 170 µg/L, MRID 416988-01), the acute toxicity of oxyfluorfen to estuarine/marine fish was assumed to be similar to the acute toxicity of oxyfluorfen to freshwater fish; therefore, the acute RQs and LOC exceedences were assumed to be similar as well.

For estuarine invertebrates, the Acute Risk LOC was exceeded for all Florida citrus scenarios. For freshwater invertebrates, the Acute Risk LOC was exceeded for two Florida citrus scenarios with higher application rates, and the Acute Restricted Use LOC was exceeded for the Florida citrus scenario with the lowest application rate (Citrus, Florida, 0.8 lbs ai/acre/app, 3 ground app., 04/01/xx 08/01/xx, and 12/31/xx). Of the modeled single-application scenarios, the only ones that did not have an exceedence of the Endangered Species LOC for estuarine invertebrates were the lower application rate on California walnut (0.8 lbs ai/acre/application, 1 ground app., 01/07/xx) and the ground application on California cole crops (0.25 lbs ai/acre/application, 1 ground app., 01/07/xx). Of the modeled scenarios for freshwater invertebrates, the only ones that did not have an exceedence of the Endangered Species LOC were California walnut and California cole crops (at any of the modeled application rates and methods for both crops).

Of the scenarios modeled, there were no Chronic Risk LOC exceedences for freshwater fish. For freshwater invertebrates, the Chronic LOC was exceeded in all Florida citrus scenarios and for the maximum application rate on New York grapes (2.0 lbs ai/acre/application, 1 ground app., 01/07/xx).

Table 6: Summarized Acute Aquatic Organism Risk Quotients [a,b]						
Crop (location)	Application Rate (lbs ai/ac)	Application number/type	App. Dates	Freshwater Fish[c]	Freshwater Invert.	Estuar. Invert.
Citrus (Florida)	2.0	2 ground	07/01/xx 07/31/xx	0.25**	0.62***	1.56***
Citrus (Florida)	1.2	3 ground	04/01/xx 08/01/xx 12/01/xx	0.20**	0.50***	1.25***
Citrus (Florida)	0.8	3 ground	04/01/xx 08/01/xx 12/01/xx	0.13**	0.34**	0.84***
Apples (Oregon)	2.0	1 ground	01/07/xx	0.04	0.10**	0.25**
Apples (Oregon)	1.0	1 ground	01/07/xx	0.03	0.05*	0.13**
Grapes (New York)	2.0	1 ground	01/07/xx	0.10**	0.25**	0.61***
Grapes (New York)	0.9	1 ground	01/07/xx	0.04	0.11**	0.28**
Walnut (California)	2.0	1 ground	01/07/xx	0.02	0.04	0.10*
Walnut (California)	0.8	1 ground	01/07/xx	0.01	0.02	0.04
Cotton (Mississippi)	0.5	1 aerial	01/07/xx	0.02	0.06*	0.15**
Cotton (Mississippi)	0.5	1 ground	01/07/xx	0.02	0.06*	0.14**
Cole crops (California)	0.5	1 aerial	01/07/xx	0.02	0.04	0.10**
Cole crops (California)	0.25	1 aerial	01/07/xx	0.01	0.02	0.05*
Cole crops (California)	0.25	1 ground	01/07/xx	0.01	0.02	0.04

[a] * indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

[b] Acute toxicity thresholds (LC_{50} or EC_{50}) were 200, 80, and 32 µg/L for freshwater fish, freshwater invertebrates, and estuarine invertebrates, respectively.

[c] Based on the available data, acute toxicity of oxyfluorfen to estuarine/marine fish is assumed to be similar to the acute toxicity of oxyfluorfen to freshwater fish.

Table 7: Summarized Chronic Aquatic Organism Risk Quotients [a,b]					
Crop (location)	Application Rate (lbs ai/acre)	Application number/type	Application Dates	Freshwater Fish	Freshwater Invert.
Citrus (Florida)	2.0	2 ground	07/01/xx 07/31/xx	0.67	2.35+
Citrus (Florida)	1.2	3 ground	04/01/xx 08/01/xx 12/01/xx	0.52	1.96+
Citrus (Florida)	0.8	3 ground	04/01/xx 08/01/xx 12/01/xx	0.35	1.32+
Apples (Oregon)	2.0	1 ground	01/07/xx	0.10	0.38
Apples (Oregon)	1.0	1 ground	01/07/xx	0.05	0.19
Grapes (New York)	2.0	1 ground	01/07/xx	0.33	1.11+
Grapes (New York)	0.9	1 ground	01/07/xx	0.15	0.50
Walnut (California)	2.0	1 ground	01/07/xx	0.11	0.82
Walnut (California)	0.8	1 ground	01/07/xx	0.10	0.33
Cotton (Mississippi)	0.5	1 ground	01/07/xx	0.09	0.29
Cotton (Mississippi)	0.5	1 aerial	01/07/xx	0.08	0.27
Cole crops (California)	0.5	1 aerial	01/07/xx	0.04	0.15
Cole crops (California)	0.25	1 aerial	01/07/xx	0.02	0.08
Cole crops (California)	0.25	1 ground	01/07/xx	0.02	0.06

[a] + indicates an exceedence of Chronic LOC.

[b] Chronic toxicity thresholds (NOEC) were 38 and 13 μg/L for freshwater fish and freshwater invertebrates, respectively.

Aquatic Plants

An analysis of the results indicates exceedence of the Acute Risk LOC for all scenarios. Detailed calculations for risk quotients are presented in Table G-2. Risks to endangered aquatic vascular plants cannot be assessed at this time since no acceptable toxicity test for *Lemna gibba* has been submitted.

For all modeled scenarios, the Acute Risk LOC for aquatic plants was exceeded. The acute RQs ranged from 4.59 (Cole crops, California, 0.25 lbs ai/acre/app , 1 ground app., 01/07/xx) to 171.59 (Citrus, Florida, 2 lbs ai/acre/app, 2 ground app., 07/01/xx and 07/31/xx).

Aquatic Organism Risk Characterization

The results of the risk assessment suggest concern for aquatic acute and chronic risks to non-endangered and endangered species. Oxyfluorfen has the potential to affect aquatic ecological systems at all trophic levels, as it is toxic to plants, invertebrates, and fish, and exceedences of the Levels of Concern are expected for all these trophic levels.

The risks to aquatic plants are of the greatest concern as the Acute Risk LOC is exceeded for all modeled scenarios, even for the lowest application rates of 0.25 lb ai/acre/application with only one application per year.

Since oxyfluorfen adsorbs tightly to the soil, it will be available in runoff primarily by erosion. Oxyfluorfen availability to aquatic organisms residing in the water column may be reduced because of its high affinity to sediment particles and because of its relatively low solubility in water (116 μg/L). There is some evidence to suggest that oxyfluorfen may be released from the sediment particles in an aquatic environment under certain conditions. A study submitted to the Agency (MRID 420480-01, supplemental, non-guideline) evaluated the acute toxicity of Goal 1.6E (a TEP of oxyfluorfen, 19.5% a.i.) to a sediment-dwelling midge larvae (*Chironomus tentans*) in a sediment and water test system. After addition of "flood" water (which did not contain oxyfluorfen) to the Goal-treated soil, there was a decline in the concentrations of oxyfluorfen in the soil, and measurable amounts of oxyfluorfen were detected in the "flood" water at the two higher test concentrations (1.28 and 5.1 mg ai/kg-soil[dry weight]) at 24 hours (7 and 35 μg/L oxyfluorfen) and 120 hours (5 and 22 μg/L oxyfluorfen) post-flood. No statistically significant mortality in the test groups was noted; however, growth is typically a more sensitive parameter and it was not measured in this study. Pore water concentrations of oxyfluorfen and/or organic carbon percentage also must be measured in order to perform a more quantitative risk assessment for the sediment-dwelling organisms.

There is potential for exposure of sediment-dwelling organisms to oxyfluorfen as concentrations in sampled sediments (San Joaquin River and Columbia River Valley waters) did reach high levels (at least one sample > 500 ppb). Therefore, EFED is requesting a 10-day survival and growth toxicity test for both freshwater and estuarine sediment-dwelling species using any one of the guideline species, as outlined in Section 12, Test Method 100.2, USEPA (2000).

The presence of oxyfluorfen pond water from a nursery after a realistic application in a nursery field has been documented (Keese et al. 1994). Rout, a granular formulation, was applied to an ornamental nursery plot which drained into a 0.5 ha containment pond at a rate of 2 lb oxyfluorfen/acre and 1.0 lb oryzalin/acre. Following application, the area was irrigated for 2.75 hrs with 13 mm of water. Oxyfluorfen concentrations in the runoff water were below 1000 μg/L for 3.5 hrs after Rout was applied; runoff sampling ceased at 3.5 hrs after herbicide application. Concentrations in the pond water were highest (147 μg/L) 1 day after treatment, decreased to less than 40 μg/L three days after treatment, and remained at detectable levels 14 days after treatment. Oxyfluorfen concentrations were highest in the pond sediment three days after treatment (0.35 mg/kg). Within seven days after treatment, the concentrations in sampled pond sediment decreased to below the detection limit. The concentrations of oxyfluorfen presented above were averages based on multiple sampling sites within the pond. Measurement of oxyfluorfen at concentrations higher than solubility may be due to colloidal material (to which oxyfluorfen may have sorbed) passing through the laboratory filter and that the formulation may have altered the solubility of oxyflurofen. The pond used in this study was not a stagnant body of water; runoff water exits the pond at the opposite side of runoff water entering the pond. If a PRZM/EXAMS scenario was conducted for this situation (i.e., the pond in this study was similar to the 'standard pond' used in PRZM/EXAMS in all aspects except for the runoff exiting the pond), the water concentrations predicted by PRZM/EXAMS would be higher than the water concentrations observed in the pond because of the outflow. Unfortunately, no other pond measurements (e.g., depth, suspended sediments, organic carbon) were provided in the paper to facilitate a stronger comparative analysis.

These measured oxyfluorfen concentrations in the nursery pond water caused exceedences of the Acute Risk LOCs for aquatic plants (RQ = 507), freshwater fish (RQ = 0.74) and invertebrates (RQ = 1.84), and estuarine/marine invertebrates (RQ = 4.59). Based on available data, EFED assumed the RQs for estuarine/marine fish would be similar to the RQs calculated for freshwater fish. These RQs were higher than any of the acute RQs obtained from the modeled scenarios, even those with a higher total annual application rate. The initial measured concentrations in the pond water also exceeded the chronic toxicity endpoints for freshwater fish and invertebrates; however, the measurable presence of oxyfluorfen in the pond water was short-lived (between 14 and 28 days).

Oxyfluorfen falls into the class of light-dependent peroxidizing herbicides (LDPHs). LPDHs act in plants by inhibiting the enzyme protoporphyrinogen oxidase (protox), which is the last common enzyme in the heme and chlorophyll biosynthetic pathways (Matringe et al. 1989). Protox exists in both plants and animals and the enzyme from both sources has been shown to be highly sensitive to many LDPHs (Birchfield and Casida 1997). Potential phototoxicity may not be reported in many LDPH toxicity tests because of relatively low light conditions in laboratories. Animals in sunny environments would be expected to be at highest risk for potential phototoxic effects. In nature, fish and other aquatic organisms are expected to be exposed to LDPHs through run-off and spray drift. Aquatic organisms inhabiting small, shallow water bodies, exposed to high levels of solar radiation would be expected to be at greatest risk for potential phototoxic effects.

Limited monitoring data also provide further information to the evaluation of environmental risk to aquatic organisms. Based on sampling during February 1992 in the San Joaquin River (at Vernalis, California), oxyfluorfen concentrations in suspended sediment ranged from 11.8 to 82.2 μg/L (Bergamaschi et al. 1997). Using a partitioning factor of 100 (see Appendix C), dissolved water concentrations are estimated to be between 0.12 and .82 μg/L. Using 0.82 μg/L as an EEC, the Acute Risk LOC was exceeded for aquatic plants (RQ = 2.8), but there were no acute LOC exceedences for freshwater and estuarine/marine fish (RQ < 0.01), freshwater invertebrates (RQ < 0.01), and estuarine invertebrates (RQ = 0.02). These concentrations of oxyfluorfen in water are comparable to concentrations expected in the standard farm pond based on PRZM/EXAMS modeling for California cole crops; however, they are lower than those expected based on PRZM/EXAMS modeling for California walnuts. Long term sampling at four sites in the San Joaquin River had estimated average concentrations in water ranging from 0.01 to 0.27 µg/L (Bergamaschi et al. 1997 and Appendix C), indicating a lower risk to aquatic organisms on average.

Localized high concentrations of oxyfluorfen have been observed. As a result of the Goal 2XL spill in the Columbia River Basin (Fifteen Mile Creek) on 22 August 2000 (Incident# I010844-01, I010949-001 and Appendix C), a focused sediment and water sampling was conducted. Water and sediment samples were collected as background measures from areas thought not to be impacted by the spill. The few background water samples did not have detectable amounts of oxyfluorfen, but 2 of the 35 background sediment samples did have detectible amounts of oxyfluorfen (the highest was 541 ppb). It is important to note that these background samples were collected seven months after most oxyfluorfen applications would have occurred (oxyfluorfen is primarily applied during the dormant winter season).

As a result of the Goal spill in Fifteen Mile Creek near the Columbia River, fish samples in the Columbia were collected for oxyfluorfen measurements. The fish were collected from fishermen several miles up and downstream of the spill site during a three month period after the spill. Of 108 fin fish tissue samples collected from the Columbia River, 57 had quantifiable levels of oxyfluorfen, 20 had trace levels, 31 had undetectable levels. The average quantified fish tissue concentration was 48 ppb (range of 10 to 370 ppb).

Given the containment efforts at the spill site and the enormous dilution from Fifteen Mile Creek into the Columbia River, it is likely that residues measured in many of these fish were a result of background levels of oxyfluorfen from registered uses. Some of the fish collected upstream would not be expected to have contacted contaminated water from the spill site, yet they still had significant levels of oxyfluorfen in their tissues.

Uncertainties in the Aquatic Assessment

There are a number of areas of uncertainty in the aquatic organism risk assessment that merit discussion. These include the following:

1. **The risk assessment only considers the most sensitive species tested**. Aquatic acute and chronic risks are based on toxicity data for the most sensitive fish, invertebrate, and plant species tested. Responses to a toxicant can be expected to be variable across species. Sensitivity differences between species can be considerable (even up to four orders of magnitude) for some chemicals (Mayer and Ellersieck 1986). The position of the tested species relative to the distribution of all species' sensitivities to oxyfluorfen is unknown. In the case of oxyfluorfen, three freshwater fish species were tested with a ratio of the largest LC_{50} to the smallest LC_{50} equal to 2 (variability among species was less than one order of magnitude). Only one species of estuarine fish was tested, so no inferences regarding the variability in species sensitivities can be made. For the two

freshwater invertebrate species and the three estuarine invertebrate species, the range in species sensitivities was much greater (one to two orders of magnitude). Plants were the most sensitive aquatic species tested; however, these conclusions are based on one species so no information on variation in species sensitivity is available.

2. **The aquatic plant risk assessment is based on only one species, a freshwater algae.** The only aquatic plant toxicity study submitted to the Agency and classified as either core or supplemental was *Selenastrum capricornutum*. Although this species was used to represent aquatic plants in the risk assessment there is a large uncertainty because the response of non-vascular plants (like the freshwater algae, *Selenastrum capricornutum*) to oxyfluorfen may be different than the response of the vascular plants (like *Lemna gibba*) to oxyfluorfen. Without additional toxicity tests for aquatic plant species, the risk characterization of oxyfluorfen on vascular aquatic plants is very uncertain.
3. **The risk assessment only considered a subset of possible use scenarios.** Oxyfluorfen is labeled for a wide range of crops and a large geographic area. For this risk assessment, the scenarios were selected to represent a range of application rates and methods, crops, and geographic areas. Some of the labeled uses that were not modeled may have a greater risk to the environment than those included in this risk assessment. The uses that may exhibit a greater risk to the environment would include coffee, cacao, and ornamentals, as the maximum application rates are higher than those modeled. Other uses that may pose higher risks are those occurring in sensitive locations (close proximity to aquatic environments and high runoff potentials).
4. **Chronic risk quotients for estuarine fish and invertebrates are not available.** No chronic studies for estuarine fish or invertebrates were submitted to the Agency, so the toxicity of oxyfluorfen to these organisms is unknown. If the same acute-to-chronic ratio of toxicity endpoints (i.e., LD_{50} and NOEC) is assumed for freshwater and estuarine invertebrates, then the chronic risk quotients for estuarine invertebrates would be higher than those for the freshwater invertebrates by 2.5x. Because a 96-hr LC_{50} was not established for estuarine fish (>170 μg/L), using the acute-to chronic ratio to extrapolate a chronic toxicity endpoint for estuarine fish from freshwater fish will involve a greater uncertainty since it is unknown how much higher the LC_{50} for sheepshead minnow truly is. If the conservative assumption that the LC_{50} for estuarine fish is 170 μg/L was made, then the chronic risk quotients for estuarine fish would be higher than those for the freshwater fish by 1.2x.
5. **There is uncertainty in the NOEC for the freshwater invertebrate (*Daphnia magna*) life-cycle study.** Since the raw data for this single study (reviewed under MRIDs 921361-06 and 421423-05) were not submitted, the Agency is unable to verify the author's stated NOEC of 13 μg/L. Pending submission and review of the raw data, the NOEC may change, thus influencing the chronic risk quotients for the freshwater invertebrates.
6. **Aquatic risks have not been assessed for a myriad of aquatic habitats**, such as marshes, streams, creeks, and shallow rivers, intermittent aquatic areas, etc., which are more extensive and are frequently more productive than 2-meter deep ponds. Risks to aquatic species in these shallow aquatic habitats are likely to be considerably greater than for organisms in a 2-meter deep ponds, since exposure to sunlight and the likelihood of

phototoxic effects may increase. Shallow water areas provide habitat for a diversity of aquatic organisms which are distinct from species found in deeper ponds or are only found in the shallow margins. For example, amphibians such as tadpoles and newts may spawn and develop in temporary, shallow pools of water. Bluegill sunfish typically spawn and fry inhabit the edge of ponds in water depths of 1 to 3 feet.

VII. Terrestrial Exposure and Risk Assessment

Hazard Summary

Toxicity to Birds

In general, toxicity tests show oxyfluorfen is “practically non-toxic” to birds exposed for short periods; however, negative effects were demonstrated in one of the two submitted avian reproduction toxicity studies.

The acute toxicity of technical grade oxyfluorfen to birds was established with the following guideline tests: one avian single-dose oral (LD_{50}) study on the bobwhite quail; two sub-acute dietary studies (LC_{50}) on the mallard duck and the bobwhite quail.

Avian acute and subacute toxicity summary data for oxyfluorfen are presented in Table E-6. The LD_{50} for bobwhite quail was > 2150 mg ai/kg-bw (reviewed under MRIDs 921361-02 and 422559-01) and the LC_{50}'s for both bobwhite quail and mallard ducks was > 5000 mg ai/kg-diet (MRIDs 921361-03 and 921361-04, respectively). Based on these studies, oxyfluorfen was classified as “practically non-toxic” to birds. Guidelines 71-1 and 71-2 are fulfilled by these core studies.

Avian chronic exposure reproduction effects studies were performed for oxyfluorfen using two species, bobwhite quail and mallard duck (Table E-7). In the quail study (MRID 4153012-06), a NOEC was not established, as body weights of 14-d chicks were reduced at both dose concentrations (50 and 100 mg ai/kg-diet). For mallards (MRID 4153012-05), no negative effects were observed at the only dose concentration (100 mg ai/kg-diet); therefore, a conservative NOEC was set at 100 mg ai/kg-diet. These studies meet the requirements of Guidelines 71-4(a) and 71-4(b); however, both were classified as supplemental.

Toxicity to Mammals

In general, toxicity tests show oxyfluorfen is “practically non-toxic” to mammals exposed for short periods; however, negative effects were demonstrated in the submitted mammalian sub-chronic, developmental, and 2-generation toxicity studies.

In most cases, mammalian toxicity from the Agency's Health Effects Division (HED) are used to approximate toxicity to mammals. However, wild mammal toxicity tests may be required on a case-by-case basis, depending on the results of the lower tier studies such as acute and sub-acute testing, intended use pattern, and pertinent environmental fate characteristics. The registrant has not conducted toxicity testing on wild mammal species. For the purposes of this risk assessment, EFED used the available mammalian toxicity data on laboratory rodents as surrogates for mammalian wildlife (Tables E-8, E-9, and E-10).

Oxyfluorfen demonstrates low acute toxicity to mammals when administered in an oral dose (LD_{50} > 5000 mg ai/kg-bw, MRIDs 447120-10 and 448289-03). In contrast, subchronic toxic effects were observed in mice with dietary concentrations of oxyfluorfen as low as 200 mg ai/kg-diet (MRID 117602) in a 90-day oral toxicity study with mice. The effects observed in this study were anemia, elevated liver enzymes, increased liver weight, and microscopic liver lesions.

Toxic effects of oxyfluorfen were observed in several pre-natal developmental toxicity studies with rats and rabbits. Of these studies, the lowest maternal NOEC was 10 mg ai/kg-bw/day, based on based on decreased bodyweight gain and clinical signs (Acc# 94052). The lowest developmental NOEC was 18 mg ai/kg-bw/day, based on decreased fetal body weight, vascular deformities, and bone deformities (MRID 418065-01). Chronic toxic effects of oxyfluorfen were observed in a 2-generation reproduction study with rats (MRID 420149-01) where the NOEC was determined to be 400 mg ai/kg-diet, for both the parental and reproductive endpoints. The parental NOEC was based on mortality, decreased body weight, and liver and kidney histopathology. The reproductive NOEC was based on decreased body weight and a decreased number of live pups/litter.

There is some evidence to suggest that the removal of impurities in the technical grade of oxyfluorfen (currently approximately 98% ai) has reduced the toxic effects relative to the older technical grade of oxyfluorfen (approximately 72% ai). With an increased purity of oxyfluorfen in the technical grade (98% ai) the NOEL in a subchronic study was 1500 mg ai/kg-diet (MRID 449331-01). In subchronic studies with a less pure technical grade of oxyfluorfen (72-72.5% ai), the NOELs were <200mg ai/kg-diet, 200 mg ai/kg-diet, and 800 mg ai/kg-diet (Acc# 117602, 117603, and 117601, respectively). A similar trend was also observed in the pre-natal developmental rat studies. With an increased purity of oxyfluorfen in the technical grade (98% ai), the maternal and developmental NOELs were 1000 mg/kg-bw/day (the highest dose level, MRID 449331-01); however, with a less pure technical grade of oxyfluorfen (71.4% ai), the maternal NOEL was 18 mg/kg-bw/day and the developmental NOEL was 30 mg/kg-bw/day (MRID 418065-01). The apparent reduction in toxicity may also be due to variability between and within laboratories, changes in laboratory methods and procedures over time, and different tolerances in strains of test animals.

Toxicity to Non-Target Insects

Toxicity tests show oxyfluorfen is "practically non-toxic" to bees; however, a non-guideline study demonstrated that an oxyfluorfen TEP caused almost 100% mortality of predaceous mites at an application rate less than the maximum labeled rate (2 lbs ai/acre/application) (Table E-11).

Based on an LD_{50} of >100 ug/bee, oxyfluorfen (71.4% ai) appears to be "practically non-toxic" to honeybees (MRID 423681-01). Guideline 141-1 is fulfilled with this core study.

The registrant also submitted a non-guideline, supplemental study evaluating the toxicity of acute contact of oxyfluorfen on a predaceous mite [*Typhlodromus pyri* Schueten (acari: Phytoseiidae)] (MRID 452713-03). The formulation used in this test was Goal 4F (aka Goal 480SC, 42.09% ai measured), and the rate was 1.44 kg ai/hectare (i.e., 1.28 lb ai/acre). Seven-day mortality of the treated predaceous mites was 98%, compared to a 7-day mortality rate of 5% in the control group.

Toxicity to Terrestrial Plants

In general, toxicity tests demonstrate oxyfluorfen negatively impacts seedling emergence and vegetative vigor of terrestrial plants. Results of Tier II toxicity testing on the technical material are summarized in Tables E-12 and E-13.

Oxyfluorfen adversely affects seedling emergence of both monocots and dicots (MRID 416440-01). Of the two variables that were measured, shoot length was more sensitive; the EC_{25}'s ranged from 0.0027 lb ai/acre to 1.3 lb ai/acre. For all tested species, the EC_{25}'s based on percent emergence could not be accurately estimated, as they were greater than the highest tested application rate.

In addition, the results indicate oxyfluorfen adversely affects vegetative vigor of both monocots and dicots (MRID 416440-01). All tested species were negatively affected, and the tomato was the most sensitive, based on all three measured endpoints. For tomato, the EC_{25}'s were 0.00067, 0.00043, 0.00071 lb ai/acre for shoot length, shoot weight, and root weight, respectively.

Both the seedling emergence and the vegetative vigor studies (MRID 416440-01) do not meet the requirement of Guidelines 123-1(a) and 123-1(b); they were classified as supplemental. EFED is recommending these studies to be repeated using the TEP.

Reported Incidents

There are several reported incidents in the Environmental Incident Information System (EIIS) database with a terrestrial organism effect. One incident occurred on 7 March 1996, when a pest control operator in Madera County, California, applied Roundup (glyphosate) and Goal (oxyfluorfen) to an unspecified site (Incident# I003377-003). These herbicides drifted to 40 acres of plums and 90-100 acres of almonds with total damage estimated at $520,000 to $760,000. Either of these compounds may have contributed to the damage of these crops.

A similar incident (#I005625-012) occurred in May 1996 in Desha County, Arkansas. A grower stated that aerial drift of Roundup Ultra and Goal damaged 160 acres of rice, and 80 acres had to be replanted. Either of these compounds may have contributed to the damage of these crops.

Another aerial drift incident (#I005625-016) occurred in March 1996 in Kern County, California. A grower stated that aerial drift of Roundup Ultra and Goal damaged 10 acres of oranges. Investigation by Monsanto representatives revealed that adequate buffer zones had not been employed. Either of these compounds may have contributed to the damage of these crops.

One incident (# I001734-001) involved repeated applications of Goal to 8 acres of fir trees in Idaho. Trees exhibited one or more of the following symptoms: death, loss of turgidity, some woody tissue above base of tree was enlarged with necrosis and darkening of internal tissue, and stem brittleness and fissures.

There are 2 reported incidents (#I003268-050 and #I010800-098) of damage attributed to a home use product (Ortho GroundClear Triox). Both incidents involved damage and death to small numbers of ornamentals and juniper trees. The damage may have been caused by oxyfluorfen and/or the other active ingredient in Triox, isopropylamine salt.

The lack of reported incidents cannot be considered as evidence of lack of hazard. The major concerns for risks to birds and mammals are chronic effects. If oxyfluorfen is having a chronic impact to bird and mammal populations in the wild, observance of these effects is much less likely than if the risks of concern were acute effects (e.g., mortality). Also, incident reporting is a passive voluntary process. No attempt has been made to actively investigate if mortality of wildlife and non-target plants is occurring on fields treated with oxyfluorfen, and there are many reasons why incidents would not get reported by growers who use oxyfluorfen. In addition, the Agency is aware of many reports of pesticide incidents that are in the files of State agencies, and which have not been submitted to the Agency. Therefore, at the present time, the lack of wildlife mortality incidents in the EIIS database cannot be considered as evidence of a lack of hazard to terrestrial organisms.

Exposure

Birds and mammals

Toxicant concentrations on terrestrial food items are based on data from by Hoerger and Kenaga (1972) as modified by Fletcher et al. (1994) that determined residue levels on various terrestrial items immediately following toxicant application in the field. Specifically, for every 1 lb ai/acre of application, it is assumed that the resulting maximum concentrations on short grasses, tall grasses, broad-leaved plants/small insects, and seeds/large insects are 240, 110, 135, and 15 ppm, respectively. The respective mean concentrations are 85, 36, 45, and 7 ppm. Toxicant concentrations on food items following multiple applications are predicted using EFED's "FATE5" model, which allows determination of residue dissipation over time incorporating degradation half-life.

Predicted maximum and mean EECs resulting from multiple applications are calculated from FATE5 program (Table 8). FATE5 estimates the highest one-day residue, based on the maximum or mean initial EEC from the first application, the total number of applications, interval between applications, and a first-order degradation rate, consistent with EFED policy. In accordance with EFED policy, the half-life used in FATE5 for oxyfluorfen was 35 days, as no relevant foliar residue data dissipation were available.

One study evaluating dislodgeable foliar residues of oxyfluorfen (MRID 420983-01) was submitted to the Agency; however, these data were not applicable to estimate foliar residue available for terrestrial animal consumption. In this study, Goal (combined with Benlate and diazinon) was applied to pine seedlings. Treated needles were sampled over several days and the dislodgeable residues were measured. Total concentrations of oxyfluorfen remaining on the pine needles or on other vegetation in the treated area was not measured.

Table 8: Calculated EECs (mg ai/kg-bw) for Terrestrial Animal Risk Assessment for Spray Applications								
	Predicted Maximum Residue Levels				Predicted Mean Residue Levels			
Scenario	**short grass**	**tall grass**	**broadleaf forage, small insects**	**fruit, pods, seeds, small insects**	**short grass**	**tall grass**	**broadleaf forage, small insects**	**fruit, pods, seeds, small insects**
Citrus - Florida (2 lbs ai/ac/app, 2 app., ground, 30 day interval)								
	745	341	419	47	264	112	140	22
Citrus - Florida (1.2 lbs ai/ac/app, 3 app., ground, 120 day interval)								
	317	145	178	20	112	48	59	9
Citrus - Florida (0.8 lbs ai/ac/app, 3 app., ground, 120 day interval)								
	211	97	119	13	78	36	44	5
Apples - Oregon, Walnut - California, Grapes - New York (2 lbs ai/ac/app, 1 app., ground)								
	480	220	270	30	170	72	90	14
Grapes - New York (0.9 lbs ai/ac/app, 1 app., ground)								
	216	99	122	13.5	77	32	41	6
Apples - Oregon (1 lbs ai/ac/app, 1 app., ground)								
	240	110	135	15	85	36	45	7
Walnut - California (0.8 lbs ai/ac/app, 1 app., ground)								
	192	88	108	12	68	29	36	6
Cotton - Mississippi, Cole crops - California (0.5 lbs ai/ac/app, 1 app., ground or aerial)								
	120	55	68	8	43	18	23	4
Cole crops - California (0.25 lbs ai/ac/app, 1 app., ground or aerial)								
	60	28	34	4	22	9	12	2

Plants

Terrestrial plants inhabiting dry and semi-aquatic areas may be exposed to pesticides from runoff, spray drift or volatilization. Semi-aquatic areas are those low-lying wet areas that may be dry at certain times of the year. EFED's runoff scenario is: (1) based on the water solubility of the pesticide and the amount of pesticide present on the soil surface and its top one inch, (2) characterized as "sheet runoff" (one treated acre to an adjacent acre) for dry areas, (3) characterized as "channelized runoff" (10 treated acres to a distant low-lying acre) for semi-aquatic areas, and (4) based on runoff values of 1%, 2%, and 5% of the application rate for water solubility of <10 mg/L, 10-100 mg/L, and >100 mg/L, respectively. Since the water solubility of oxyfluorfen is 0.11 mg/L, the runoff value is assumed to be 1% of the application rate. Spray drift exposure from ground application is assumed to be 1% of the application rate. Spray drift from aerial application is assumed to be 5% of the application rate.

Risk Quotients

Birds

RQs were not calculated to evaluate the potential acute risks (i.e., Acute Endangered, Acute Restricted Use, and Acute Risk) to birds because of a high, unquantified LC_{50} (>5000 mg/kg-diet). No mortality was observed in the bobwhite quail acute dietary study(highest dose = 5000 mg/kg-diet, MRID 921361-03), and one mortality (out of ten exposed birds) was observed at the highest dose of 5000 mg/kg-diet in the mallard duck acute dietary study (MRID 921361-04). Minimal acute risk is assumed with current label application rates for spray or granular formulations.

The chronic risk quotients for oxyfluorfen are summarized in Table 9, and detailed calculations are provided in Table G-3.

Assuming maximum residue levels, Chronic Risk LOCs were exceeded for short grass, tall grass, and broadleaf forage/small insects for all application rates greater than or equal to 0.5 lb ai/acre/year. For application rates of 0.2 lb ai/acre/year, Chronic Risk LOCs were exceeded for short grass when maximum residue levels were assumed. Assuming mean residue levels, Chronic Risk LOCs were exceeded for short grass, tall grass, and broadleaf forage/small insects for all modeled scenarios with 1.2 lb ai/acre or greater in a single application. Chronic Risk LOCs were exceeded for short grass for all modeled scenarios with 0.8 lb ai/acre or greater in a single application, assuming mean residue levels.

At this time, EFED does not assess chronic risks from granular applications.

Table 9: Summarized Chronic Avian Risk Quotients for Spray Applications [a,b]		
Scenario	**Chronic RQ Range for Predicted Maximum Residue Levels**	**Chronic RQ range for Predicted Mean Residue Levels**
Citrus - Florida (2 lbs ai/acre/app, 2 app., ground, 30 day interval)		
	>0.09 - >14.9	>0.4 - >5.3
Citrus - Florida (1.2 lbs ai/acre/app, 3 app., ground, 120 day interval)		
	>0.04 - >6.3	>0.02 - >2.2
Citrus - Florida (0.8 lbs ai/acre/app, 3 app., ground, 120 day interval)		
	>0.03 - >4.2	>0.1 - >1.6
Apples - Oregon, Walnut - California, Grapes - New York (2 lbs ai/acre/app, 1 app., ground)		
	>0.6 - >9.6	>0.3 - >3.4
Apples - Oregon (1 lbs ai/acre/app, 1 app., ground)		
	>0.3 - >4.8	>0.2 >1.7
Grapes - New York (0.9 lbs ai/acre/app, 1 app., ground)		
	>0.3 - >4.3	>0.2 >1.5
Walnut - California (0.8 lbs ai/acre/app, 1 app., ground)		
	>0.2 - >3.8	>0.1 - >1.4
Cotton - Mississippi, Cole crops - California (0.5 lbs ai/acre/app, 1 app., ground or aerial)		
	>0.2 - >2.4	>0.8 - >0.9
Cole crops - California (0.25 lbs ai/acre/app, 1 app., ground or aerial)		
	>0.1 - >1.0	>0.04 - >0.3

[a] Chronic RQ ranges represent the four terrestrial food item groups (lowest was seeds, highest was short grass).
[b] Chronic toxicity threshold (NOEC) was <50 mg ai/kg-diet; Chronic LOC = 1.0.

Mammals

RQs were not calculated to evaluate the potential acute risks (i.e., Acute Endangered, Acute Restricted Use, and Acute Risk) to mammals because of a high, unquantified LD_{50} (>5000 mg/kg-bodyweight). No mortality or clinical signs were observed in the either of the acute oral mammalian studies (highest dosage 5000 mg ai/kg-bw, MRIDs 447120-10 and 448289-03). Minimal acute risk is assumed with current label application rates for spray or granular applications.

The detailed calculations for chronic risk quotients for oxyfluorfen are provided in Tables G-4 and G-5 and a summary for herbivorous/insectivorous mammals is provided in Table 10.

Assuming maximum residue levels, Chronic Risk LOCs were exceeded for herbivorous/insectivorous feeding on short grass and broadleaf forage/small insects for the Florida citrus scenario with the highest application rate (2 lbs ai/acre/app, 2 app., ground spray, 30 day interval) and for short grass for all scenarios with 2 lb ai/acre/year application rate. Assuming mean residue levels, there were no chronic LOC exceedences in any of the modeled scenarios for herbivorous/insectivorous mammals. Assuming mean or maximum residue levels, there were no chronic LOC exceedences in any of the modeled scenarios for granivorous mammals.

At this time, EFED does not assess chronic risks from granular applications.

Table 10: Summarized Herbivorous/Insectivorous Mammal Chronic Risk Quotients for Spray Applications [a,b,c]

Scenario	Predicted Maximum Residue Levels	Predicted Mean Residue Levels
Citrus - Florida (2 lbs ai/acre/app, 2 app., ground, 30 day interval)		
Short grass	1.86+	0.66
Broadleaf forage, small insects	1.05+	0.35
Apples - Oregon, Walnut - California, Grapes - New York (2 lbs ai/acre/app, 1 app., ground)		
Short grass	1.20+	0.43
Broadleaf forage, small insects	0.68	0.23

[a] Only chronic scenarios with LOC exceedences are provided here; full details for all modeled scenarios are provided in Tables G-4 and G-5.
[b] Chronic toxicity threshold (NOEC) was 400 mg ai/kg-diet.
[c] + indicates an exceedence of the Chronic Risk LOC.

Terrestrial Non-Target Insects

EFED currently does not quantify risks to terrestrial non-target insects; therefore, risk quotients are not calculated for these organisms. Risks are qualitatively discussed in the Terrestrial Organism Risk Characterization section of this document.

Terrestrial Plants

An analysis of the results indicates exceedence of the Acute Risk LOC and the Acute Endangered Species LOC for nearly all modeled scenarios (Table 11).

Detailed calculations for risk quotients are presented in Appendix F and Tables G-6 and G-7.

For nearly all modeled scenarios, the Acute Non-Endangered Risk LOC for terrestrial plants was exceeded. For plants adjacent to treated sites, the LOC was not exceeded for monocot vegetative vigor with application rates less than or equal to 0.5 lb ai/acre using ground application. The RQs exceeding the Acute Non-Endangered Risk LOC ranged from 1.14 to 93.02. For plants in semi-aquatic areas, the LOC was not exceeded for monocot vegetative vigor with application rates less than or equal to 0.5 lb ai/acre using ground application and for monocot seedling emergence with application rates less than or equal to 0.25 lb ai/acre using ground application. The RQs exceeding the Acute Non-Endangered Risk LOC ranged from 1.14 to 169.23.

For nearly all modeled scenarios, the Acute Endangered Risk LOC for terrestrial plants was exceeded. For plants adjacent to treated sites, the LOC was not exceeded for monocot vegetative vigor with application rates less than or equal to 0.5 lb ai/acre using ground application. The RQs exceeding the Acute Endangered Risk LOC ranged from 1.13 to 60.61. For plants in semi-aquatic areas, the LOC was not exceeded for monocot vegetative vigor with application rates less than or equal to 0.5 lb ai/acre using ground application. The RQs exceeding the Acute Endangered Risk LOC ranged from 1.13 to 183.66.

Right-of-way uses will also exceed the Acute Non-Endangered Risk LOC (RQ range from 2.86 to 85) and the Acute Endangered Risk LOC (RQ range from 2.82 to 92) with one application at the labeled application rate of 2 lbs ai/acre/application. Impacts may be greater since no maximum number of applications per year are specified on the labels (Goal 2XL and Galigan 2E).

Currently, EFED does not perform chronic risk assessments for terrestrial plants.

Table 11: Summarized Terrestrial Plant Risk Quotients [a, b, c]					
		Acute Non-endangered RQs		Acute Endangered RQs	
Scenario		adjacent to treated sites	semi-aquatic areas	adjacent to treated sites	semi-aquatic areas
Citrus - Florida (2 lbs ai/ac/app, 2 app., ground)					
Seed Emerg.	Monocot	13.79***	75.86***	33.33*	183.33*
	Dicot	30.77***	169.23***	33.33*	183.33*
Veg Vigor	Monocot	5.71***	5.71***	5.63*	5.63*
	Dicot	93.02***	93.02***	60.61*	60.61*
Citrus - Florida (1.2 lbs ai/ac/app, 3 app., ground)					
Seed Emerg.	Monocot	12.07***	68.97***	29.17*	166.67*
	Dicot	26.92***	153.85***	29.17*	166.67*
Veg Vigor	Monocot	5.71***	5.71***	5.63*	5.63*
	Dicot	93.02***	93.02***	60.61*	60.61*
Citrus - Florida (0.8 lbs ai/ac/app, 3 app., ground)					
Seed Emerg.	Monocot	8.62***	44.83***	20.83*	108.33*
	Dicot	19.23***	100.00***	20.83*	108.33*
Veg Vigor	Monocot	2.86***	2.86***	2.82*	2.82*
	Dicot	46.51***	46.51***	30.30*	30.30*
Apples - Oregon, Walnut - California, Grapes - New York (2 lbs ai/ac/app, 1 app., ground)					
Seed Emerg.	Monocot	6.90***	37.93***	16.67*	91.67*
	Dicot	15.38***	84.62***	16.67*	91.67*
Veg Vigor	Monocot	2.86***	2.86***	2.82*	2.82*
	Dicot	46.51***	46.51***	30.30*	30.30*
Grapes - New York (0.9 lbs ai/ac/app, 1 app., ground)					
Seed Emerg.	Monocot	3.45***	18.97***	7.50*	41.25*
	Dicot	7.69***	42.31***	7.50*	41.25*
Veg Vigor	Monocot	1.43***	1.43***	1.27*	1.27*
	Dicot	23.26***	23.26***	13.64*	13.64*
Apples - Oregon (1 lbs ai/ac/app, 1 app., ground)					
Seed Emerg.	Monocot	3.45***	17.07***	8.33*	45.83*
	Dicot	7.69***	38.08***	8.33*	45.83*
Veg Vigor	Monocot	1.29***	1.29***	1.41*	1.41*
	Dicot	20.93***	20.93***	15.15*	15.15*

Table 11: Summarized Terrestrial Plant Risk Quotients [a, b, c]					
		Acute Non-endangered RQs		Acute Endangered RQs	
Scenario		adjacent to treated sites	semi-aquatic areas	adjacent to treated sites	semi-aquatic areas
Walnut - California (0.8 lbs ai/ac/app, 1 app., ground)					
Seed Emerg.	Monocot	3.45***	15.17***	8.33*	36.67*
	Dicot	7.69***	33.85***	8.33*	36.67*
Veg Vigor	Monocot	1.14***	1.14***	1.13*	1.13*
	Dicot	18.60***	18.60***	12.12*	12.12*
Cotton - Mississippi, Cole crops - California (0.5 lbs ai/ac/app, 1 app., aerial)					
Seed Emerg.	Monocot	4.83***	9.48***	11.67*	22.92*
	Dicot	10.77***	21.15***	11.67*	22.92*
Veg Vigor	Monocot	3.57***	3.57***	3.52*	3.52*
	Dicot	58.14***	58.14***	37.88*	37.88*
Cotton - Mississippi (0.5 lbs ai/ac/app, 1 app., ground)					
Seed Emerg.	Monocot	1.72***	9.48***	4.17*	22.92*
	Dicot	3.85***	21.15***	4.17*	22.92*
Veg Vigor	Monocot	0.71	0.71	0.70	0.70
	Dicot	11.63***	11.63***	7.58*	7.58*
Cole crops - California (0.25 lbs ai/ac/app, 1 app., aerial)					
Seed Emerg.	Monocot	2.41***	4.83***	5.83*	11.67*
	Dicot	5.38***	10.77***	5.83*	11.67*
Veg Vigor	Monocot	1.86***	1.86***	1.83*	1.83*
	Dicot	30.23***	30.23***	19.70*	19.70*
Cole crops - California (0.25 lbs ai/ac/app, 1 app., ground)					
Seed Emerg.	Monocot	0.86	4.83***	2.08*	11.67*
	Dicot	1.92***	10.77***	2.08*	11.67*
Veg Vigor	Monocot	0.43	0.43	0.42	0.42
	Dicot	6.98***	6.98***	4.55*	4.55*

[a] Acute non-endangered toxicity thresholds (EC_{25}) were 0.0058, 0.0026, 0.007, 0.00043 lb ai/acre for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot, respectively.
[c] Acute endangered toxicity thresholds (NOEC) were 0.0024, 0.0024, 0.0071, 0.00066 lb ai/acre for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot, respectively.
[c] * indicates an exceedence of the Endangered Species Level of Concern (LOC).
*** indicates an exceedence of the Acute Risk LOC.

Terrestrial Organism Risk Characterization

Risks to Birds and Mammals

For the current label application rates, there are minimal acute risks to birds and mammals. However, there is a concern for chronic risks to birds and mammals.

With current label application rates, there are concerns for chronic risks to birds. Even using the less conservative assumption of mean residue levels (as opposed to maximum residue levels), chronic effects are predicted with application rates as low as 0.8 lbs ai/acre/year. The risks are greatest for birds feeding on short grass, tall grass, broadleaf vegetation, and small insects. Granivorous birds are not predicted to be impacted by oxyfluorfen in the modeled scenarios.

There are concerns for chronic risks in herbivorous/insectivorous mammals relative to reproductive and developmental aspects in all crops with higher application rates (2 lbs ai/acre/app). The parental toxic effects observed in the 2-generation rat reproduction study were mortality, decreased body weight, and liver and kidney histopathology, and toxic effects observed in the pups were decreased body weight and a decreased number of live pups/litter. In three of the four developmental toxicity studies, increases in spontaneous abortions, fetal resorptions, and fetal bone deformities as well as decreases in litter size were observed. Any of these effects would have an effect on the fitness of individuals, and may have an effect on the overall fitness of wild mammal populations exposed to oxyfluorfen.

Although oxyfluorfen inhibits heme synthesis, the anemia described in all but one of the sub-chronic studies was generally mild, with varying hematologic abnormalities. The anemia described one subchronic study with rats (MRID 449331-01) was more severe. The red blood cell count was normal, but the red blood cell mass was decreased because of the small size of the red blood cells, presumably because of inhibition of the protoporphyrinogen oxidase enzyme. In wild mammal populations, these hematologic effects have the potential to magnify. Under typical laboratory conditions, lighting is provided by fluorescent bulbs with little or no light emitted in the range of the spectrum that will activate LDPHs. To account for fact that most mammals require exposure to sunlight to produce vitamin D (required for proper bone formation), animal feed in the laboratory is supplemented with vitamin D. This lack of natural sunlight does reduce the likelihood of activating the phototoxic effects of oxyfluorfen. Therefore, the impacts of oxyfluorfen on mammalian populations in the wild that are exposed to sunlight may be greater than those described in the submitted toxicity studies. Although no phototoxic effects were described in the avian reproduction studies, the likelihood that they would be observed in the wild does exist.

Risks to Non-Target Insects

Oxyfluorfen is practically non-toxic to bees using the TGAI for an acute contact study (MRID 423681-01). However, the high toxicity of oxyfluorfen to a predacious mite [*Typhlodromus pyri* Schueten (acari: Phytoseiidae)] suggests the potential for oxyfluorfen to have adverse effects on beneficial insects (MRID 452713-03). This study was conducted using an end-use product recently registered in the United States [Goal 4F (41% ai)] at a rate of 1.28 lb ai/acre, an application rate is less than the maximum labeled rate for many crops on the current label for Goal 2XL or Goal 4F.

In comparing the results of these two studies, there appears to be a wide range of toxicity levels to oxyfluorfen by beneficial insects. Different insect species may have different sensitivities to oxyfluorfen. With only two species tested (and the two tests did not use the same form of the chemical), it is impossible to determine which species, if either, is more representative of the level of sensitivity to oxyfluorfen across the insect class.

Risks to Terrestrial Plants

The risk quotient calculations suggest concern for non-target terrestrial plants across all use sites. The Acute Endangered Terrestrial Plant RQs and the Acute Non-Endangered Terrestrial Plant RQs exceeded the LOC for all the modeled scenarios.

Spray drift is an important factor in characterizing the risk of oxyfluorfen to non-target plants. There is as much as a 5-fold increase in the RQs when aerial application is used as opposed to ground application. Although there were only a few reported terrestrial plant incidents in the EIIS database, the Agency is aware of many reports of pesticide incidents that are in the files of State agencies, and which have not been submitted to the Agency. In fact, growers of cole crops in California rely on ground spray as an application method in California because of the risk to nearby crops (R. Smith, personal communication), even though the product is labeled for aerial application.

Since oxyfluorfen does not appear to be translocated in the plant, the effects are mostly caused by contact of the chemical with plant tissues. Therefore, if oxyfluorfen contacts a small portion of the surface area of the plant, there is a possibility that the plant may only be damaged and not die as a result. The impacted plants may recover from the damage, or they may die if the damage reduced their ability to compete with other plants for light and resources. Damage to plants is most likely to occur to young, susceptible individuals, but it is not limited to them (note the incident, #I003377-003, with plums and almonds).

None of the modeled scenarios included the use of granules (e.g., Rout Ornamental Herbicide) on ornamental nursery crops. The maximum application rates are relatively high (2.0 lbs ai/acre/application with a maximum of 8.0 lbs ai/acre/year). Because of oxyfluorfen's long half-life, these granules have a long residual activity. There is also potential for oxyfluorfen to be removed from the intended use area in runoff or irrigation water, which could pose risks for plants being irrigated with the contaminated water.

The risk assessment for terrestrial plants was based on RQs calculated from toxicity studies using the technical grade of oxyfluorfen instead of a TEP (typical end-use product). Often the TEPs include surfactants or adjuvants to increase the herbicide's adsorption into the plant, thereby increasing its efficacy. If the toxicity tests were conducted using a TEP of oxyfluorfen (e.g., Goal 2XL) at the same rates as the technical grade, the toxicity endpoints may be much lower. Furthermore, if the toxicity endpoints were reduced with the TEP, the RQs and the risks would be higher than currently estimated.

Uncertainties in the Terrestrial Assessment

There are a number of areas of uncertainty in the avian risk assessment that merit discussion. These include the following:

1. **The risk assessment only considers the most sensitive species tested.** Terrestrial acute and chronic risks are based on toxicity data for the most sensitive bird, mammal, and plant species tested. Responses to a toxicant can be expected to be variable across species. In the case of oxyfluorfen, only two bird, three mammalian, two beneficial insect, and 10 agricultural plant species were tested. Sensitivity differences between species can be considerable (even up to two orders of magnitude) for some chemicals (ECOFRAM 1999). The position of the tested species relative to the distribution of all species' sensitivities to oxyfluorfen is unknown. In addition, the toxicity of oxyfluorfen to wild (non-laboratory) species relative to laboratory species is unknown.
2. **The risk assessment only considered a subset of possible use scenarios.** Oxyfluorfen is labeled for a wide range of crops and a large geographic area. For this risk assessment, the scenarios were selected to represent a range of application rates, crops, and geographic areas. An attempt was made to examine scenarios that are expected to cause the greatest risks based on geographic and application-related factors. It is possible, however, that some of the labeled uses that were not modeled will have a greater risk to the environment than those included in this risk assessment. These uses that may exhibit a greater risk to the environment would include coffee, cacao, and ornamentals, as the maximum application rates are higher than those modeled. Other uses that may pose higher risks are those occurring in or near sensitive environments (e.g., close proximity to habitat that supports or has the potential to support endangered or threatened terrestrial plants).
3. **There is uncertainty in the Chronic RQ estimates for the birds.** In the supplemental chronic toxicity study using mallards (MRID 4153012-05), only one diet concentration (100 mg ai/kg-diet) was used; however, since no significant effects were noted at that concentration, the NOEC was set at 100 mg ai/kg-diet. In the supplemental chronic toxicity study using bobwhites (MRID 4153012-06), two diet concentrations (50 and 100 mg ai/kg-diet) were used, and significant effects were noted at both concentrations. At 50 mg ai/kg-diet, there was a statistically significant reduction in the average weight of 14-day chicks; therefore, the LOEC was set at 50 mg ai/kg-diet, and the NOEC could not be determined (< 50 mg ai/kg-diet). To calculate risk quotients and determine chronic LOC exceedences, a chronic toxicity threshold of 50 mg ai/kg-diet was used. The true magnitude of the RQs for chronic avian toxicity is unknown, since the estimates are a lower bound. If a NOEC (with a value < 50 mg ai/kg-diet) had been observed in the study, the calculated RQs would be larger than those calculated in this risk assessment.

4. **Only dietary exposure is included in the exposure assessment.** Other exposure routes are possible for animals in treated areas. These routes include ingestion of contaminated drinking water, ingestion of contaminated soils, preening/grooming, dermal contact, and inhalation. Consumption of drinking water would appear to be inconsequential if water concentrations were equivalent to the concentrations from PRZM/EXAMS; however, puddled water sources on treated fields may have much higher concentrations than those modeled ponds. Preening exposures, involving the oral ingestion of material from the feathers remains an unquantified, but potentially important, exposure route. Toxicity due to dermal contact is likely to be of low importance because mammal testing revealed oxyfluorfen was not a sensitizer (MRID 447120-15 and 448149-01) and it was a negative to slight dermal irritant (MRID 447120-14 and MRID 448289-05). However, the potential for oxyfluorfen to be percutaneously absorbed into the body and to cause systemic toxic effects remains unqualified. Because oxyflurofen does not volatilize appreciably (v.p. 2.5 x 10^{-7} Torr at 25°C), inhalation of gas phase oxyfluorfen does not appear to be a significant contributor to overall exposure.
5. **The risk assessment assumes 100% of the diet is relegated to single food types foraged only from treated fields.** Oxyfluorfen applications to treefruit/nut/vine (not including citrus) are restricted to the dormant season. In northern and central parts of the United States, there will be little food variety and much of the diet at this time is granivorous; therefore, exposures would be to a food source with relatively lower residues. In southern regions of the United States, greater food variety will be available during the shorter, less pronounced dormant season, thus, the higher exposures through this greater variety of foodstuffs may occur. Furthermore, many labeled uses of oxyfluorfen are not restricted to the dormant season. For example, spring and summer applications in Florida would coincide with many bird breeding and fledging cycles. During this time, consumption of insects (and, thus, potentially high residues) by many species would be high because of their seasonal abundance.
6. **The exposure assessment modeled repeat application residues using a mean food item dissipation half life of 35 days.** As discussed in the exposure assessment section of this document, the value used for foliar dissipation was a half-life of 35 days, due to lack of submitted data appropriate for estimating dissipation on a variety of foliage, seeds and insects. If the actual foliar dissipation was significantly different from the EFED policy value of 35 days, large increases or decreases in the estimated risk quotients are possible for those scenarios with multiple applications per year. In this risk assessment, the only modeled scenario with multiple applications per year was citrus; however, other crops are labeled for multiple applications per year.

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APPENDIX A: Environmental Fate Assessment

I. Summary

The environmental fate data base is adequate to perform a fate assessment for oxyfluorfen.

Except for the photolysis in water study (which indicates relatively rapid degradation) laboratory data indicate that oxyfluorfen is very persistent. Adsorption/desorption studies suggest oxyfluorfen is relatively immobile, except perhaps when used on very sandy soils. The most likely route of dissipation is soil binding. Conversely, the guideline field dissipation study data indicate that the compound and its metabolites are only moderately persistent.

Since, oxyfluorfen binds tightly to the soil, it will be available in runoff primarily by erosion to surface water under many use conditions. Laboratory data suggest that once oxyfluorfen reaches surface water that contains sufficient sediments, it will persist, since it is stable to hydrolysis and since light penetration would be limited. Open literature studies of pond and estuarine sediments suggest that oxyfluorfen is not readily released from sediment.

II. Physical/Chemical Properties

Molecular formula:	$C_{15}H_{11}ClF_3NO_4$.
Molecular weight:	361.7
Physical state:	Orange crystalline solid
Melting point:	65-84 °C
Vapor pressure (25°C):	0.0267 mPa (2.5 x 10^{-7} Torr)
Solubility (25°C):	0.116 mg/L water; 725 g/kg acetone;500-550 g/kg chloroform; 615 g/kg cyclohexanone; >500 g/kg dimethylformamide.
Octanol/water:	2.94 x 10^4 at 25ºC
Log K_{ow}:	4.46

III. Environmental Fate Assessment

At the present time additional fate data are not requested. Based on all the data submitted (acceptable and supplemental) it is possible for EFED to identify a route of dissipation of oxyfluorfen in surface soils. Acceptable and supplemental laboratory data (hydrolysis, aqueous and soil photodegradation, aerobic and anaerobic soil metabolism, leaching/adsorption/desorption, terrestrial field dissipation, accumulation in fish and drift-field evaluation) except for photolysis, indicate that the compound is persistent (hydrolysis, >97% parent after 30 days at pH 4, 7 and 10; aerobic soil metabolism half-lives of 291 and 294 days in a clay loam soil and 556 and 596 days in a sandy loam soil; and anaerobic soil metabolism half-lives between 554 and 603 days). The compound is readily degraded by sunlight when dissolved in water (half-lives = 2 and 7.5 days), and is moderately degraded by sunlight when on soil surfaces (half-life = 28 days, a minor route of dissipation).

Oxyfluorfen dissipated from bare ground loamy sand and clay loam soil plots in California with half-lives of 53 and 58 days, respectively. The half lives for the degradates RH-4672, RH-0671 and RH-2382, varied from 37 to 61 days. However, EFED notes that it is difficult to obtain an accurate half-life for degradates since they are being produced from the parent and at the same time being degraded to other compounds.

The leaching data indicate that the compound is slightly mobile in sandy soils and immobile in sandy loam, clay loam and silty clay loam soils (K_ds = 8.5. 62, 99, 228 mL/g). In an unaged column leaching study, oxyfluorfen did not leach below four inches in any soil, except sand, where traces were found at 9 inches. The majority of the radioactivity was detected in the 0-2 inch soil depth. In an aged column leaching study, between 1.35 and 1.85% of the radioactivity was detected in the leachate. Greater than 82% of the radioactivity was detected in the top 2 inches of soil, indicating slight mobility of aged degradates.

The major degradate found in the environmental fate studies was MW-332 [2-chloro-1-(3-ethoxy-4-hydroxyphenol)-4-(trifluoromethyl) benzene] which was identified in the aqueous photolysis study (MRID 42129101) $\geq$ 10 % of the applied radioactivity. Other degradates identified in the aqueous photolysis study but not quantified include RH-3467, RH-34860, RH-34800, RH-45469, MW-327, and MW-180. In the hydrolysis study (MRID 00096882), RH-34670 [(2-chloro-1-(3-hydroxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene] was identified at a maximum concentration of 1.2-1.7% of the applied radioactivity. RH-34800 was the only degradate identified in the aerobic soil metabolism study (MRID 42142309) at a maximum concentration of 2.9 % of the applied radioactivity. There were no degradates identified in the anaerobic soil metabolism, leaching adsorption/desorption and soil photolysis studies.

Fish accumulation studies indicate that the compound bioconcentrates in bluegill fish, with bioconcentration factors of 450 and 605X in muscle, 3265 and 4360X in viscera and 1075 and 2200X in whole fish; and 82 to 94% depurates within 14 days.

IV. Environmental Fate and Transport Studies

<u>Degradation</u>

<u>Hydrolysis (161-1)</u>

Guideline study data suggest oxyfluorfen is resistant to hydrolysis. In a hydrolysis study, a concentration of 0.05 ppm oxyfluorfen was stable in aqueous buffered pH 4, 7 and 10 solutions, since >97% of the radioactivity present after 30 days was parent oxyfluorfen. Other than parent, the only compound detected was RH-34670 [(2-chloro-1-(3-hydroxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene] at 1.2-1.7% of the applied radioactivity. Accession No. 96882

Photodegradation in water (161-2)

A guideline study showed that oxyfluorfen in water degrades fairly rapidly in the presence of light. In an aqueous photolysis study, ^{14}C-labeled oxyfluorfen added to sterile aqueous solution (0.01M sodium phosphate buffer) at approximately 1 ppm and irradiated with natural sunlight, photodegraded with half-lives of 6.2 and 7.5 days for the nitrophenyl ring-labeled and the chlorophenyl ring-labeled, respectively. Volatile compounds accounted for <2% of the applied radioactivity. Although there were numerous compounds observed in the TLC plates, oxyfluorfen and the MW-332 degradate [2-chloro-1-(3-ethoxy-4-hydroxyphenol)-4-(trifluoromethyl) benzene] were the only single components present in concentrations $\geq$10% of the applied radioactivity. MRID 421291-01

In another aqueous photolysis study, ^{14}C-labeled oxyfluorfen dosed at a concentration of approximately 1 ppm in sterile pH 7 aqueous buffer solution (1% acetonitrile) and irradiated with 12 hours light/dark with a xenon arc lamp at 25 $\pm$ 1 ºC for 30 days, photodegraded with half-lives of 3.7 to 5.4 days, for the chlorophenyl ring-labeled and the nitrophenyl ring-labeled, respectively. In contrast, 94% of the radioactivity was identified as [^{14}C]oxyfluorfen, in the dark controls, after 30 days. MRID 421423-07

Photodegradation on soil (161-3)

A guideline study showed oxyfluorfen (nitrophenyl and chlorophenyl ring- labeled) on a soil surface photodegraded with a half-life of 28 days; with little degradation occurring in the dark controls. After 30 days approximately 41-46% of the applied oxyfluorfen remained. Carbon dioxide accounted for 4.0-8.1% of the applied radioactivity after 30 days; while individual degradates in extracts and unextractable radioactivity (soil bound residues) were $\leq$10.0% of the applied radioactivity. MRID 419999-01

Aerobic soil (162-1)

Guideline study results suggest that oxyfluorfen is resistant to aerobic degradation on soil. Nitrophenyl ring-labeled and chlorophenyl ring-labeled [^{14}C]oxyfluorfen added to soil at 8.83-9.64 ppm concentration degraded with half-lives of 556 and 596 days in a sandy loam soil and 291 and 294 days in a clay loam soil. The minor degradate, RH-34800, was identified in the extracts from the clay loam soil treated with the chlorophenyl ring-labeled compound. Parent oxyfluorfen was 44-64% of applied by the end of the study. Soil bound residues accounted for up to 43% of applied radioactivity and CO_2 was up to 5% of applied.

Anaerobic soil metabolism (162-2)

In the guideline study oxyfluorfen was highly persistent in anaerobic soil. Nitrophenyl ring-labeled [^{14}C]oxyfluorfen (uniformly labeled; radiochemical purity >93%), at 8.83 ppm, and chlorophenyl ring-labeled [^{14}C]oxyfluorfen (uniformly labeled; radiochemical purity 96%), at 9.46 ppm, degraded with half-lives of 603 and 554 days, respectively, in sandy loam soil that was incubated in the dark under aerobic conditions for 30 days and under anaerobic conditions (flooding plus nitrogen atmosphere) for 60 days at 25 $\pm$ 1 C. After 60 days under anaerobic conditions, 82% of the applied was extractable parent. Soil bound residues (unextractable residues) were 6.8-12.4% of applied during the anaerobic phase; while organic volatiles and CO_2 were <1%. MRID 421423-10

Mobility

Leaching/adsorption/desorption (163-1)

Oxyfluorfen is relatively immobile in soils with significant organic content. In an unaged column leaching study, oxyfluorfen did not leach below four inches in any soil, except sand, where traces were found at 9 inches. The majority of the radioactivity was detected in the 0-2 inch soil depth. In an aged column leaching study, between 1.35 and 1.85% of the radioactivity was detected in the leachate. Greater than 82% of the radioactivity was detected in the top 2 inches of soil, indicating slight mobility. TLC analysis of the methanol extractable residues was shown to be all parent compound. Approximately 15% of the radioactivity was unaccounted for and was attributed, by the study author, to volatilization; a doubtful conclusion given the low vapor pressure (2 x 10^{-7} Torr) of the compound. Accession No. 94336

The leaching data from a batch equilibrium study indicate that the compound is slightly mobile in sandy soils and immobile in sandy loam, clay loam and silty clay loam soils (K_d's = 8.5. 62, 99, 228). The study was not acceptable because the effect of chemical binding to the teflon tube on the K_d values was not discussed, and the concentration range was too narrow. MRID 421423-11

EFED does not believe that any further leaching/adsorption/desorption studies are needed at the present time, since previous acceptable leaching/adsorption/desorption studies (Accession Numbers 094336, 096882 and 096884) generally confirm the results presented in this study. Therefore, the leaching/adsorption/desorption study (Subdivision N Guideline 163-1) is satisfied.

Field Dissipation

Guideline terrestrial field dissipation data indicate that the compound and its metabolites are moderately persistent. However, the route of dissipation was not identified. Oxyfluorfen dissipated from bare ground loamy sand and clay loam soil plots in CA with half-lives of 53 and 58 days, respectively. The half lives for the degradates RH-4672, RH-0671 and RH-2382, varied from 37 to 61 days. EFED notes that it is difficult to obtain an accurate half-life for degradates since they are being produced from the parent and at the same time being degraded to other compounds. (MRID 438401-01)

Two published studies reporting oxyfluorfen persistence in different soils showed a larger range of dissipation rates than the guideline studies. The field half life of oxyfluorfen applied to muck soils in Canada used for growing onions ranged from 30 to 103 days (Frank et al 1991).

Increased persistence over winter months was noted in the study (no measurable dissipation) suggesting persistence may be increased in colder climates. Consistent with available information on leaching, the study also stated no residues were found in tile drain water, however, the detection limit and method of analysis for water samples were not described. Ying and Williams (2000) reported a longer field dissipation half life (119 days) than studies above. The study was conducted in Australian vineyards during a cool and damp season. Oxyfluorfen levels were measured over an approximate 14 week period, with little change in concentration apparent after approximately 6 weeks. The authors attributed oxyfluorfen's most likely route of dissipation to volatilization.

Accumulation In Fish (165-4)

The data indicates that the compound can accumulate in bluegill sunfish, since bioconcentration factors were 450 and 605X in muscle, 3265 and 4360X in viscera and 1075 and 2200X in whole fish. However, rapid loss of the compound occurred out of tissues, since after 14 days of depuration, 86 and 94% elimination of ^{14}C-residues in the muscle tissue, 83 and 94% elimination in the viscera and 82 and 91% elimination in whole fish. Cumulative mortalities for bluegill in the control and treated aquaria were 2 and 1%, respectively. Accession No. 96883

Fish collected in the Columbia River in the Northwestern US showed significant levels of oxyfluorfen in their tissues. The range of quantifiable concentrations was 10 to 370 ppb (see SectionVI, this document).

Spray Drift

Droplet size spectrum (201-1)

A droplet size spectrum (201-1) study is required since the product may be applied by aerial and ground spray equipment and due to the concern for potential risk to nontarget plants. However, to satisfy these requirements the registrant, in conjunction with other registrants of other pesticide active ingredients, formed the Spray Drift Task Force (SDTF). The SDTF has completed and submitted to the Agency its series of studies which are intended to characterize spray droplet drift potential due to various factors, including application methods, application equipment, meteorological conditions, crop geometry, and droplet characteristics. In the interim and for this assessment, the Agency is relying on previously submitted spray drift data and the open literature for off-target drift rates. The standard assumption used by EFED for ground and aerial application is that 1 and 5% of the application rate is deposited 100 ft down wind, respectively. After peer review of the SDTF data is completed, the Agency will determine whether a reassessment is warranted of the potential risks from the application of this chemical.

Drift-field evaluation (202-1)

In field drift evaluation studies using lettuce as a bioassay, lettuce plants showed visible symptoms as far as 800 meters downwind from the point of application, but symptoms were quantifiable only up to 100 meters. Accession No. 144894

V. Water Resources

Ground water

Oxyfluorfen's tendency to bind strongly to soil reduces its potential to contaminate ground water.

The leaching data indicate that the compound is slightly mobile in sandy soils and immobile in sandy loam, clay loam and silty clay loam soils (K_ds = 8.5. 62, 99, 228). In an unaged column leaching study, oxyfluorfen did not leach below four inches in any soil, except sand, where traces were found at 9 inches. The majority of the radioactivity was detected in the 0-2 inch soil depth. In an aged column leaching study, between 1.35 and 1.85% of the radioactivity was detected in the leachate. Greater than 82% of the radioactivity was detected in the top 2 inches of soil, indicating slight mobility of aged degradates. The chemical does not appear to have the potential to contaminate the ground water when used at recommended rates.

Surface water

Since the compound is tightly bound to the soil, oxyfluorfen will be available in runoff by erosion to surface water in many use conditions. Once in deep or turbid surface water, oxyfluorfen is expected to persist, since it is stable to hydrolysis and since light penetration would be limited. It may degrade by photolysis in clear, shallow water.

APPENDIX B: PRZM and EXAMS Input Files

PRZM input file 1; Florida Citrus
Oxyfluorfen 2 ground applications at 2.0 lbs ai/acre on 7/1 and 7/31

```
***PRZM 3.1 Input Data File, created from PRZM 2.3***
***FLCITRS1.INP Created 12/24/97***
***Assume sparse grass underneath the trees for heating***
***Assume sparse grass within channels leading to surface waters***
***Osceola County, Florida; slop 2-4 percent***
Oxyfluorfen
Adamsville Sand; MLRA U-156A, Osceola County, FL
   0.770   0.150       0   25.00       1       1
       4
    0.10    0.13    1.00   10.00    6.20       3    4.00   354.0
       1
       1    0.10  100.00   80.00       3  94  84  89                0.00     500
       1       3
0101 0105 0108
0.30 0.30 0.30
0.04 0.04 0.04
      36
  110548  170748  010848       1
  110549  170749  010849       1
  110550  170750  010850       1
  110551  170751  010851       1
  110552  170752  010852       1
  110553  170753  010853       1
  110554  170754  010854       1
  110555  170755  010855       1
  110556  170756  010856       1
  110557  170757  010857       1
  110558  170758  010858       1
  110559  170759  010859       1
  110560  170760  010860       1
  110561  170761  010861       1
  110562  170762  010862       1
  110563  170763  010863       1
  110564  170764  010864       1
  110565  170765  010865       1
  110566  170766  010866       1
  110567  170767  010867       1
  110568  170768  010868       1
  110569  170769  010869       1
  110570  170770  010870       1
  110571  170771  010871       1
  110572  170772  010872       1
  110573  170773  010873       1
  110574  170774  010874       1
  110575  170775  010875       1
  110576  170776  010876       1
  110577  170777  010877       1
  110578  170778  010878       1
  110579  170779  010879       1
  110580  170780  010880       1
  110581  170781  010881       1
  110582  170782  010882       1
  110583  170783  010883       1
Application schedule: 2 ground spray @ 2.0 lb a.i/a, 99% appl eff, 1% spray drift
      72       1       0
Oxyfluorfen Koc:5586;ASM: T1/2 = 871 days; AnSM: T1/2 = 654 days
  010748  0 2 0.00  2.24 0.99 0.01
  310748  0 2 0.00  2.24 0.99 0.01
  010749  0 2 0.00  2.24 0.99 0.01
  310749  0 2 0.00  2.24 0.99 0.01
  010750  0 2 0.00  2.24 0.99 0.01
  310750  0 2 0.00  2.24 0.99 0.01
```

010751	0	2	0.00	2.24	0.99	0.01
310751	0	2	0.00	2.24	0.99	0.01
010752	0	2	0.00	2.24	0.99	0.01
310752	0	2	0.00	2.24	0.99	0.01
010753	0	2	0.00	2.24	0.99	0.01
310753	0	2	0.00	2.24	0.99	0.01
010754	0	2	0.00	2.24	0.99	0.01
310754	0	2	0.00	2.24	0.99	0.01
010755	0	2	0.00	2.24	0.99	0.01
310755	0	2	0.00	2.24	0.99	0.01
010756	0	2	0.00	2.24	0.99	0.01
310756	0	2	0.00	2.24	0.99	0.01
010757	0	2	0.00	2.24	0.99	0.01
310757	0	2	0.00	2.24	0.99	0.01
010758	0	2	0.00	2.24	0.99	0.01
310758	0	2	0.00	2.24	0.99	0.01
010759	0	2	0.00	2.24	0.99	0.01
310759	0	2	0.00	2.24	0.99	0.01
010760	0	2	0.00	2.24	0.99	0.01
310760	0	2	0.00	2.24	0.99	0.01
010761	0	2	0.00	2.24	0.99	0.01
310761	0	2	0.00	2.24	0.99	0.01
010762	0	2	0.00	2.24	0.99	0.01
310762	0	2	0.00	2.24	0.99	0.01
010763	0	2	0.00	2.24	0.99	0.01
310763	0	2	0.00	2.24	0.99	0.01
010764	0	2	0.00	2.24	0.99	0.01
310764	0	2	0.00	2.24	0.99	0.01
010765	0	2	0.00	2.24	0.99	0.01
310765	0	2	0.00	2.24	0.99	0.01
010766	0	2	0.00	2.24	0.99	0.01
310766	0	2	0.00	2.24	0.99	0.01
010767	0	2	0.00	2.24	0.99	0.01
310767	0	2	0.00	2.24	0.99	0.01
010768	0	2	0.00	2.24	0.99	0.01
310768	0	2	0.00	2.24	0.99	0.01
010769	0	2	0.00	2.24	0.99	0.01
310769	0	2	0.00	2.24	0.99	0.01
010770	0	2	0.00	2.24	0.99	0.01
310770	0	2	0.00	2.24	0.99	0.01
010771	0	2	0.00	2.24	0.99	0.01
310771	0	2	0.00	2.24	0.99	0.01
010772	0	2	0.00	2.24	0.99	0.01
310772	0	2	0.00	2.24	0.99	0.01
010773	0	2	0.00	2.24	0.99	0.01
310773	0	2	0.00	2.24	0.99	0.01
010774	0	2	0.00	2.24	0.99	0.01
310774	0	2	0.00	2.24	0.99	0.01
010775	0	2	0.00	2.24	0.99	0.01
310775	0	2	0.00	2.24	0.99	0.01
010776	0	2	0.00	2.24	0.99	0.01
310776	0	2	0.00	2.24	0.99	0.01
010777	0	2	0.00	2.24	0.99	0.01
310777	0	2	0.00	2.24	0.99	0.01
010778	0	2	0.00	2.24	0.99	0.01
310778	0	2	0.00	2.24	0.99	0.01
010779	0	2	0.00	2.24	0.99	0.01
310779	0	2	0.00	2.24	0.99	0.01
010780	0	2	0.00	2.24	0.99	0.01
310780	0	2	0.00	2.24	0.99	0.01
010781	0	2	0.00	2.24	0.99	0.01
310781	0	2	0.00	2.24	0.99	0.01
010782	0	2	0.00	2.24	0.99	0.01
310782	0	2	0.00	2.24	0.99	0.01
010783	0	2	0.00	2.24	0.99	0.01

```
  310783  0 2 0.00  2.24 0.99 0.01
     0.0       3     0.0
     0.0    0.00     0.5
Adamsville Sand; Hydrologic Group C;
  100.00          0   0   0   0   0   0   0   0   0
     0.0    0.00    0.00
       3
       1   10.00   1.440   0.086   0.000   0.000    0.00
         7.96E-4 7.96E-4   0.000
             0.1   0.086   0.036   0.580    32.4
       2   10.00   1.440   0.086   0.000   0.000    0.00
         7.96E-4 7.96E-4   0.000
             1.0   0.086   0.036   0.580    32.4
       3   80.00   1.580   0.030   0.000   0.000    0.00
         7.96E-4 7.96E-4   0.000
             5.0   0.030   0.023   0.116    6.48
       0
            YEAR       5            YEAR       5            YEAR       5   1
       1
       1   _____
       6    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    ESLS    TCUM   0   0   1.0E3
    RFLX    TCUM   0   0   1.0E5
    EFLX    TCUM   0   0   1.0E5
    RXFX    TCUM   0   0   1.0E5
```

PRZM input file 2; Florida Citrus
Oxyfluorfen 3 ground applications at 1.2 lbs ai/acre on 4/1,8/1,and 12/1

```
***PRZM 3.1 Input Data File, created from PRZM 2.3***
***FLCITRS1.INP Created 12/24/97***
***Assume sparse grass underneath the trees for heating***
***Assume sparse grass within channels leading to surface waters***
***Osceola County, Florida; slop 2-4 percent***
Oxyfluorfen
Adamsville Sand; MLRA U-156A, Osceola County, FL
   0.770   0.150       0   25.00       1       1
       4
    0.10    0.13    1.00   10.00    6.20       3    4.00   354.0
       1
       1    0.10  100.00   80.00       3  94  84  89                0.00     500
       1       3
0101 0105 0108
0.30 0.30 0.30
0.04 0.04 0.04
      36
  110548  170748  010848       1
  110549  170749  010849       1
  110550  170750  010850       1
  110551  170751  010851       1
  110552  170752  010852       1
  110553  170753  010853       1
  110554  170754  010854       1
  110555  170755  010855       1
  110556  170756  010856       1
  110557  170757  010857       1
  110558  170758  010858       1
  110559  170759  010859       1
  110560  170760  010860       1
  110561  170761  010861       1
  110562  170762  010862       1
  110563  170763  010863       1
  110564  170764  010864       1
  110565  170765  010865       1
  110566  170766  010866       1
  110567  170767  010867       1
  110568  170768  010868       1
  110569  170769  010869       1
  110570  170770  010870       1
  110571  170771  010871       1
  110572  170772  010872       1
  110573  170773  010873       1
  110574  170774  010874       1
  110575  170775  010875       1
  110576  170776  010876       1
  110577  170777  010877       1
  110578  170778  010878       1
  110579  170779  010879       1
  110580  170780  010880       1
  110581  170781  010881       1
  110582  170782  010882       1
  110583  170783  010883       1
Application schedule: 3 ground spray @ 1.2 lb a.i/a, 99% appl eff, 1% spray drift
     108       1       0
Oxyfluorfen Koc:5586;ASM: T1/2 = 871 days; AnSM: T1/2 = 654 days
  010448  0 2 0.00  1.34 0.99 0.01
  010848  0 2 0.00  1.34 0.99 0.01
  011248  0 2 0.00  1.34 0.99 0.01
  010449  0 2 0.00  1.34 0.99 0.01
  010849  0 2 0.00  1.34 0.99 0.01
  011249  0 2 0.00  1.34 0.99 0.01
```

010450	0	2	0.00	1.34	0.96	0.01
010850	0	2	0.00	1.34	0.99	0.01
011250	0	2	0.00	1.34	0.99	0.01
010451	0	2	0.00	1.34	0.99	0.01
010851	0	2	0.00	1.34	0.99	0.01
011251	0	2	0.00	1.34	0.99	0.01
010452	0	2	0.00	1.34	0.99	0.01
010852	0	2	0.00	1.34	0.99	0.01
011252	0	2	0.00	1.34	0.99	0.01
010453	0	2	0.00	1.34	0.99	0.01
010853	0	2	0.00	1.34	0.99	0.01
011253	0	2	0.00	1.34	0.99	0.01
010454	0	2	0.00	1.34	0.99	0.01
010854	0	2	0.00	1.34	0.99	0.01
011254	0	2	0.00	1.34	0.99	0.01
010455	0	2	0.00	1.34	0.99	0.01
010855	0	2	0.00	1.34	0.99	0.01
011255	0	2	0.00	1.34	0.99	0.01
010456	0	2	0.00	1.34	0.99	0.01
010856	0	2	0.00	1.34	0.99	0.01
011256	0	2	0.00	1.34	0.99	0.01
010457	0	2	0.00	1.34	0.99	0.01
010857	0	2	0.00	1.34	0.99	0.01
011257	0	2	0.00	1.34	0.99	0.01
010458	0	2	0.00	1.34	0.99	0.01
010858	0	2	0.00	1.34	0.99	0.01
011258	0	2	0.00	1.34	0.99	0.01
010459	0	2	0.00	1.34	0.99	0.01
010859	0	2	0.00	1.34	0.99	0.01
011259	0	2	0.00	1.34	0.99	0.01
010460	0	2	0.00	1.34	0.99	0.01
010860	0	2	0.00	1.34	0.99	0.01
011260	0	2	0.00	1.34	0.99	0.01
010461	0	2	0.00	1.34	0.99	0.01
010861	0	2	0.00	1.34	0.99	0.01
011261	0	2	0.00	1.34	0.99	0.01
010462	0	2	0.00	1.34	0.99	0.01
010862	0	2	0.00	1.34	0.99	0.01
011262	0	2	0.00	1.34	0.99	0.01
010463	0	2	0.00	1.34	0.99	0.01
010863	0	2	0.00	1.34	0.99	0.01
011263	0	2	0.00	1.34	0.99	0.01
010464	0	2	0.00	1.34	0.99	0.01
010864	0	2	0.00	1.34	0.99	0.01
011264	0	2	0.00	1.34	0.99	0.01
010465	0	2	0.00	1.34	0.99	0.01
010865	0	2	0.00	1.34	0.99	0.01
011265	0	2	0.00	1.34	0.99	0.01
010466	0	2	0.00	1.34	0.99	0.01
010866	0	2	0.00	1.34	0.99	0.01
011266	0	2	0.00	1.34	0.99	0.01
010467	0	2	0.00	1.34	0.99	0.01
010867	0	2	0.00	1.34	0.99	0.01
011267	0	2	0.00	1.34	0.99	0.01
010468	0	2	0.00	1.34	0.99	0.01
010868	0	2	0.00	1.34	0.99	0.01
011268	0	2	0.00	1.34	0.99	0.01
010469	0	2	0.00	1.34	0.99	0.01
010869	0	2	0.00	1.34	0.99	0.01
011269	0	2	0.00	1.34	0.99	0.01
010470	0	2	0.00	1.34	0.99	0.01
010870	0	2	0.00	1.34	0.99	0.01
011270	0	2	0.00	1.34	0.99	0.01
010471	0	2	0.00	1.34	0.99	0.01
010871	0	2	0.00	1.34	0.99	0.01

```
  011271  0 2 0.00  1.34 0.99 0.01
  010472  0 2 0.00  1.34 0.99 0.01
  010872  0 2 0.00  1.34 0.99 0.01
  011272  0 2 0.00  1.34 0.99 0.01
  010473  0 2 0.00  1.34 0.99 0.01
  010873  0 2 0.00  1.34 0.99 0.01
  011273  0 2 0.00  1.34 0.99 0.01
  010474  0 2 0.00  1.34 0.99 0.01
  010874  0 2 0.00  1.34 0.99 0.01
  011274  0 2 0.00  1.34 0.99 0.01
  010475  0 2 0.00  1.34 0.99 0.01
  010875  0 2 0.00  1.34 0.99 0.01
  011275  0 2 0.00  1.34 0.99 0.01
  010476  0 2 0.00  1.34 0.99 0.01
  010876  0 2 0.00  1.34 0.99 0.01
  011276  0 2 0.00  1.34 0.99 0.01
  010477  0 2 0.00  1.34 0.99 0.01
  010877  0 2 0.00  1.34 0.99 0.01
  011277  0 2 0.00  1.34 0.99 0.01
  010478  0 2 0.00  1.34 0.99 0.01
  010878  0 2 0.00  1.34 0.99 0.01
  011278  0 2 0.00  1.34 0.99 0.01
  010479  0 2 0.00  1.34 0.99 0.01
  010879  0 2 0.00  1.34 0.99 0.01
  011279  0 2 0.00  1.34 0.99 0.01
  010480  0 2 0.00  1.34 0.99 0.01
  010880  0 2 0.00  1.34 0.99 0.01
  011280  0 2 0.00  1.34 0.99 0.01
  010481  0 2 0.00  1.34 0.99 0.01
  010881  0 2 0.00  1.34 0.99 0.01
  011281  0 2 0.00  1.34 0.99 0.01
  010482  0 2 0.00  1.34 0.99 0.01
  010882  0 2 0.00  1.34 0.99 0.01
  011282  0 2 0.00  1.34 0.99 0.01
  010483  0 2 0.00  1.34 0.99 0.01
  010883  0 2 0.00  1.34 0.99 0.01
  011283  0 2 0.00  1.34 0.99 0.01
     0.0       3     0.0
     0.0    0.00     0.5
Adamsville Sand; Hydrologic Group C;
  100.00           0   0   0   0   0   0   0   0   0
     0.0    0.00    0.00
       3
       1   10.00   1.440   0.086   0.000   0.000    0.00
         7.96E-4 7.96E-4   0.000
             0.1   0.086   0.036   0.580    32.4
       2   10.00   1.440   0.086   0.000   0.000    0.00
         7.96E-4 7.96E-4   0.000
             1.0   0.086   0.036   0.580    32.4
       3   80.00   1.580   0.030   0.000   0.000    0.00
         7.96E-4 7.96E-4   0.000
             5.0   0.030   0.023   0.116    6.48
       0
           YEAR       5            YEAR       5            YEAR       5   1
       1
       1  _____
       6   YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    ESLS    TCUM   0   0   1.0E3
    RFLX    TCUM   0   0   1.0E5
    EFLX    TCUM   0   0   1.0E5
    RXFX    TCUM   0   0   1.0E5
```

PRZM input file 3; Florida Citrus
Oxyfluorfen 3 ground applications at 0.8 lbs ai/acre on 4/1,8/1,and 12/1

```
***PRZM 3.1 Input Data File, created from PRZM 2.3***
***FLCITRS1.INP Created 12/24/97***
***Assume sparse grass underneath the trees for heating***
***Assume sparse grass within channels leading to surface waters***
***Osceola County, Florida; slop 2-4 percent***
Oxyfluorfen
Adamsville Sand; MLRA U-156A, Osceola County, FL
   0.770   0.150       0   25.00       1       1
       4
    0.10    0.13    1.00   10.00    6.20       3    4.00   354.0
       1
       1    0.10  100.00   80.00       3  94  84  89                0.00     500
       1       3
0101 0105 0108
0.30 0.30 0.30
0.04 0.04 0.04
      36
  110548  170748  010848       1
  110549  170749  010849       1
  110550  170750  010850       1
  110551  170751  010851       1
  110552  170752  010852       1
  110553  170753  010853       1
  110554  170754  010854       1
  110555  170755  010855       1
  110556  170756  010856       1
  110557  170757  010857       1
  110558  170758  010858       1
  110559  170759  010859       1
  110560  170760  010860       1
  110561  170761  010861       1
  110562  170762  010862       1
  110563  170763  010863       1
  110564  170764  010864       1
  110565  170765  010865       1
  110566  170766  010866       1
  110567  170767  010867       1
  110568  170768  010868       1
  110569  170769  010869       1
  110570  170770  010870       1
  110571  170771  010871       1
  110572  170772  010872       1
  110573  170773  010873       1
  110574  170774  010874       1
  110575  170775  010875       1
  110576  170776  010876       1
  110577  170777  010877       1
  110578  170778  010878       1
  110579  170779  010879       1
  110580  170780  010880       1
  110581  170781  010881       1
  110582  170782  010882       1
  110583  170783  010883       1
Application schedule: 3 ground spray @ 0.8 lb a.i/a, 99% appl eff, 1% spray drift
     108       1       0
Oxyfluorfen Koc:5586;ASM: T1/2 = 871 days; AnSM: T1/2 = 654 days
  010448  0 2 0.00  0.90 0.99 0.01
  010848  0 2 0.00  0.90 0.99 0.01
  011248  0 2 0.00  0.90 0.99 0.01
  010449  0 2 0.00  0.90 0.99 0.01
  010849  0 2 0.00  0.90 0.99 0.01
  011249  0 2 0.00  0.90 0.99 0.01
```

010450	0	2	0.00	0.90	0.96	0.01
010850	0	2	0.00	0.90	0.99	0.01
011250	0	2	0.00	0.90	0.99	0.01
010451	0	2	0.00	0.90	0.99	0.01
010851	0	2	0.00	0.90	0.99	0.01
011251	0	2	0.00	0.90	0.99	0.01
010452	0	2	0.00	0.90	0.99	0.01
010852	0	2	0.00	0.90	0.99	0.01
011252	0	2	0.00	0.90	0.99	0.01
010453	0	2	0.00	0.90	0.99	0.01
010853	0	2	0.00	0.90	0.99	0.01
011253	0	2	0.00	0.90	0.99	0.01
010454	0	2	0.00	0.90	0.99	0.01
010854	0	2	0.00	0.90	0.99	0.01
011254	0	2	0.00	0.90	0.99	0.01
010455	0	2	0.00	0.90	0.99	0.01
010855	0	2	0.00	0.90	0.99	0.01
011255	0	2	0.00	0.90	0.99	0.01
010456	0	2	0.00	0.90	0.99	0.01
010856	0	2	0.00	0.90	0.99	0.01
011256	0	2	0.00	0.90	0.99	0.01
010457	0	2	0.00	0.90	0.99	0.01
010857	0	2	0.00	0.90	0.99	0.01
011257	0	2	0.00	0.90	0.99	0.01
010458	0	2	0.00	0.90	0.99	0.01
010858	0	2	0.00	0.90	0.99	0.01
011258	0	2	0.00	0.90	0.99	0.01
010459	0	2	0.00	0.90	0.99	0.01
010859	0	2	0.00	0.90	0.99	0.01
011259	0	2	0.00	0.90	0.99	0.01
010460	0	2	0.00	0.90	0.99	0.01
010860	0	2	0.00	0.90	0.99	0.01
011260	0	2	0.00	0.90	0.99	0.01
010461	0	2	0.00	0.90	0.99	0.01
010861	0	2	0.00	0.90	0.99	0.01
011261	0	2	0.00	0.90	0.99	0.01
010462	0	2	0.00	0.90	0.99	0.01
010862	0	2	0.00	0.90	0.99	0.01
011262	0	2	0.00	0.90	0.99	0.01
010463	0	2	0.00	0.90	0.99	0.01
010863	0	2	0.00	0.90	0.99	0.01
011263	0	2	0.00	0.90	0.99	0.01
010464	0	2	0.00	0.90	0.99	0.01
010864	0	2	0.00	0.90	0.99	0.01
011264	0	2	0.00	0.90	0.99	0.01
010465	0	2	0.00	0.90	0.99	0.01
010865	0	2	0.00	0.90	0.99	0.01
011265	0	2	0.00	0.90	0.99	0.01
010466	0	2	0.00	0.90	0.99	0.01
010866	0	2	0.00	0.90	0.99	0.01
011266	0	2	0.00	0.90	0.99	0.01
010467	0	2	0.00	0.90	0.99	0.01
010867	0	2	0.00	0.90	0.99	0.01
011267	0	2	0.00	0.90	0.99	0.01
010468	0	2	0.00	0.90	0.99	0.01
010868	0	2	0.00	0.90	0.99	0.01
011268	0	2	0.00	0.90	0.99	0.01
010469	0	2	0.00	0.90	0.99	0.01
010869	0	2	0.00	0.90	0.99	0.01
011269	0	2	0.00	0.90	0.99	0.01
010470	0	2	0.00	0.90	0.99	0.01
010870	0	2	0.00	0.90	0.99	0.01
011270	0	2	0.00	0.90	0.99	0.01
010471	0	2	0.00	0.90	0.99	0.01
010871	0	2	0.00	0.90	0.99	0.01

```
  011271  0 2 0.00  0.90 0.99 0.01
  010472  0 2 0.00  0.90 0.99 0.01
  010872  0 2 0.00  0.90 0.99 0.01
  011272  0 2 0.00  0.90 0.99 0.01
  010473  0 2 0.00  0.90 0.99 0.01
  010873  0 2 0.00  0.90 0.99 0.01
  011273  0 2 0.00  0.90 0.99 0.01
  010474  0 2 0.00  0.90 0.99 0.01
  010874  0 2 0.00  0.90 0.99 0.01
  011274  0 2 0.00  0.90 0.99 0.01
  010475  0 2 0.00  0.90 0.99 0.01
  010875  0 2 0.00  0.90 0.99 0.01
  011275  0 2 0.00  0.90 0.99 0.01
  010476  0 2 0.00  0.90 0.99 0.01
  010876  0 2 0.00  0.90 0.99 0.01
  011276  0 2 0.00  0.90 0.99 0.01
  010477  0 2 0.00  0.90 0.99 0.01
  010877  0 2 0.00  0.90 0.99 0.01
  011277  0 2 0.00  0.90 0.99 0.01
  010478  0 2 0.00  0.90 0.99 0.01
  010878  0 2 0.00  0.90 0.99 0.01
  011278  0 2 0.00  0.90 0.99 0.01
  010479  0 2 0.00  0.90 0.99 0.01
  010879  0 2 0.00  0.90 0.99 0.01
  011279  0 2 0.00  0.90 0.99 0.01
  010480  0 2 0.00  0.90 0.99 0.01
  010880  0 2 0.00  0.90 0.99 0.01
  011280  0 2 0.00  0.90 0.99 0.01
  010481  0 2 0.00  0.90 0.99 0.01
  010881  0 2 0.00  0.90 0.99 0.01
  011281  0 2 0.00  0.90 0.99 0.01
  010482  0 2 0.00  0.90 0.99 0.01
  010882  0 2 0.00  0.90 0.99 0.01
  011282  0 2 0.00  0.90 0.99 0.01
  010483  0 2 0.00  0.90 0.99 0.01
  010883  0 2 0.00  0.90 0.99 0.01
  011283  0 2 0.00  0.90 0.99 0.01
     0.0       3     0.0
     0.0    0.00     0.5
Adamsville Sand; Hydrologic Group C;
  100.00          0   0   0   0   0   0   0   0   0
     0.0    0.00    0.00
       3
       1   10.00   1.440   0.086   0.000   0.000    0.00
         7.96E-4 7.96E-4   0.000
             0.1   0.086   0.036   0.580    32.4
       2   10.00   1.440   0.086   0.000   0.000    0.00
         7.96E-4 7.96E-4   0.000
             1.0   0.086   0.036   0.580    32.4
       3   80.00   1.580   0.030   0.000   0.000    0.00
         7.96E-4 7.96E-4   0.000
             5.0   0.030   0.023   0.116    6.48
       0
            YEAR       5            YEAR       5            YEAR       5   1
       1
       1   _____
       6    YEAR
     PRCP    TCUM   0   0
     RUNF    TCUM   0   0
     ESLS    TCUM   0   0   1.0E3
     RFLX    TCUM   0   0   1.0E5
     EFLX    TCUM   0   0   1.0E5
     RXFX    TCUM   0   0   1.0E5
```

PRZM input file 4; Oregon Apple
Oxyfluorfen 1 ground application at 2.0 lbs ai/acre on 07/01/XX

```
***PRZM 3.1 Input File Converted from PRZM 2***
***ORAPPLE1.inp created 12/22/97 Revised by Kevin Costello 8/15/01***
***Washington County, Oregon; Meadow/Orchard Scenario; MLRA: A2***
***Pesticide is applied by ground spray/air blast***
***Temperature data read***
Cornelius silt loam, 12% slope, Hydrologic Group: C
   0.740   0.150       0  15.000       1       3
       4
    0.33    3.64     1.0    10.0     5.4       2   12.00   354.0
       1
       1    0.25    45.0  98.000       3  84  79  82                 0.0     240
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.008 .009 .013 .015 .020 .026 .029 .032 .034 .033 .031 .028 .024 .020 .018 .018
.040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040
0109 1609 0110 1610 0111 1611 0112 1612
.018 .020 .022 .024 .005 .006 .006 .007
.040 .040 .040 .040 .040 .040 .040 .040
      36
  250448  310548  071148       1
  250449  310549  071149       1
  250450  310550  071150       1
  250451  310551  071151       1
  250452  310552  071152       1
  250453  310553  071153       1
  250454  310554  071154       1
  250455  310555  071155       1
  250456  310556  071156       1
  250457  310557  071157       1
  250458  310558  071158       1
  250459  310559  071159       1
  250460  310560  071160       1
  250461  310561  071161       1
  250462  310562  071162       1
  250463  310563  071163       1
  250464  310564  071164       1
  250465  310565  071165       1
  250466  310566  071166       1
  250467  310567  071167       1
  250468  310568  071168       1
  250469  310569  071169       1
  250470  310570  071170       1
  250471  310571  071171       1
  250472  310572  071172       1
  250473  310573  071173       1
  250474  310574  071174       1
  250475  310575  071175       1
  250476  310576  071176       1
  250477  310577  071177       1
  250478  310578  071178       1
  250479  310579  071179       1
  250480  310580  071180       1
  250481  310581  071181       1
  250482  310582  071182       1
  250483  310583  071183       1
Application schedule: 1 apps of 2 lb a.i./acre, ground spray@ 99% eff. w/1.0% drift
      36       1       0       0
Oxyfluorfen Koc: 5586; AeSM: T1/2: 871 days; AnSM: T1/2 = 654 days
  070148  0 2 0.00  2.24 0.99 0.01
  070149  0 2 0.00  2.24 0.99 0.01
  070150  0 2 0.00  2.24 0.99 0.01
  070151  0 2 0.00  2.24 0.99 0.01
```

```
  070152  0 2 0.00  2.24 0.99 0.01
  070153  0 2 0.00  2.24 0.99 0.01
  070154  0 2 0.00  2.24 0.99 0.01
  070155  0 2 0.00  2.24 0.99 0.01
  070156  0 2 0.00  2.24 0.99 0.01
  070157  0 2 0.00  2.24 0.99 0.01
  070158  0 2 0.00  2.24 0.99 0.01
  070159  0 2 0.00  2.24 0.99 0.01
  070160  0 2 0.00  2.24 0.99 0.01
  070161  0 2 0.00  2.24 0.99 0.01
  070162  0 2 0.00  2.24 0.99 0.01
  070163  0 2 0.00  2.24 0.99 0.01
  070164  0 2 0.00  2.24 0.99 0.01
  070165  0 2 0.00  2.24 0.99 0.01
  070166  0 2 0.00  2.24 0.99 0.01
  070167  0 2 0.00  2.24 0.99 0.01
  070168  0 2 0.00  2.24 0.99 0.01
  070169  0 2 0.00  2.24 0.99 0.01
  070170  0 2 0.00  2.24 0.99 0.01
  070171  0 2 0.00  2.24 0.99 0.01
  070172  0 2 0.00  2.24 0.99 0.01
  070173  0 2 0.00  2.24 0.99 0.01
  070174  0 2 0.00  2.24 0.99 0.01
  070175  0 2 0.00  2.24 0.99 0.01
  070176  0 2 0.00  2.24 0.99 0.01
  070177  0 2 0.00  2.24 0.99 0.01
  070178  0 2 0.00  2.24 0.99 0.01
  070179  0 2 0.00  2.24 0.99 0.01
  070180  0 2 0.00  2.24 0.99 0.01
  070181  0 2 0.00  2.24 0.99 0.01
  070182  0 2 0.00  2.24 0.99 0.01
  070183  0 2 0.00  2.24 0.99 0.01
     0.0       1     0.0
*** Foliar dissipation parameters ***
    0.00   .0016    0.50
Cornelius silt loam, 15% slope, Hydrologic  Group: C
   148.0           0   0   0   0   0   0   0   0   0
*** line 26 - soil volatilization constants
   0.000   0.000   0.000
       5
       1    15.0    1.30   0.329     0.0     0.0    0.0
         7.96E-4 7.96E-4   0.000
             0.1   0.329   0.099    2.30  128.48
       2    13.0    1.38   0.338     0.0     0.0    0.0
         7.96E-4 7.96E-4   0.000
             1.0   0.338   0.108    1.11    62.0
       3    15.0    1.58   0.340     0.0     0.0    0.0
         7.96E-4 7.96E-4   0.000
             1.0   0.340   0.110    0.21    11.7
       4    55.0    1.52   0.358     0.0     0.0    0.0
         7.96E-4 7.96E-4   0.000
             5.0   0.358   0.148   0.145    8.10
       5    50.0    1.46   0.202     0.0     0.0    0.0
         7.96E-4 7.96E-4   0.000
             5.0   0.202   0.142    0.07     3.9
       0
            YEAR       5            YEAR       5            YEAR       5   1
       1
       1  -----
       6    YEAR
    PRCP    TSER   0   0
    RUNF    TSER   0   0
    ESLS    TSER   0   0   1.0E3
    RFLX    TSER   0   0   1.0E5
    EFLX    TSER   0   0   1.0E5
```

```
RZFX    TSER   0   0   1.0E5
```

PRZM input file 5; California Walnuts
Oxyfluorfen 1 ground application at 2.0 lbs ai/acre on 07/01/XX

```
***PRZM 3.1 Input File Modified from  PRZM 2 File***
***CAWAL5.INP created 07/28/99***
***Crop: Walnuts***
***Kern Co, CA; Sacramento and San Joaquin Valleys, MLRA 17***
***Based on mature trees approximately 50 feet tall with sparse grass understory***
***IRRIGATION APPLIED USING SPRINKLER**
*** TALKED TO EXTENSION AGENT AT UC DAVIS, Joe Grant 209-468-2085. ***
Oxyfluorfen
Kimberlina Sandy Loam; Hyrologic Group B
   0.852   0.450       0  20.000       1       3
       4
    0.05    0.01     0.1    10.0     3.8       3     0.5   356.0
       1
       1    0.30    60.0  90.000       1  86  78  82                 0.0  1500.0
       1       3
0101 0104 0112
0.05 0.05 0.05
.023 .023 .023
      36
  250148  200948  041048       1
  250149  200949  041049       1
  250150  200950  041050       1
  250151  200951  041051       1
  250152  200952  041052       1
  250153  200953  041053       1
  250154  200954  041054       1
  250155  200955  041055       1
  250156  200956  041056       1
  250157  200957  041057       1
  250158  200958  041058       1
  250159  200959  041059       1
  250160  200960  041060       1
  250161  200961  041061       1
  250162  200962  041062       1
  250163  200963  041063       1
  250164  200964  041064       1
  250165  200965  041065       1
  250166  200966  041066       1
  250167  200967  041067       1
  250168  200968  041068       1
  250169  200969  041069       1
  250170  200970  041070       1
  250171  200971  041071       1
  250172  200972  041072       1
  250173  200973  041073       1
  250174  200974  041074       1
  250175  200975  041075       1
  250176  200976  041076       1
  250177  200977  041077       1
  250178  200978  041078       1
  250179  200979  041079       1
  250180  200980  041080       1
  250181  200981  041081       1
  250182  200982  041082       1
  250183  200983  041083       1
Application Schedule: 1 app @ 2.0 lb/acre, GROUND SPRAY @ 99% eff. w/1% drift
      36       1       0       0
Oxyfluorfen Koc: 5585 ; ASM: T1/2 = 871 days; AnSM: T1/2 = 654 days
  070148  0 2 0.00  2.24 0.99 0.01
  070149  0 2 0.00  2.24 0.99 0.01
  070150  0 2 0.00  2.24 0.96 0.01
  070151  0 2 0.00  2.24 0.99 0.01
```

```
   070152  0 2 0.00  2.24 0.99 0.01
   070153  0 2 0.00  2.24 0.99 0.01
   070154  0 2 0.00  2.24 0.99 0.01
   070155  0 2 0.00  2.24 0.99 0.01
   070156  0 2 0.00  2.24 0.99 0.01
   070157  0 2 0.00  2.24 0.99 0.01
   070158  0 2 0.00  2.24 0.99 0.01
   070159  0 2 0.00  2.24 0.99 0.01
   070160  0 2 0.00  2.24 0.99 0.01
   070161  0 2 0.00  2.24 0.99 0.01
   070162  0 2 0.00  2.24 0.99 0.01
   070163  0 2 0.00  2.24 0.99 0.01
   070164  0 2 0.00  2.24 0.99 0.01
   070165  0 2 0.00  2.24 0.99 0.01
   070166  0 2 0.00  2.24 0.99 0.01
   070167  0 2 0.00  2.24 0.99 0.01
   070168  0 2 0.00  2.24 0.99 0.01
   070169  0 2 0.00  2.24 0.99 0.01
   070170  0 2 0.00  2.24 0.99 0.01
   070171  0 2 0.00  2.24 0.99 0.01
   070172  0 2 0.00  2.24 0.99 0.01
   070173  0 2 0.00  2.24 0.99 0.01
   070174  0 2 0.00  2.24 0.99 0.01
   070175  0 2 0.00  2.24 0.99 0.01
   070176  0 2 0.00  2.24 0.99 0.01
   070177  0 2 0.00  2.24 0.99 0.01
   070178  0 2 0.00  2.24 0.99 0.01
   070179  0 2 0.00  2.24 0.99 0.01
   070180  0 2 0.00  2.24 0.99 0.01
   070181  0 2 0.00  2.24 0.99 0.01
   070182  0 2 0.00  2.24 0.99 0.01
   070183  0 2 0.00  2.24 0.99 0.01
     0.00       3     0.0
        0       0     0.5
Kimberlina Sandy Loam; Hydrologic Group B;
    125.0       0   0   0   0   0   0   1   0   0
     0.00    0.00    0.00
        4     0.2     0.5    0.75
        3
        1     5.0    1.45   0.212     0.0     0.0   0.000
          7.96E-4 7.96E-4   0.000
              0.1   0.212   .0973    0.80    44.7
        2    20.0    1.45   0.212     0.0     0.0   0.000
          7.96E-4 7.96E-4   0.000
              5.0   .2240   .0973    0.80    44.7
        3   100.0    1.65   0.211     0.0     0.0   0.000
          7.96E-4 7.96E-4   0.000
              5.0  0.2020  0.0962    0.80    44.7
        0
            YEAR      10            YEAR      10            YEAR      10   1
        1
        1  -----
        7    YEAR
     PRCP    TCUM   0   0
     RUNF    TCUM   0   0
     INFL    TCUM   1   1
     ESLS    TCUM   0   0  1.0E3
     RFLX    TCUM   0   0  1.0E5
     EFLX    TCUM   0   0  1.0E5
     RZFX    TCUM   0   0  1.0E5
```

PRZM input file 6; New York Grapes
Oxyfluorfen 1 ground application at 2.0 lbs ai/acre on 07/01/XX

```
***PRZM 3.1 Input Data File converted from PRZM 2.3***
***Modeler M. Corbin***
***IRNYGrp.INP, modified from NYGrape1.inp October 31, 2000; Chautauqua County, NY.***
***Chautauqua County has highest acreage of Grapes in NY (3rd highest state in US) ***
***Erie, PA Weather Station used - closest to county, Grapes with grass cover ***
***Soil Hornell, Hydrologic Group D ***
***Application timing provided by Phillip Throop of Cornell U. and Fredonia Regional
Extension***
***Office, Viticulture Specialist: pthroop@cce.cornell.edu; (716) 672-2191.***
***All values are average of 15 years of data collection for early-mid bloom, fruit***
***ripening (veraison), and prior to harvest. Prior to bunch closing is assumed to
occur***
***at August 1, this benchmark is not a common factor to measure and will vary
according to environmental***
***conditions and type of grape. This scenario is based on the Concord variety.***
***Emergence, maturation and harvest are set as early bloom, veraison and harvest.***
***Assume poor grass coverage under vines and overland flow***
***Pesticide is spray applied***
*** set up for Koc input (see records 20 and 30)***
***Meteorology Data using MET100.met (Data from 1961 to 1983)***
Oxyfluorfen
Hornell silt loam; MLRA L-100, Chautauqua County, New York, Grapes
   0.780   0.300       0   15.00       1       1
       4
    0.33    1.00    1.00    10.0    5.80       3   15.00   354.0
       1
       1    0.25   90.00  100.00       3  94  91  93     0.00   150.0
       1       3
0101 0106 0110
0.50 0.50 0.50
.023 .023 .023
      36
  310548  220848  151048       1
  310549  220849  151049       1
  310550  220850  151050       1
  310551  220851  151051       1
  310552  220852  151052       1
  310553  220853  151053       1
  310554  220854  151054       1
  310555  220855  151055       1
  310556  220856  151056       1
  310557  220857  151057       1
  310558  220858  151058       1
  310559  220859  151059       1
  310560  220860  151060       1
  310561  220861  151061       1
  310562  220862  151062       1
  310563  220863  151063       1
  310564  220864  151064       1
  310565  220865  151065       1
  310566  220866  151066       1
  310567  220867  151067       1
  310568  220868  151068       1
  310569  220869  151069       1
  310570  220870  151070       1
  310571  220871  151071       1
  310572  220872  151072       1
  310573  220873  151073       1
  310574  220874  151074       1
  310575  220875  151075       1
  310576  220876  151076       1
  310577  220877  151077       1
```

```
  310578  220878  151078       1
  310579  220879  151079       1
  310580  220880  151080       1
  310581  220881  151081       1
  310582  220882  151082       1
  310583  220883  151083       1
Application Schedule: 2.0 lb a.i./acre ground spray app, 99% effic. w/1% drift
***(early-mid bloom, prior to bunch closing, begin. fruit ripening, prior to
harvest)***
      23       1       0       0
Oxyfluorfen Koc: 5585 ; ASM: T1/2 = 871 days; AnSM: T1/2 = 654 days
  070161  0 2 0.00  2.24 0.99 0.01
  070162  0 2 0.00  2.24 0.99 0.01
  070163  0 2 0.00  2.24 0.99 0.01
  070164  0 2 0.00  2.24 0.99 0.01
  070165  0 2 0.00  2.24 0.99 0.01
  070166  0 2 0.00  2.24 0.99 0.01
  070167  0 2 0.00  2.24 0.99 0.01
  070168  0 2 0.00  2.24 0.99 0.01
  070169  0 2 0.00  2.24 0.99 0.01
  070170  0 2 0.00  2.24 0.99 0.01
  070171  0 2 0.00  2.24 0.99 0.01
  070172  0 2 0.00  2.24 0.99 0.01
  070173  0 2 0.00  2.24 0.99 0.01
  070174  0 2 0.00  2.24 0.99 0.01
  070175  0 2 0.00  2.24 0.99 0.01
  070176  0 2 0.00  2.24 0.99 0.01
  070177  0 2 0.00  2.24 0.99 0.01
  070178  0 2 0.00  2.24 0.99 0.01
  070179  0 2 0.00  2.24 0.99 0.01
  070180  0 2 0.00  2.24 0.99 0.01
  070181  0 2 0.00  2.24 0.99 0.01
  070182  0 2 0.00  2.24 0.99 0.01
  070183  0 2 0.00  2.24 0.99 0.01
     0.0       3     0.0
    0.00    0.00    0.50
Hornell Silt Loam; Hydrologic Group D;
  100.00     0.0   0   0   1   0   0   0   0   0   0
     0.0     0.0     0.0
       4    5585
       3
       1   18.00   1.400   0.322   0.000   0.000   0.00
         7.96E-4 7.96E-4   0.000
             0.1   0.322   0.162   1.740     0.0
       2   66.00   1.500   0.310   0.000   0.000   0.00
         7.96E-4 7.96E-4   0.000
             1.0   0.310   0.200   0.174     0.0
       3   16.00   1.950   0.260   0.000   0.000   0.00
         7.96E-4 7.96E-4   0.000
             1.0   0.260   0.190   0.116     0.0
       0
            YEAR       5            YEAR       5            YEAR       5   1
       1
       1  -----
       1    DAY
*** PRCP    TSER   0   0
    RUNF    TCUM   0   0
*** ESLS    TSER   0   0   1.0E3
*** RFLX    TSER   0   0   1.0E5
*** EFLX    TSER   0   0   1.0E5
*** RZFX    TSER   0   0   1.0E5
```

PRZM input file 7; California Cabbage
Oxyfluorfen 1 ground application at 0.5 lbs ai/acre on 07/01/XX

```
Pico sandy loam, MLRA C-14; Coastal Valley, CA, Cabbage
   0.790   0.300       0   17.00       1       1
       4
    0.19    1.00   1.000   10.00               3   1.00   354.0
       1
       1    0.25   12.00   80.00       3  86  78  82    0.00  100.00
       1       3
0101 21 9 2209
0.10 0.10 0.10
.023 .023 .023
      36
  100248  050548  120548       1
  100249  050549  120549       1
  100250  050550  120550       1
  100251  050551  120551       1
  100252  050552  120552       1
  100253  050553  120553       1
  100254  050554  120554       1
  100255  050555  120555       1
  100256  050556  120556       1
  100257  050557  120557       1
  100258  050558  120558       1
  100259  050559  120559       1
  100260  050560  120560       1
  100261  050561  120561       1
  100262  050562  120562       1
  100263  050563  120563       1
  100264  050564  120564       1
  100265  050565  120565       1
  100266  050566  120566       1
  100267  050567  120567       1
  100268  050568  120568       1
  100269  050569  120569       1
  100270  050570  120570       1
  100271  050571  120571       1
  100272  050572  120572       1
  100273  050573  120573       1
  100274  050574  120574       1
  100275  050575  120575       1
  100276  050576  120576       1
  100277  050577  120577       1
  100278  050578  120578       1
  100279  050579  120579       1
  100280  050580  120580       1
  100281  050581  120581       1
  100282  050582  120582       1
  100283  050583  120583       1
Application: 1 ground appl. 0.56 kg/ha @99% eff), w1%drift
     36       1       0       0
Oxyfluorfen:koc= 5585 Aesm t1/2= 871 days,Ansm t1/2= 654 days
  070148  0 2 0.00  0.56 0.99 0.01
  070149  0 2 0.00  0.56 0.99 0.01
  070150  0 2 0.00  0.56 0.99 0.01
  070151  0 2 0.00  0.56 0.99 0.01
  070152  0 2 0.00  0.56 0.99 0.01
  070153  0 2 0.00  0.56 0.99 0.01
  070154  0 2 0.00  0.56 0.99 0.01
  070155  0 2 0.00  0.56 0.99 0.01
  070156  0 2 0.00  0.56 0.99 0.01
  070157  0 2 0.00  0.56 0.99 0.01
  070158  0 2 0.00  0.56 0.99 0.01
  070159  0 2 0.00  0.56 0.99 0.01
```

```
070160  0 2 0.00  0.56 0.99 0.01
070161  0 2 0.00  0.56 0.99 0.01
070162  0 2 0.00  0.56 0.99 0.01
070163  0 2 0.00  0.56 0.99 0.01
070164  0 2 0.00  0.56 0.99 0.01
070165  0 2 0.00  0.56 0.99 0.01
070166  0 2 0.00  0.56 0.99 0.01
070167  0 2 0.00  0.56 0.99 0.01
070168  0 2 0.00  0.56 0.99 0.01
070169  0 2 0.00  0.56 0.99 0.01
070170  0 2 0.00  0.56 0.99 0.01
070171  0 2 0.00  0.56 0.99 0.01
070172  0 2 0.00  0.56 0.99 0.01
070173  0 2 0.00  0.56 0.99 0.01
070174  0 2 0.00  0.56 0.99 0.01
070175  0 2 0.00  0.56 0.99 0.01
070176  0 2 0.00  0.56 0.99 0.01
070177  0 2 0.00  0.56 0.99 0.01
070178  0 2 0.00  0.56 0.99 0.01
070179  0 2 0.00  0.56 0.99 0.01
070180  0 2 0.00  0.56 0.99 0.01
070181  0 2 0.00  0.56 0.99 0.01
070182  0 2 0.00  0.56 0.99 0.01
070183  0 2 0.00  0.56 0.99 0.01
    0.       1     0.0
   0.00   0.072     0.5
Pico sandy loam; Hydrologic Group B
 150.00     0.0   0   0   0   0   0   0   0   0   0
    0.0   0.000    0.00
      3
      1   35.00   1.500   0.306   0.000   0.000  0.000
        7.96E-4 7.96E-4   0.000
          0.500   0.306   0.166   0.600   33.51
      2  100.00   1.500   0.264   0.000   0.000  0.000
        7.96E-4 7.96E-4   0.000
            5.0   0.264   0.124   0.100   5.585
      3   15.00   1.500   0.101   0.000   0.000  0.000
        7.96E-4 7.96E-4   0.000
            5.0   0.101   0.051   0.100   5.585
      0
   WATR    YEAR      10    PEST    YEAR      10    CONC    YEAR      10   1
      6
     11  -----
      5    DAY
   RFLX    TSER   0   0   1.E5
   EFLX    TSER   0   0   1.E5
   ESLS    TSER   0   0   1.E0
   RUNF    TSER   0   0   1.E0
   PRCP    TSER   0   0   1.E0
```

PRZM input file 8; Mississippi Cotton
Oxyfluorfen 1 aerial application at 0.5 lbs ai/acre on 07/01/XX

```
PRZM3 Input File, Oxycottn.inp (May 7, 2001)
Location: MS Crop: cotton  MLRA 131
    0.74    0.15       0   17.00       1       3
       4
    0.49    0.40    1.00   10.00    5.80       3    6.00   354.0
       3
       1    0.20  125.00   98.00       3  99  93  92                0.00  100.00
       2    0.20  125.00   98.00       3  94  84  83                0.00  100.00
       3    0.20  125.00   98.00       3  94  84  83                0.00  100.00
       1       3
0101 2109 2209
0.63 0.16 0.18
0.02 0.02 0.02
       2       3
0105 0709 2209
0.16 0.13 0.13
0.02 0.02 0.02
       3       3
0105 0709 2209
0.16 0.13 0.09
0.02 0.02 0.02
      20
  01 564  07 964  220964       2
  01 565  07 965  220965       3
  01 566  07 966  220966       1
  01 567  07 967  220967       2
  01 568  07 968  220968       3
  01 569  07 969  220969       1
  01 570  07 970  220970       2
  01 571  07 971  220971       3
  01 572  07 972  220972       1
  01 573  07 973  220973       2
  01 574  07 974  220974       3
  01 575  07 975  220975       1
  01 576  07 976  220976       2
  01 577  07 977  220977       3
  01 578  07 978  220978       1
  01 579  07 979  220979       2
  01 580  07 980  220980       3
  01 581  07 981  220981       1
  01 582  07 982  220982       2
  01 583  07 983  220983       3
Application: 1 aerial appl. 0.56 kg/ha @95% eff), w5%drift
     20       1       0       0
Oxyfluorfen:koc= 5585 Aesm t1/2= 871 days,Ansm t1/2= 654 days
  070164  0 2 0.00  0.56 0.95 0.05
  070165  0 2 0.00  0.56 0.95 0.05
  070166  0 2 0.00  0.56 0.95 0.05
  070167  0 2 0.00  0.56 0.95 0.05
  070168  0 2 0.00  0.56 0.95 0.05
  070169  0 2 0.00  0.56 0.95 0.05
  070170  0 2 0.00  0.56 0.95 0.05
  070171  0 2 0.00  0.56 0.95 0.05
  070172  0 2 0.00  0.56 0.95 0.05
  070173  0 2 0.00  0.56 0.95 0.05
  070174  0 2 0.00  0.56 0.95 0.05
  070175  0 2 0.00  0.56 0.95 0.05
  070176  0 2 0.00  0.56 0.95 0.05
  070177  0 2 0.00  0.56 0.95 0.05
  070178  0 2 0.00  0.56 0.95 0.05
  070179  0 2 0.00  0.56 0.95 0.05
  070180  0 2 0.00  0.56 0.95 0.05
```

```
  070181  0 2 0.00  0.56 0.95 0.05
  070182  0 2 0.00  0.56 0.95 0.05
  070183  0 2 0.00  0.56 0.95 0.05
    0.       1
    0.00    0.00    0.50
Soil Series: Loring silt loam; Hydrogic Group C
  125.00    0.00   0   0   0   0   0   0   0   0   0
    0.00    0.00   00.00
       3
       1  10.000   1.600   0.294   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           0.100   0.191   0.086   1.160   64.79
       2  10.000   1.600   0.294   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           2.000   0.191   0.086   1.160   64.79
       3 105.000   1.800   0.147   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           5.000   0.249   0.109   0.174   9.72
       0
    WATR    YEAR      10    PEST    YEAR      10    CONC    YEAR      10   1
       6
      11  -----
       7    DAY
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0   1.E3
    RFLX    TCUM   0   0   1.E5
    EFLX    TCUM   0   0   1.E5
    RZFX    TCUM   0   0   1.E5
```

PRZM input file 9; Mississippi Cotton
Oxyfluorfen 1 ground application at 0.5 lbs ai/acre on 07/01/XX

```
PRZM3 Input File, Oxycottn.inp (May 7, 2001)
Location: MS Crop: cotton  MLRA 131
    0.74    0.15       0   17.00       1       3
       4
    0.49    0.40    1.00   10.00    5.80       3    6.00   354.0
       3
       1    0.20  125.00   98.00       3  99  93  92                0.00  100.00
       2    0.20  125.00   98.00       3  94  84  83                0.00  100.00
       3    0.20  125.00   98.00       3  94  84  83                0.00  100.00
       1       3
0101 2109 2209
0.63 0.16 0.18
0.02 0.02 0.02
       2       3
0105 0709 2209
0.16 0.13 0.13
0.02 0.02 0.02
       3       3
0105 0709 2209
0.16 0.13 0.09
0.02 0.02 0.02
      20
  01 564  07 964  220964        2
  01 565  07 965  220965        3
  01 566  07 966  220966        1
  01 567  07 967  220967        2
  01 568  07 968  220968        3
  01 569  07 969  220969        1
  01 570  07 970  220970        2
  01 571  07 971  220971        3
  01 572  07 972  220972        1
  01 573  07 973  220973        2
  01 574  07 974  220974        3
  01 575  07 975  220975        1
  01 576  07 976  220976        2
  01 577  07 977  220977        3
  01 578  07 978  220978        1
  01 579  07 979  220979        2
  01 580  07 980  220980        3
  01 581  07 981  220981        1
  01 582  07 982  220982        2
  01 583  07 983  220983        3
Application: 1 ground appl. 0.56 kg/ha @99% eff), w1%drift
     20       1       0       0
Oxyfluorfen:koc= 5585 Aesm t1/2= 871 days,Ansm t1/2= 654 days
  070164  0 2 0.00  0.56 0.99 0.01
  070165  0 2 0.00  0.56 0.99 0.01
  070166  0 2 0.00  0.56 0.99 0.01
  070167  0 2 0.00  0.56 0.99 0.01
  070168  0 2 0.00  0.56 0.99 0.01
  070169  0 2 0.00  0.56 0.99 0.01
  070170  0 2 0.00  0.56 0.99 0.01
  070171  0 2 0.00  0.56 0.99 0.01
  070172  0 2 0.00  0.56 0.99 0.01
  070173  0 2 0.00  0.56 0.99 0.01
  070174  0 2 0.00  0.56 0.99 0.01
  070175  0 2 0.00  0.56 0.99 0.01
  070176  0 2 0.00  0.56 0.99 0.01
  070177  0 2 0.00  0.56 0.99 0.01
  070178  0 2 0.00  0.56 0.99 0.01
  070179  0 2 0.00  0.56 0.99 0.01
  070180  0 2 0.00  0.56 0.99 0.01
```

```
  070181  0 2 0.00  0.56 0.99 0.01
  070182  0 2 0.00  0.56 0.99 0.01
  070183  0 2 0.00  0.56 0.99 0.01
    0.        1
    0.00    0.00    0.50
Soil Series: Loring silt loam; Hydrogic Group C
  125.00    0.00   0   0   0   0   0   0   0   0   0
    0.00    0.00   00.00
       3
       1  10.000   1.600   0.294   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           0.100   0.191   0.086   1.160   64.79
       2  10.000   1.600   0.294   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           2.000   0.191   0.086   1.160   64.79
       3 105.000   1.800   0.147   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           5.000   0.249   0.109   0.174   9.72
       0
    WATR    YEAR      10    PEST    YEAR      10    CONC    YEAR      10   1
       6
      11  -----
       7    DAY
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0   1.E3
    RFLX    TCUM   0   0   1.E5
    EFLX    TCUM   0   0   1.E5
    RZFX    TCUM   0   0   1.E5
```

PRZM input file 10; IR Oregon Apple
Oxyfluorfen 1 ground application at 2.0 lbs ai/acre on 07/01/XX

```
***PRZM 3.1 Input File Converted from PRZM 2***
***ORAPPLE1.inp created 12/22/97 Revised by Kevin Costello 8/15/01***
***Washington County, Oregon; Meadow/Orchard Scenario; MLRA: A2***
***Pesticide is applied by ground spray/air blast***
***Temperature data read***
Cornelius silt loam, 12% slope, Hydrologic Group: C
   0.740   0.150       0  15.000       1       3
       4
    0.33    3.64     1.0   172.8     5.4       2   12.00   600.0
       1
       1    0.25    45.0  98.000       3  84  79  82                 0.0     240
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.008 .009 .013 .015 .020 .026 .029 .032 .034 .033 .031 .028 .024 .020 .018 .018
.040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040
0109 1609 0110 1610 0111 1611 0112 1612
.018 .020 .022 .024 .005 .006 .006 .007
.040 .040 .040 .040 .040 .040 .040 .040
      36
  250448  310548  071148       1
  250449  310549  071149       1
  250450  310550  071150       1
  250451  310551  071151       1
  250452  310552  071152       1
  250453  310553  071153       1
  250454  310554  071154       1
  250455  310555  071155       1
  250456  310556  071156       1
  250457  310557  071157       1
  250458  310558  071158       1
  250459  310559  071159       1
  250460  310560  071160       1
  250461  310561  071161       1
  250462  310562  071162       1
  250463  310563  071163       1
  250464  310564  071164       1
  250465  310565  071165       1
  250466  310566  071166       1
  250467  310567  071167       1
  250468  310568  071168       1
  250469  310569  071169       1
  250470  310570  071170       1
  250471  310571  071171       1
  250472  310572  071172       1
  250473  310573  071173       1
  250474  310574  071174       1
  250475  310575  071175       1
  250476  310576  071176       1
  250477  310577  071177       1
  250478  310578  071178       1
  250479  310579  071179       1
  250480  310580  071180       1
  250481  310581  071181       1
  250482  310582  071182       1
  250483  310583  071183       1
Application schedule: 1 apps of 2 lb a.i./acre, ground spray@ 99% eff. w/6.4% drift
      36       1       0       0
Oxyfluorfen Koc: 5586; AeSM: T1/2: 871 days; AnSM: T1/2 = 654 days
  070148  0 2 0.00  2.24 0.99 0.064
  070149  0 2 0.00  2.24 0.99 0.064
  070150  0 2 0.00  2.24 0.99 0.064
  070151  0 2 0.00  2.24 0.99 0.064
```

```
  070152  0 2 0.00  2.24 0.99 0.064
  070153  0 2 0.00  2.24 0.99 0.064
  070154  0 2 0.00  2.24 0.99 0.064
  070155  0 2 0.00  2.24 0.99 0.064
  070156  0 2 0.00  2.24 0.99 0.064
  070157  0 2 0.00  2.24 0.99 0.064
  070158  0 2 0.00  2.24 0.99 0.064
  070159  0 2 0.00  2.24 0.99 0.064
  070160  0 2 0.00  2.24 0.99 0.064
  070161  0 2 0.00  2.24 0.99 0.064
  070162  0 2 0.00  2.24 0.99 0.064
  070163  0 2 0.00  2.24 0.99 0.064
  070164  0 2 0.00  2.24 0.99 0.064
  070165  0 2 0.00  2.24 0.99 0.064
  070166  0 2 0.00  2.24 0.99 0.064
  070167  0 2 0.00  2.24 0.99 0.064
  070168  0 2 0.00  2.24 0.99 0.064
  070169  0 2 0.00  2.24 0.99 0.064
  070170  0 2 0.00  2.24 0.99 0.064
  070171  0 2 0.00  2.24 0.99 0.064
  070172  0 2 0.00  2.24 0.99 0.064
  070173  0 2 0.00  2.24 0.99 0.064
  070174  0 2 0.00  2.24 0.99 0.064
  070175  0 2 0.00  2.24 0.99 0.064
  070176  0 2 0.00  2.24 0.99 0.064
  070177  0 2 0.00  2.24 0.99 0.064
  070178  0 2 0.00  2.24 0.99 0.064
  070179  0 2 0.00  2.24 0.99 0.064
  070180  0 2 0.00  2.24 0.99 0.064
  070181  0 2 0.00  2.24 0.99 0.064
  070182  0 2 0.00  2.24 0.99 0.064
  070183  0 2 0.00  2.24 0.99 0.064
     0.0       1     0.0
*** Foliar dissipation parameters ***
    0.00   .0016    0.50
Cornelius silt loam, 15% slope, Hydrologic  Group: C
   148.0           0   0   0   0   0   0   0   0   0
*** line 26 - soil volatilization constants

   0.000   0.000   0.000
       5
       1    15.0    1.30   0.329     0.0     0.0    0.0
         7.96E-4 7.96E-4   0.000
             0.1   0.329   0.099    2.30  128.48
       2    13.0    1.38   0.338     0.0     0.0    0.0
         7.96E-4 7.96E-4   0.000
             1.0   0.338   0.108    1.11    62.0
       3    15.0    1.58   0.340     0.0     0.0    0.0
         7.96E-4 7.96E-4   0.000
             1.0   0.340   0.110    0.21    11.7
       4    55.0    1.52   0.358     0.0     0.0    0.0
         7.96E-4 7.96E-4   0.000
             5.0   0.358   0.148   0.145    8.10
       5    50.0    1.46   0.202     0.0     0.0    0.0
         7.96E-4 7.96E-4   0.000
             5.0   0.202   0.142    0.07     3.9
       0
            YEAR       5            YEAR       5            YEAR       5   1
       1
       1  -----
       6    YEAR
    PRCP    TSER   0   0
    RUNF    TSER   0   0
    ESLS    TSER   0   0   1.0E3
    RFLX    TSER   0   0   1.0E5
```

```
EFLX    TSER   0   0   1.0E5
RZFX    TSER   0   0   1.0E5
```

PRZM input file 11; IR Mississippi Cotton
Oxyfluorfen 1 aerial application at 0.5 lbs ai/acre on 07/01/XX

```
*** PRZM 3.1 Input data File,IROXYCOT.inp ***
*** Index Reservoir scenario for oxyfluorfen on cotton ***
*** Location: Yazoo County, Mississippi; MLRA: O-134 ***
*** Weather: MET131.MET Jackson, MS ***
*** Manning's N: Assume fallow surface with residues not more than 1 ton/acre ***
*** See MSCOTTN1.wpd for scenario description and metadata prior to IR development ***
*** PCA for cotton alone is 0.20 ***
Chemical:Oxyfluorfen
Location: Mississippi; Crop: cotton;  MLRA: O-134
    0.76    0.15       0   17.00       1       1
       4
    0.49    0.40    0.75   172.8    5.80       4    6.00   600.0
       3
       1    0.20  125.00   98.00       3  99  93  92                0.00  120.00
       2    0.20  125.00   98.00       3  94  84  83                0.00  120.00
       3    0.20  125.00   98.00       3  99  83  83                0.00  120.00
       1       3
0101 2109 2209
0.63 0.16 0.18
0.02 0.02 0.02
       2       3
0105 0709 2209
0.16 0.13 0.13
0.02 0.02 0.02
       3       3
0105 0709 2209
0.16 0.13 0.09
0.02 0.02 0.02
      20
  01 564  07 964  220964       1
  01 565  07 965  220965       2
  01 566  07 966  220966       3
  01 567  07 967  220967       1
  01 568  07 968  220968       2
  01 569  07 969  220969       3
  01 570  07 970  220970       1
  01 571  07 971  220971       2
  01 572  07 972  220972       3
  01 573  07 973  220973       1
  01 574  07 974  220974       2
  01 575  07 975  220975       3
  01 576  07 976  220976       1
  01 577  07 977  220977       2
  01 578  07 978  220978       3
  01 579  07 979  220979       1
  01 580  07 980  220980       2
  01 581  07 981  220981       3
  01 582  07 982  220982       1
  01 583  07 983  220983       2
Application: 1 aerial appl. 0.56 kg/ha @95% eff. w/16%drift
      20       1       0       0
Oxyfluorfen:koc= 5585 Aesm t1/2= 871 days,Ansm t1/2= 654 days
  070164  0 2 0.00  0.56 0.95 0.16
  070165  0 2 0.00  0.56 0.95 0.16
  070166  0 2 0.00  0.56 0.95 0.16
  070167  0 2 0.00  0.56 0.95 0.16
  070168  0 2 0.00  0.56 0.95 0.16
  070169  0 2 0.00  0.56 0.95 0.16
  070170  0 2 0.00  0.56 0.95 0.16
  070171  0 2 0.00  0.56 0.95 0.16
  070172  0 2 0.00  0.56 0.95 0.16
  070173  0 2 0.00  0.56 0.95 0.16
```

```
  070174  0 2 0.00  0.56 0.95 0.16
  070175  0 2 0.00  0.56 0.95 0.16
  070176  0 2 0.00  0.56 0.95 0.16
  070177  0 2 0.00  0.56 0.95 0.16
  070178  0 2 0.00  0.56 0.95 0.16
  070179  0 2 0.00  0.56 0.95 0.16
  070180  0 2 0.00  0.56 0.95 0.16
  070181  0 2 0.00  0.56 0.95 0.16
  070182  0 2 0.00  0.56 0.95 0.16
  070183  0 2 0.00  0.56 0.95 0.16
    0.       1
    0.00    0.00    0.50
Soil Series: Loring silt loam; Hydrogic Group C
  155.00    0.00   0   0   0   0   0   0   0   0   0
    0.00    0.00   00.00
       6
       1   13.00   1.400   0.385   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           0.100   0.385   0.151   2.180   121.8
       2   23.00   1.400   0.370   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           1.000   0.370   0.146   0.490   27.37
       3   33.00   1.400   0.370   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           1.000   0.370   0.146   0.160   8.936
       4   30.00   1.450   0.340   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           1.000   0.340   0.125   0.124   6.925
       5   23.00   1.490   0.335   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           1.000   0.335   0.137   0.070   3.910
       6   33.00   1.510   0.343   0.000   0.000   0.000
         7.96E-4 7.96E-4   0.000
           1.000   0.343   0.147   0.060   3.351
       0
    WATR    YEAR      10    PEST    YEAR      10    CONC    YEAR      10   1
       1
       1  -----
       7    DAY
    PRCP    TSER   0   0
    RUNF    TSER   0   0
    INFL    TSER   1   1
    ESLS    TSER   0   0   1.E3
    RFLX    TSER   0   0   1.E5
    EFLX    TSER   0   0   1.E5
    RZFX    TSER   0   0   1.E5
```

PRZM input file 12; IR Florida Citrus
Oxyfluorfen 2 ground applications at 2.0 lbs ai/acre on 1/7/XX and 4/7/XX

```
PRZM3 Input File, flcit.inp (Jan 28 2000)
Location: Osceola County, FL.; Crop: citrus; MLRA 156A
    0.77    0.15       0   25.00       1       1
       4
    0.10    0.13    1.00   172.8               3   1.00   600.0
       1
       1    0.10  100.00   80.00       3  94  84  89    0.00  100.00
       1       3
0101 21 9 2209
0.10 0.10 0.10
.023 .023 .023
      36
  110548  170748   10848       1
  110549  170749   10849       1
  110550  170750   10850       1
  110551  170751   10851       1
  110552  170752   10852       1
  110553  170753   10853       1
  110554  170754   10854       1
  110555  170755   10855       1
  110556  170756   10856       1
  110557  170757   10857       1
  110558  170758   10858       1
  110559  170759   10859       1
  110560  170760   10860       1
  110561  170761   10861       1
  110562  170762   10862       1
  110563  170763   10863       1
  110564  170764   10864       1
  110565  170765   10865       1
  110566  170766   10866       1
  110567  170767   10867       1
  110568  170768   10868       1
  110569  170769   10869       1
  110570  170770   10870       1
  110571  170771   10871       1
  110572  170772   10872       1
  110573  170773   10873       1
  110574  170774   10874       1
  110575  170775   10875       1
  110576  170776   10876       1
  110577  170777   10877       1
  110578  170778   10878       1
  110579  170779   10879       1
  110580  170780   10880       1
  110581  170781   10881       1
  110582  170782   10882       1
  110583  170783   10883       1
Application: 72 ground appl. 2.0 lb a.i./ac @99% eff, w/6.4%drift
      72       1       0       0
Oxyfluorfen
  070148  0 2 0.00 2.24 0.99 0.064
  070448  0 2 0.00 2.24 0.99 0.064
  070149  0 2 0.00 2.24 0.99 0.064
  070449  0 2 0.00 2.24 0.99 0.064
  070150  0 2 0.00 2.24 0.99 0.064
  070450  0 2 0.00 2.24 0.99 0.064
  070151  0 2 0.00 2.24 0.99 0.064
  070451  0 2 0.00 2.24 0.99 0.064
  070152  0 2 0.00 2.24 0.99 0.064
  070452  0 2 0.00 2.24 0.99 0.064
  070153  0 2 0.00 2.24 0.99 0.064
```

```
  070453  0 2 0.00 2.24 0.99 0.064
  070154  0 2 0.00 2.24 0.99 0.064
  070454  0 2 0.00 2.24 0.99 0.064
  070155  0 2 0.00 2.24 0.99 0.064
  070455  0 2 0.00 2.24 0.99 0.064
  070156  0 2 0.00 2.24 0.99 0.064
  070456  0 2 0.00 2.24 0.99 0.064
  070157  0 2 0.00 2.24 0.99 0.064
  070457  0 2 0.00 2.24 0.99 0.064
  070158  0 2 0.00 2.24 0.99 0.064
  070458  0 2 0.00 2.24 0.99 0.064
  070159  0 2 0.00 2.24 0.99 0.064
  070459  0 2 0.00 2.24 0.99 0.064
  070160  0 2 0.00 2.24 0.99 0.064
  070460  0 2 0.00 2.24 0.99 0.064
  070161  0 2 0.00 2.24 0.99 0.064
  070461  0 2 0.00 2.24 0.99 0.064
  070162  0 2 0.00 2.24 0.99 0.064
  070462  0 2 0.00 2.24 0.99 0.064
  070163  0 2 0.00 2.24 0.99 0.064
  070463  0 2 0.00 2.24 0.99 0.064
  070164  0 2 0.00 2.24 0.99 0.064
  070464  0 2 0.00 2.24 0.99 0.064
  070165  0 2 0.00 2.24 0.99 0.064
  070465  0 2 0.00 2.24 0.99 0.064
  070166  0 2 0.00 2.24 0.99 0.064
  070466  0 2 0.00 2.24 0.99 0.064
  070167  0 2 0.00 2.24 0.99 0.064
  070467  0 2 0.00 2.24 0.99 0.064
  070168  0 2 0.00 2.24 0.99 0.064
  070468  0 2 0.00 2.24 0.99 0.064
  070169  0 2 0.00 2.24 0.99 0.064
  070469  0 2 0.00 2.24 0.99 0.064
  070170  0 2 0.00 2.24 0.99 0.064
  070470  0 2 0.00 2.24 0.99 0.064
  070171  0 2 0.00 2.24 0.99 0.064
  070471  0 2 0.00 2.24 0.99 0.064
  070172  0 2 0.00 2.24 0.99 0.064
  070472  0 2 0.00 2.24 0.99 0.064
  070173  0 2 0.00 2.24 0.99 0.064
  070473  0 2 0.00 2.24 0.99 0.064
  070174  0 2 0.00 2.24 0.99 0.064
  070474  0 2 0.00 2.24 0.99 0.064
  070175  0 2 0.00 2.24 0.99 0.064
  070475  0 2 0.00 2.24 0.99 0.064
  070176  0 2 0.00 2.24 0.99 0.064
  070476  0 2 0.00 2.24 0.99 0.064
  070177  0 2 0.00 2.24 0.99 0.064
  070477  0 2 0.00 2.24 0.99 0.064
  070178  0 2 0.00 2.24 0.99 0.064
  070478  0 2 0.00 2.24 0.99 0.064
  070179  0 2 0.00 2.24 0.99 0.064
  070479  0 2 0.00 2.24 0.99 0.064
  070180  0 2 0.00 2.24 0.99 0.064
  070480  0 2 0.00 2.24 0.99 0.064
  070181  0 2 0.00 2.24 0.99 0.064
  070481  0 2 0.00 2.24 0.99 0.064
  070182  0 2 0.00 2.24 0.99 0.064
  070482  0 2 0.00 2.24 0.99 0.064
  070183  0 2 0.00 2.24 0.99 0.064
  070483  0 2 0.00 2.24 0.99 0.064
      0.        1
    0.00   0.289    0.50
Soil Series: Adamsville sand; Hydrogic Group C
  100.00           0   0   0   0   0   0   0   0   0
```

```
4300.0  0.0012   00.00
     3
     1  10.000   1.440   0.086   0.000   0.000   0.000
       7.96E-4 7.96E-4   0.000
         0.100   0.086   0.036   0.580    32.4
     2  10.000   1.440   0.086   0.000   0.000   0.000
       7.96E-4 7.96E-4   0.000
         1.000   0.086   0.036   0.580    32.4
     3  80.000   1.580   0.030   0.000   0.000   0.000
       7.96E-4 7.96E-4   0.000
         5.000   0.030   0.023   0.116    6.48
     0
          YEAR       5            YEAR       5            YEAR       5   1
     1
     1  _____
     6    YEAR
  PRCP    TCUM   0   0
  RUNF    TCUM   0   0
  ESLS    TCUM   0   0   1.0E3
  RFLX    TCUM   0   0   1.0E5
  EFLX    TCUM   0   0   1.0E5
  RXFX    TCUM   0   0   1.0E5
```

EXAMS Chemical File for Oxyfluorfen

```
1 0 0 0 0 0 0
 361.7     5585.    0.0000
0.0000    0.0000    0.0000    2.0000E-050.0000
 1.160    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
3.8500E-030.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
0.0000    0.0000    0.0000
1.6600E-051.6600E-051.6600E-051.6600E-05
 2.000     2.000     2.000     2.000
2.2100E-052.2100E-052.2100E-052.2100E-05
 2.000     2.000     2.000     2.000
```

APPENDIX C: Detailed Drinking Water Assessment Memo

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

Date: 30 August 2001
Chemical: oxyfluorfen
PC Code: 111601
DP barcode: D277546

Subject: **Oxyfluorfen – Revised Drinking Water Assessment – Apples**

To: Felicia Fort
Jose Morales
Health Effects Division (7509C)

Deanna Scher
Special Review and Reregistration Division (7508C)

From: Amer Al-Mudallal
Norman Birchfield
Environmental Risk Branch 1
Environmental Fate and Effects Division (7507C)

Thru: Kevin Costello, Risk Assessment Process Leader
Dana Spatz, Acting Branch Chief
Environmental Risk Branch 1
Environmental Fate and Effects Division (7507C)

Summary

This is a revised Drinking Water Assessment and replaces the assessment forwarded to you in July where recommended drinking water concentrations were based on the cotton use scenario. Improvements in the PRZM/EXAMS modeling scenario for Oregon apples now result in higher drinking water estimates than were previously communicated.

In the environment, Oxyfluorfen is expected to be very persistent with low mobility. In general oxyfluorfen degrades very slowly in both soil and water and binds strongly to soil. Modeling results generally predict low concentrations in surface and groundwater but when oxyfluorfen reaches water it is likely to persist for long periods.

The proposed surface water-derived drinking water concentrations are:

23.4 μg /L for the 1 in 10 year annual peak concentration (acute)
7.1 μg /L for the 1 in 10 year annual mean concentration (chronic) and
5.7 μg /L for the 36 year annual mean concentration.

These concentrations were derived from modeling oxyfluorfen use on Oregon apples with an application rate of 2.0 lb ai/acre. The recommended estimates changed from the previous Drinking Water Assessment (DP Barcode - D275798) due to improvements in the PRZM/EXAMS scenario for Oregon apples.

The SCI-GROW model concentration estimate of oxyfluorfen in drinking water from shallow groundwater sources is **0.08** μg/L. This concentration can be considered as both the acute and chronic value.

1) Surface Water Modeling

Modeling results are the source of the proposed drinking water concentrations. Three different crop scenarios; citrus in Florida, apples in Oregon, and cotton in Mississippi were chosen to estimate the concentration of oxyfluorfen in surface drinking water. These scenarios were chosen to represent a geographically dispersed range of modeled surface water concentrations in areas representative of where oxyfluorfen is heavily used (west coast states and the Mississippi delta region) or has the potential for heavy use (Florida).

PRZM 3.12/ EXAMS 2.7.97 modeling was performed with index reservoir (IR) scenarios and percent cropped area (PCA) adjustment factors. For a description of the IR/PCA scenarios and the uncertainties associated with them see R.D. Jones et al (March 21, 2000). A default PCA factor of 0.87 was used for citrus and apples because a PCA factor for these crops is not available. PCA factors of 0.20 and 0.87 were applied to cotton model results. The more conservative 0.87 factor was applied to cotton results to account for the possibility of other crops grown within cotton watersheds being treated with oxyfluorfen. A review of use/usage data (Quantitative Usage Analysis from BEAD) suggests that oxyfluorfen use on cotton occurs in areas where uses on other crops (peaches, cabbage, onion, soybeans, citrus, and broccoli) does occur or could potentially occur. EFED recommends that the estimated concentrations of oxyfluorfen derived from the apple scenario with the 0.87 PCA factor be used in the human health risk assessment.

Tables 1 and 2 present the PRZM/EXAMS estimated concentrations of oxyfluorfen in surface drinking water for the three different crop scenarios and the model input parameters:

TABLE 1. TIER 2 CONCENTRATION OF OXYFLUORFEN IN SURFACE WATER USING IR/PCA PRZM/EXAMS SCENARIOS						
Crop Scenario	**Application Rate** (lbs ai/acre)	**Number of Applications**	**PCA Adjustment Factor**	**1/10 Peak Conc.**	**1/10 Yearly Conc.**	**36 Year Annual Mean Conc.**
Citrus (non-bearing)	2.0 lbs ai/acre	2	0.87 (default)	51.6 μg /L	10.4 μg /L	7.4 μg /L
Apples*	2.0 lbs ai/acre	1	0.87 (default)	**23.4 μg /L***	**7.1 μg /L***	**5.7 μg /L***
Cotton	0.5 lbs ai/acre	1	0.87 (default)	13.6 μg /L	5.1 μg /L	3.2 μg /L
Cotton	0.5 lbs ai/acre	1	0.20 (cotton)	3.1 μg /L	1.2 μg /L	0.7 μg /L

* Recommended for use in the human health risk assessment.

Table 2. PRZM/EXAMS INPUT PARAMETERS FOR OXYFLUORFEN			
MODEL PARAMETER	**VALUE**	**COMMENTS**	**SOURCE**
Application Rate	0.5 lbs ai/acre for cotton 2.0 lbs ai/acre for apples and citrus		Label (Goal 2XL EPA Reg. No. 62719-424)
Number of Applications	1 application for cotton and apples 2 applications for citrus		Label (Goal 2XL EPA Reg. No. 62719-424)
Aerobic Soil Metabolism $t_{1/2}$	870.5 days	estimated 90 th upper percentile	MRID #s 92136110, 92136097
Anaerobic Soil Metabolism $t_{1/2}$	653.9 days	estimated 90 th upper percentile	MRID # 92136111
Aerobic Aquatic Degradation Rate (KBACW)	1.66 x10-5 $(cfu/mL)^{-1}$ $hour^{-1}$ ($t_{1/2}$ 1741 days)	half the aerobic soil metabolism degradation rate	MRID #s 92136110, 92136097
Anaerobic Aquatic Degradation Rate (KBACS)	$2.21x10^{-5}$ $(cfu/mL)^{-1}$ $hour^{-1}$ ($t_{1/2}$ 1308 days)	half the anaerobic soil metabolism degradation rate	MRID # 92136111
Aqueous Photolysis $t_{1/2}$	7.5 days		MRID # 42129101
Hydrolysis $t_{1/2}$	Stable		MRID #00096882
K_{OC}	5585 ml/g	Lowest non sand	MRID #s 92136112, 92136099
Molecular Weight	361.7		Product Chemistry
Water Solubility	1.16 mg/l	10 x solubility	Product Chemistry
Vapor Pressure	2.0 E-5 torr		Product Chemistry

Although the modeling results for citrus produce higher results, EFED recommends the apple scenario be used for the drinking water concentration of oxyfluorfen in surface water. The apple IR scenario (adjusted for a default PCA factor of 0.87) produced a 1 in 10 year annual peak concentration (acute) of **23.4** μg /L. The 1 in 10 year annual mean concentration (chronic) was **7.1** μg /L. The 36 year annual mean concentration was **5.7** μg /L. EFED believes the limitation of oxyfluorfen use to non-bearing citrus precludes large portions of watersheds from being treated simultaneously, as is simulated in the model. The term "non-bearing" refers to young trees which are not producing substantial quantities of fruit and is distinct from dormant trees which are not in a fruiting season. It is unlikely that a substantial portion of a watershed would be comprised of non-bearing citrus. Therefore the apple scenario provides a more realistic drinking water concentration.

The citrus, apple and cotton scenarios do not represent the highest registered use rates for oxyfluorfen. Rates for ornamentals, coffee, and cacao are higher than the modeled application rates. Although the highest application rates were not modeled, the proposed drinking water concentration is expected to be conservative because of geographic and usage area considerations discussed below.

The label use rate of granular oxyfluorfen on ornamentals at 8 lbs ai/acre, represents the highest registered use rate. Not having an IR/PCA PRZM/EXAMS scenario for ornamentals, prevented EFED from modeling the highest registered use rate. However, it is not expected that large portions of drinking water watersheds are likely to be comprised of ornamental nurseries receiving oxyfluorfen applications.

Label use rates for coffee (grown in Hawaii and Puerto Rico) at 6 lbs ai/acre exceed the rate allowed for citrus, apples, and cotton. However, other than the Kona region of Hawaii, EFED is not aware of coffee growing areas in the US or its territories that contain watersheds compromised largely of land devoted to coffee agriculture. EFED is not aware of any surface water intakes used for drinking water in the Kona region of Hawaii. The absence of surface water intakes in Kona and the absence of watersheds comprised largely of coffee agriculture suggest that oxyfluorfen use on coffee at present is unlikely to contaminate drinking water at levels greater than the recommended drinking water concentration above.

Label use rates for Cacao at 6 lbs ai/acre, also exceed the rate allowed for citrus, apples, and cotton. However, EFED is not aware of watersheds containing cacao agriculture in the US or its territories.

A recent drinking water assessment (supporting a section 18 request, DP Barcode D252219) estimated lower concentrations for oxyfluorfen in water. The change in concentration is attributed to more realistic scenario parameters for Oregon apples, as well as the use of different model input parameters for the aerobic soil metabolism half-life, anaerobic metabolism half-life, and aqueous photolysis half-life. The water solubility input was also changed but this difference was not expected to affect the results. The input parameters used in this assessment are consistent with EFED's current input selection policies for using an upper percentile input for the aerobic soil metabolism and estimating anaerobic aquatic degradation rate when no data are submitted.

2) Surface Water Monitoring

There are limited surface water monitoring data available for oxyfluorfen. The data are not adequate to perform a quantitative drinking water assessment because: 1) dissolved oxyfluorfen concentrations are most relevant to drinking water concentrations but some data is limited to sediment levels; 2) oxyfluorfen use is widespread but the monitoring data is limited to a few locations; 3) oxyfluorfen application timing is broad and guideline fate data suggest it is likely to be persistent but the monitoring data is temporally limited.

Oxyfluorfen was not analyzed as a standard analyte under the National Water-Quality Assessment (NAWQA) Program of the U.S. Geological Survey (USGS). The USGS did, however, measure oxyfluorfen concentrations in suspended sediment in the San Joaquin River in central California. In addition to the USGS data, some samples have been collected and analyzed for oxyfluorfen in water and sediments in the Columbia River basin of Oregon and Washington. Brief summaries of the results collected are presented below in order to characterize oxyflourfen occurrence in surface waters used to supply drinking water.

USGS: The USGS has conducted monitoring of oxyfluorfen bound to suspended sediment in central California (Bergamaschi et al 1997, Bergamaschi et al 1999). The monitoring data is relevant to drinking water because it was collected in the vicinity of drinking water intakes (such as the intake for Antioch CA), it is collected from the same water bodies used for surface drinking water sources, and is collected downstream of areas where oxyfluorfen is heavily used. The data show frequent detections of oxyfluorfen associated with sediment during several years in the 1990's. Average concentrations of oxyfluorfen associated with suspended sediment at four sites ranged from **1.0** to **27.2 ppb** (Bergamaschi et al 1997). Since sediment is removed from water during the water treatment process, dissolved phase concentrations are more useful for estimating drinking water exposure. If oxyfluorfen partitioning between water and sediment is assumed to be reversible and at equilibrium upon entering the drinking water facility intake, the K_d partitioning coefficient may be used with sediment bound concentrations to estimate how much oxyfluorfen is present in the dissolved phase (see Figure 1).

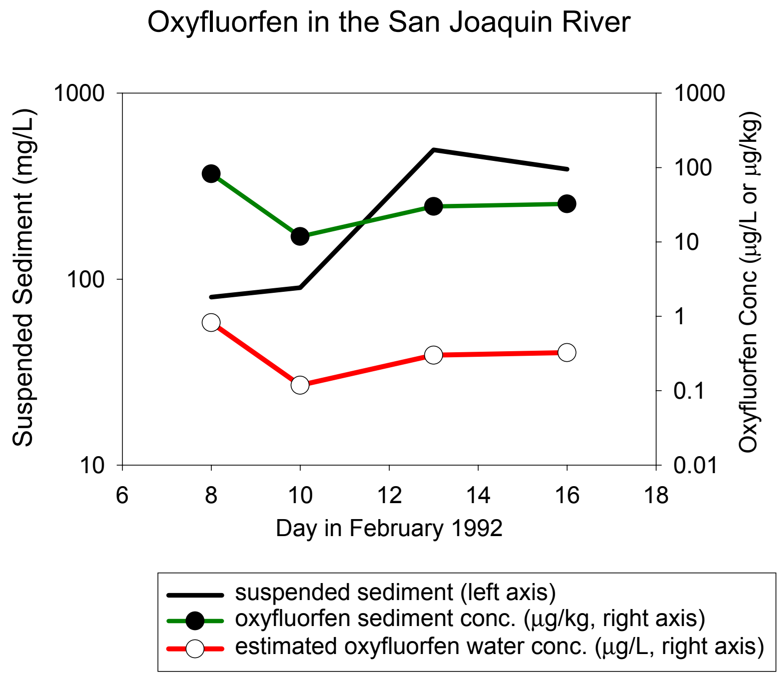

Figure 1. USGS data for sediment levels and sediment associated oxyfluorfen concentrations was graphed and adjusted by the average of three non-sand soil/water partition coefficients, K_d s, from guideline studies to estimate dissolved phase oxyfluorfen concentrations. The average K_d was 100. Inherent in this calculation is the assumption that oxyfluorfen binding is reversible and at equilibrium. Analysis of other pesticides associated with sediment in the same area suggests that dissolved phase concentrations are lower than would be expected based on partition coefficients.

Transit time from fields where sediments were removed and where river sediments were sampled is short. A number of other pesticides measured on sediments were present only at low or undetectable levels, presumably because sediments did not have adequate time to reach equilibrium with water. If dissociation kinetics of sediment bound oxyfluorfen are also slow, the concentrations estimated in Figure 1 are likely higher than those that were actually present.

Columbia River Basin: Fifteen Mile Creek near the Dalles Dam in Oregon was the site of an oxyfluorfen spill (August 24, 2000). A truck carrying formulated oxyfluorfen (Goal 2XL) crashed on a bridge dumping thousands of gallons of herbicide into the creek yards from where the creek enters the Columbia River. Oxyfluorfen measurements were made in water, soil, and sediment in response to the spill. In order to determine background levels of oxyfluorfen in the environment, the spill response team collected several samples in areas that were unaffected by the spill, including upstream in Fifteen Mile Creek, upstream in the Columbia River, and in other creeks feeding into the Columbia River. The samples collected are relevant to drinking water because the Columbia River is used as a drinking water source and significant oxyfluorfen use is understood to occur in the watershed. Most samples collected up and downstream outside the spill site contained undetectable levels (< 0.01 ppb) of oxyfluorfen. Excluding the two weeks immediately following the spill, only 7 of approximately 300 water samples collected in the Columbia contained any detectable levels of oxyfluorfen. The detections were at relatively high levels and were most likely a result of leakage from the spill site. The few water samples collected from nearby rivers contained undetectable levels. Of 35 background sediment measurements made in nearby rivers and streams which were unaffected by the spill, 2 detections of oxyfluorfen in sediment were noted. The highest detection, 541 ppb in Mosier Creek, is downstream of orchards (see Figure 2).

Figure 2. An aerial photograph of orchards on Mosier Creek Oregon near where oxyfluorfen was detected in sediments.

For a further discussion of oxyfluorfen persistence in sediments, see the Environmental Fate section EFED's RED chapter.

3) Ground Water

Oxyfluorfen's capacity to bind strongly to soil reduces its potential to contaminate ground water. There are limited ground water monitoring data readily available for oxyfluorfen. Oxyfluorfen was included in the 1992 *Pesticides in Ground Water Database* (U.S. EPA/EFED/EFGWB). Among 188 wells sampled in the state of Texas between 1987 and 1988, no detections of oxyfluorfen were reported. Because of the limited availability of ground water monitoring data, the SCI-GROW screening model was used to estimate ground water concentrations. The model estimates upper-bound ground water concentrations of pesticides likely to occur when the pesticide is used at the maximum allowable rate in areas where ground water is vulnerable to contamination. Since SCI-GROW, unlike the PRZM/EXAMS surface water models, does not require a specific crop scenario, EFED used the highest use rate of four applications at 2.0 lbs ai/acre as used for ornamentals to estimate the concentration of oxyfluorfen in drinking water from shallow groundwater sources. Table 3 presents the input parameters used in the SCI-GROW model.

Table 3. SCI-GROW Input Parameters			
Model Input Parameters	**Input Value**	**Comments**	**Source**
Aerobic Soil Metabolism $t_{1/2}$	434 days	Average value	MRID #s 92136110, 92136097
K_{OC}	6831	Median value	MRID #s 92136112, 92136099
Application Rate	2.0 lbs ai/acre		Label (Rout Ornamental Herbicide, EPA Reg. No. 58185-27)
Max. Number of Application Per Season	4 applications		Label (Rout Ornamental Herbicide, EPA Reg. No. 58185-27)

The SCI-GROW model estimated the concentration of oxyfluorfen in drinking water from shallow ground water sources to be **0.08** μg/L. This concentration can be considered as both the acute and chronic value.

APPENDIX D: Memo Requesting Phototoxicity Study Protocol for Light-Dependent Peroxidizing Herbicides

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

MEMORANDUM

SUBJECT: Request for Phototoxicity Study Protocol for Light-Dependent Peroxidizing Herbicides

DATE: March 7, 2001

TO: Elizabeth Leovey, Acting Director
Environmental Fate and Effects Division
Office of Pesticide Programs

FROM: Norman B. Birchfield, Ph.D.
Thomas M. Steeger, Ph.D.
Brian Montague
Aquatic Biology Tech Team

The light-dependent peroxidizing herbicides (LDPHs) are a growing class of weed control chemicals (see partial listing attached). They act in plants by inhibiting the enzyme protoporphyrinogen oxidase (protox), which is the last common enzyme in the heme and chlorophyll biosynthetic pathways.[1] Protox exists in both plants and animals and the enzyme from both sources has been shown to be highly sensitive to many LDPHs.[2]

LDPH protox inhibition in plants results in a rapid accumulation of protoporphyrin IX, a phototoxic heme and chlorophyll precursor. In the presence of light, protoporphyrin IX is a powerful generator of singlet oxygen which in plants causes lipid membrane peroxidation leading to a rapid loss of turgidity and foliar burns. LDPH exposure in mammals has been shown to result in excretion of porphyrins in urine (porphynuria) and feces, increased liver weight, elevated blood porphyrin levels, developmental abnormalities, and cancer. Humans with a hereditary protox disorder (variegate porphyria) which results in lowered protox activity

[1] Matringe, M., J.-M. Camadro, P. Labbe, and R. Scalla. 1989. Protoporphyrinogen oxidase as a molecular target for diphenyl ether herbicides. *Biochem. J.* **260**: 231-235.

[2] Birchfield, N.B., and J.E. Casida. 1997. Protoporphyrinogen oxidase of mouse and maize: Target site selectivity and thiol effects on peroxidizing herbicide action. *Pesticide Biochemistry and Physiology* **57**, 36-43.

exhibit many symptoms similar to LDPH exposure in addition to photosensitivity. However, photosensitivity is not a commonly reported symptom of LDPH exposure in animals.

An LDPH-induced occurrence of phototoxicity in rats[3] and increased cytotoxicity to human skin cells grown in culture in the presence of light and an LDPH[4] have been reported but many other LDPH toxicity studies make no mention of phototoxicity in animals. The scarcity of phototoxicity data in animals could result from physiological or biochemical distinctions from plants. For instance, animals exposed to LDPHs may not normally accumulate protoporphyrin IX in their epidermis. However, phototoxicity may not be reported in many LDPH toxicity tests because of relatively low light conditions in laboratories and/or protection afforded by the animals' fur or feathers. Animals without fur or feathers existing in sunny environments would be expected to be at highest risk for potential phototoxic effects.

The Aquatic Biology Tech Team (ABTT) recommends that phototoxicity studies be conducted on herbicides with this mode of action to determine if animals exposed to LDPHs and intense light (similar to sunlight) show increased toxicity relative to controls exposed to LDPHs and low intensity light. The results of these studies will help to determine if animals that are exposed to sunlight in LDPH use areas are at higher risk than guideline toxicity studies suggest.

The ABTT is requesting that a LDPH phototoxicity protocol be submitted for review and agreement by EFED and the registrant prior to study initiation. Protocols for standard toxicity tests have also been published.[5] In nature, fish and other aquatic organisms are expected to be exposed to LDPHs through run-off and spray drift. Aquatic organisms inhabiting small, shallow water bodies, exposed to high levels of solar radiation would be expected to be at greatest risk for potential phototoxic effects. Therefore, the ABTT is requesting a small fish species be used in a phototoxicity assay to assess the potential of light to increase LDPH toxicity.

The ABTT requests that the study adequately address the following issues and suggests the paper, "Photoenhanced Toxicity of a Carbamate Insecticide to Early Life Stage Anuran Amphibians",[5] and other studies in the peer-reviewed scientific literature serve as sources of additional guidance:

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[3]Halling, B.P., D.A. Yuhas, V.F. Fingar, and J.W. Winkleman. 1994. "Protoporphyrinogen oxidase inhibitors for tumor therapy" in *Porphyric Pesticides: Chemistry, Toxicology, and Pharmaceutical Applications*, (S.O. Duke and C.A. Rebeiz, Eds.) pp. 280-290, American Chemical Society Symposium Series 559, Am. Chem. Soc., Washington, D.C., 1994.

[4]Birchfield, N.B. *Protoporphyrinogen Oxidase as a Herbicide Target: Characterization of the [^{3}H]Desmethylflumipropyn Binding Site*. Dissertation. University of California, Berkeley. 1996.

[5]American Society for Testing and Materials. 1994. Standard guide for conducting the frog embryo teratogenesis assay-*Xenopus*. E 1439-91. In *Annual Book of ASTM Standards*, Vol 11.5, pp. 825-835. Philadelphia, PA.

Species
The fathead minnow may be an appropriate test species because of existing toxicity protocols which may be adapted for this study.

Exposure duration
A subchronic exposure duration would be adequate for proof of principle. A single exposure may not allow adequate time for porphyrin accumulation, however, a life-cycle is not necessary to identify a phototoxic effect.

Dosing
A range finding study should be conducted under defined low light conditions to identify an LC_{50} value and lower dose levels expected to be similar to controls. Doses used in the phototoxicity study should not be expected to result in significant mortality in low light controls. Dissolved concentrations of the test chemical should be confirmed by an appropriate analytical method.

Endpoints
Behavioral observations should be made in addition to measurements of mortality, growth, weight, morphology, and appearance. Ideally, measurements of protoporphyrin and heme concentrations in the blood and protox activity in the liver of each test organisms should be made.

Light sources
Artificial light may be preferred to natural light that will vary in different regions and seasons as well as with weather. If artificial light is used, the light should resemble full, natural sunlight as closely as possible, particularly around 400 nm. The most important wavelength for porphyrin induced phototoxicity in ~400 nm. No matter what the light source, the duration and intensity of UV and visible light should be reported at all wavelengths (200-800 nm). At this point EFED does not have a specific recommendation for an artificial light source.

Dark, light, and positive controls
As this study is intended to identify potential effects of light on LDPH toxicity, an appropriate study protocol should include a dark, or low light, control group. Another group not exposed to chemicals but exposed to full light should be included (a full light control). In addition to the dark and light controls, a positive control group using protoporphyrin IX may be useful.

Exposure chambers and light filters
Light intensity should be measured inside test chambers if glass or any other material is placed between the light source and the test animals. Any filters should be cured under the study light for 72-hours prior to study initiation to ensure consistent transmittance.

ATTACHMENT 1.

The following list of herbicides are believed to act by inhibiting protoporphyringen oxidase in the heme and chlorophyll biosynthetic pathway.

acifluorfen
azafenidin
carfentrazone-ethyl
flumiclorac-pentyl
flumioxazin
fluthiacet-methyl
fomesafen
lactofen
oxadiargyl
oxadiazon
oxyfluorfen
sulfentrazone
thidiazimin

APPENDIX E: Ecological Hazard Data

Table E-1: Acute Toxicity of Oxyfluorfen to Fish								
Species	**% A.I.**	**Toxicity endpoint, µg/L (confidence interval)**	**NOEC (µg/L)**	**Measured/ nominal**	**Flow-through /static**	**Toxicity Classification**	**MRID**	**Status**
Freshwater Fish								
Bluegill	71.4	96-hr LC_{50} = 210 (175, 346)	93	measured	static	highly toxic	421298-01	core
Bluegill	94.0	96-hr LC_{50} = 200 (130, 310)	56	nominal	flow-through	highly toxic	95583	core
Rainbow trout	71.4	96-hr LC_{50} = 250 (186, 355)	37	measured	static	highly toxic	421298-02	core
Rainbow trout	94.0	96-hr LC_{50} = 410 (310, 560)	180	nominal	flow-through	highly toxic	95583	core
Channel catfish	74.0	96-hr LC_{50} = 400 (360, 450)	180	nominal	static	highly toxic	96881	core
Estuarine/Marine Fish								
Sheepshead minnow	71.4	96-hr LC_{50} > 170	170	measured	static	highly toxic	416988-01	core

Table E-2: Chronic (Early-Life) Toxicity of Oxyfluorfen to Fish								
Species	**% A.I.**	**NOEC (µg/L)**	**LOEC (µg/L)**	**Measured/ nominal**	**Flow-through /static**	**Affected parameters**	**MRID**	**Status**
Freshwater Fish								
Fathead minnow	71	38	74	measured	flow-through	survival, total length, average weight	921360-57[a]	core

[a] Also reviewed under Acc# 99270.

Table E-3: Acute Toxicity of Oxyfluorfen to Invertebrates								
Species	**% A.I.**	**Toxicity endpoint, μg/L (confidence interval)**	**NOEC (μg/L)**	**Measured/ nominal**	**Flow-through/ static**	**Toxicity Classification**	**MRID**	**Status**
Freshwater Invertebrates								
Daphnia magna	82.2	48-hr LC_{50} = 1500 (750, 2900)	100	nominal	static	moderately toxic	96881	core
Daphnia magna	23.2 (Goal 2XL)	48-hr EC_{50} = 80 (60, 150)	20	measured	flow-through	very highly toxic	452713-01	supplemental
Estuarine/Marine Invertebrates								
Eastern oyster (acute toxicity)	74.0	48-hr LC_{50} > 32	3.2	nominal	static/	very highly toxic	96881	supplemental
Eastern oyster (shell deposition)	71.4	96-hr EC_{50} = 69.3 (62.2, 96.5)	37.5	measured	flow-through	very highly toxic	423789-01	core
Grass shrimp	74.0	96-hr LC_{50} = 32 (18, 56)	18	nominal	static	very highly toxic	309701-17	supplemental
Fiddler crab	74.0	96-hr LC_{50} > 1000 mg/L	<320 mg/L	nominal	static	practically non-toxic	96811	supplemental

Table E-4: Chronic (Life-cycle) Toxicity of Oxyfluorfen to Invertebrates								
Species	**% A.I.**	**NOEC (μg/L)**	**LOEC (μg/L)**	**Measured/ nominal**	**Flow-through /static**	**Affected parameters**	**MRID**	**Status**
Freshwater Invertebrate								
Daphnia magna	71.8	13	28	measured	flow-through	growth (length), reproduction	421423-05	supplemental

Table E-5: Acute Toxicity of Oxyfluorfen to Aquatic Plants						
Species	**% A.I.**	**Toxicity endpoint, μg/L (confidence interval)**	**NOEC (μg/L)**	**Measured/nominal**	**MRID**	**Status**
Selenastrum capricornutum	23.2 (Goal 2XL)	96-hr EC_{50} = 0.29 (0.27, 0.30)	0.1	measured	452713-02	core

Table E-6: Avian Acute Toxicity to Oxyfluorfen						
Species	**% A.I.**	**Toxicity Endpoint**	**NOEC**	**Toxicity Classification**	**MRID**	**Status**
Acute Single Oral Dose						
Bobwhite quail	70.1	LD_{50} > 2150 mg ai/kg-bw	< 1470 mg ai/kg-bw	practically non-toxic	921361-02[a]	core
Acute Dietary [b]						
Bobwhite quail	70.2	LC_{50} > 5000 mg ai/kg-diet	625 mg ai/kg-diet	practically non-toxic	921361-03	core
Mallard duck	70.2	LC_{50} > 5000 mg ai/kg-diet	312 mg ai/kg-diet	practically non-toxic	921361-04	core

[a] Also reviewed under MRID 422559-01.

[b] One bobwhite quail acute dietary study and one mallard duck acute dietary study (conducted in 1976 and reviewed in 1978, both under Acc# 95583) were submitted to the Agency, and both were classified as core. However, upon review of these older studies and of the more recently submitted studies (conducted in 1987 and reviewed in 1993, under MRIDs 921361-03 and 921361-04), EFED determined it was appropriate to base the environmental risk assessment on the more recent studies presented in the table above. See a 1993 summary of ecological effects data (DP Barcode D158920) and a 1994 Section 18 review for use of Goal 1.6E on raspberries to control primocanes in Washington State (DP Barcode D198736).

Table E-7: Avian Chronic Toxicity to Oxyfluorfen						
Species	**% A.I.**	**NOEC (mg ai/kg-diet)**	**LOEC (mg ai/kg-diet)**	**Effects**	**MRID**	**Status**
Bobwhite quail	72.5	< 50	50	reduced wt of 14-day chicks	4153012-06	supplemental
Mallard duck	72.5	100	>100	none observed	4153012-05	supplemental

Table E-8: Mammalian Acute Toxicity to Oxyfluorfen					
Test Type	**% A.I.**	**Toxicity Endpoint**	**Toxicity Classification**	**MRID**	**Status[a]**
Acute Oral	96	LD_{50} > 5000 mg ai/kg-bw	practically non-toxic	447120-10	acceptable
	97.1	LD_{50} > 5000 mg ai/kg-bw	practically non-toxic	448289-03	acceptable

[a] Status (acceptability) based on HEDs guidelines.

Table E-9: Mammalian Subchronic Toxicity to Oxyfluorfen						
Test Type	**% A.I.**	**NOEL (mg ai/kg-diet)**	**LOEL (mg ai/kg-diet)**	**Effects**	**MRID**	**Status[a]**
90-day oral-feeding (rats)	98.0	1500	6000	Decreased body weight, increased urine volume, decreased erythrocyte volume and Hb, increased relative liver wt	449331-01	acceptable
90-day oral-feeding (rats)	72.5	< 800	≤ 800	Increased liver wt, liver histology, adrenal histology	117601	acceptable
90-day oral-feeding (rats)	72.0	200	1000	Brown livers and kidneys, increased relative liver wt, decreased thymus wt, liver and kidney histology	117603	acceptable
90-day oral-feeding (mice)	72.5	< 200	≤ 200	Anemia, increased serum glutamate pyruvate transaminase enzyme, increased liver wt, liver histopathlogy	117602	acceptable

[a] Status (acceptability) based on HEDs guidelines.

Table E-10: Mammalian Developmental and Chronic Toxicity to Oxyfluorfen[a]					
Test Type	**% A.I.**	**NOEL (mg/kg-bw/day)**	**LOEL (mg/kg-bw/day)**	**Effects**	**MRID**
pre-natal developmental toxicity (rats)	98.0	maternal $\geq$ 1000 develop $\geq$ 1000	maternal > 1000 develop > 1000	None observed	449331-03
pre-natal developmental toxicity (rats)	71.4	maternal = 18 develop = 18	maternal = 183 develop = 183	Mat. based on clinical signs. Devel. based on decreased fetal BW, vessel variations, bone deformities	418065-01
pre-natal developmental toxicity (rabbits)	98.0	maternal = 30 develop = 30	maternal = 90 develop = 90	Mat. based on mortality, abortions, clinical signs. Devel. based on increased late resorptions	449331-02
pre-natal developmental toxicity (rabbits)	26.9 (WP formulation)	maternal =10 develop = 30	maternal = 30 develop = 90	Mat. based on decreased BW gain, clinical signs. Devel. based on decreased litter size and increased early resorptions.	94052
2-generation reproductive (rats)	71.4	parental = 400 mg ai/kg-diet repro = 400 mg ai/kg-diet	parental=1600 mg ai/kg-diet repro = 1600 mg ai/kg-diet	Parental based on mortality, decreased BW, liver and kidney histopathology. Repro. based on decreased BW, decreased live pups/litter.	420149-01

[a] Status of all studies listed was acceptable, based on HEDs guidelines.

Table E-11: Toxicity to Oxyfluorfen to Non-target Insects					
Species	**% A.I.**	**Toxicity endpoint**	**Toxicity classification**	**MRID**	**Status**
Honey bee	71.4	LD_{50} > 100 µg/bee	practically non-toxic	423681-01	core
Predaceous mite [*Typhlodromus pyri* Schueten (acari: Phytoseiidae)]	42.09 (Goal 4F)	98% mortality at 1.28 lb ai/acre	non-guideline, no classification assigned	452713-03	supplemental

Table E-12: Toxicity of Oxyfluorfen to Terrestrial Plants (Emergence)[a]				
	Percent Emergence		**Shoot Length**	
	EC_{25} [b] (95% confidence interval)	**NOEC [b]**	**EC_{25} [b] (95% confidence interval)**	**NOEC [b]**
Monocots				
Corn	>0.23	0.23	0.23 (0.032, 6.9)	0.084
Oats	>0.16	0.16	0.011 (0.0049, 0.024)	0.0074
Onion	>0.026	0.026	0.038 (0.0013, 0.010)	0.0024
Ryegrass	>0.026	0.026	0.0058[c]	0.0024
Dicots				
Cabbage	>0.021	0.021	0.0026 (0.0012, 0.0057)	0.0024
Carrot	>0.084	0.084	0.045 (0.0, 0.22)	0.0024
Cucumber	>0.026	0.026	0.015 (0.00027, 0.030)	0.0074
Lettuce	>0.021	0.0074	0.0027 (0.00042, 0.014)	0.0024
Soybean	>2.2	2.2	1.3 (0.22, 13)	0.31
Tomato	>0.31	0.31	0.015 (0.0036, 0.052)	0.012

[a] MRID 416440-01, supplemental.
[b] Units are lbs ai/ac.
[c] Registrant's note - confidence interval could not be determined due to variability in the data set.

Table E-13: Toxicity of Oxyfluorfen to Terrestrial Plants (Vegetative Vigor)[a]						
	Shoot Length		Shoot Weight		Root Weight	
	EC_{25} [b] (95% confidence interval)	NOEC [b]	EC_{25} [b] (95% confidence interval)	NOEC [b]	EC_{25} [b] (95% confidence interval)	NOEC [b]
Monocots						
Corn	0.32 (0.041, 4.1)	0.034	0.095 (0.0084, 0.078)	0.14	0.17 (0.0034, 11)	0.47
Oats	0.016 (0.0039, 0.062)	0.012	0.019 (0.00094, 0.30)	0.061	0.0070 (0.0, 0.67)	0.10
Onion	0.010 (0.0023, 0.021)	0.0071	0.0062 (0.0017, 0.20)	0.0071	>0.014	0.014
Ryegrass	0.015 (0.0068, 0.030)	0.014	0.0087 (0.0, 0.022)	0.0071	0.0093 (0.0, 0.0093)	0.014
Dicots						
Cabbage	>0.0071	0.0037	>0.0071	0.0037	0.022[c]	0.01
Carrot	0.061 (0.0058, 1.1)	0.034	0.027 (0.0012, 0.55)	0.034	>0.12	0.12
Cucumber	0.0026 (0.00059, 0.030)	0.0017	0.0017 (0.0, 0.0058)	0.0017	0.0017[c]	0.0017
Lettuce	0.0045 (0.00038, 0.063)	0.0071	0.0036 (0.00027, 0.047)	0.0071	0.0035 (0.00014, 0.080)	0.014
Soybean	0.029 (0.011, 0.11)	0.0071	0.012 (0.0015, 0.13)	0.0017	0.023 (0.0012, 2.4)	0.034
Tomato	0.00067 (0.00013, 0.0030)	0.00066	0.00043 (0.0, 0.0065)	0.00066	0.00071 (0.0, 0.0046)	0.00066

[a] MRID 416440-01, supplemental.
[b] Units are lbs ai/ac.
[c] Registrant's note - confidence interval could not be determined due to variability in the data set.

APPENDIX F: The Risk Quotient Method

The Risk Quotient Method is the means used by EFED to integrate the results of exposure and ecotoxicity data. For this method, risk quotients (RQs) are calculated by dividing exposure estimates by ecotoxicity values (i.e., RQ = EXPOSURE/TOXICITY), both acute and chronic. These RQs are then compared to OPP's levels of concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action. EFED has defined LOCs for acute risk, potential restricted use classification, and for endangered species.

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 - there is a potential for acute risk; 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.

Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to non-target 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 required studies. Examples of ecotoxicity values derived from 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) LOEL (birds, fish, and aquatic invertebrates), and (2) NOEL (birds, fish and aquatic invertebrates). The NOEL is generally used as the ecotoxicity test value in assessing chronic effects.

Risk presumptions, along with the corresponding RQs and LOCs are summarized in Table D1.

Table F-1: Risk Presumptions and LOCs		
Risk Presumption	**RQ**	**LOC**
Birds[1]		
Acute 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
Wild Mammals[1]		
Acute 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[2]		
Acute Risk	EEC/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/NOEC	1
Terrestrial and Semi-Aquatic Plants		
Acute Risk	EEC/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1
Aquatic Plants[2]		
Acute Risk	EEC/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1

[1] LD_{50}/sqft = (mg/sqft) / (LD_{50} * wt. of animal)
LD_{50}/day = (mg of toxicant consumed/day) / (LD_{50} * wt. of animal)

[2] EEC = (ppm or ppb) in water

APPENDIX G: Detailed Risk Quotients

Table G-1: Aquatic Organism Risk Quotient Calculations							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (µg/L)**	**Chronic Toxicity Threshold, NOEC (µg/L)**	**Peak Water Concentration (µg/L)**	**21-day Average Water Concentration (µg/L)**	**60-day Average Water Concentration (µg/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Citrus - Florida (2 lbs ai/ac/app, 2 ground app., 07/01/xx and 07/31/xx)							
Freshwater Fish[c]	200	38	49.76		26.75	0.25**	0.70
Freshwater Invert.	80	13	49.76	31.51		0.62***	2.42+
Estuarine Invert.	32	--	49.76	31.51		1.56***	–[d]
Citrus - Florida (1.2 lbs ai/ac/app, 3 ground app., 04/01/xx, 08/01/xx, and 12/01/xx)							
Freshwater Fish	200	38	40.04		19.79	0.20**	0.52
Freshwater Invert.	80	13	40.04	25.52		0.50***	1.96+
Estuarine Invert.	32	--	40.04	25.52		1.25***	--
Citrus - Florida (0.8 lbs ai/ac/app, 3 ground app., 04/01/xx, 08/01/xx, and 12/01/xx)							
Freshwater Fish	200	38	26.89		13.30	0.13**	0.35
Freshwater Invert.	80	13	26.89	17.14		0.34**	1.32+
Estuarine Invert.	32	--	26.89	17.14		0.84***	–
Apples - Oregon (2 lbs ai/ac/app, 1 ground app., 01/07/xx)							
Freshwater Fish	200	38	8.07		3.90	0.04	0.10
Freshwater Invert.	80	13	8.07	4.96		0.10*	0.38
Estuarine Invert.	32	--	8.07	4.96		0.25**	--
Apples - Oregon (1 lbs ai/ac/app, 1 ground app., 01/07/xx)							

Table G-1: Aquatic Organism Risk Quotient Calculations							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (µg/L)**	**Chronic Toxicity Threshold, NOEC (µg/L)**	**Peak Water Concentration (µg/L)**	**21-day Average Water Concentration (µg/L)**	**60-day Average Water Concentration (µg/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Freshwater Fish	200	38	4.04		1.95	0.02	0.05
Freshwater Invert.	80	13	4.04	2.48		0.05*	0.19
Estuarine Invert.	32	--	4.04	2.48		0.13**	--
Grapes - New York (2 lbs ai/ac/app, 1 ground app., 01/07/xx)							
Freshwater Fish	200	38	19.60		12.41	0.10**	0.33
Freshwater Invert.	80	13	19.60	14.49		0.25**	1.11+
Estuarine Invert.	32	--	19.60	14.49		0.61***	--
Grapes - New York (0.9 lbs ai/ac/app, 1 ground app., 01/07/xx)							
Freshwater Fish	200	38	8.82		5.58	0.04	0.15
Freshwater Invert.	80	13	8.82	6.52		0.11**	0.50
Estuarine Invert.	32	--	8.82	6.52		0.28**	--
Walnut - California (2 lbs ai/ac/app, 1 ground app., 01/07/xx)							
Freshwater Fish	200	38	12.97		4.26	0.06*	0.11
Freshwater Invert.	80	13	12.97	10.66		0.16**	0.82
Estuarine Invert.	32	--	12.97	10.66		0.41**	--
Walnut - California (0.8 lbs ai/ac/app, 1 ground app., 01/07/xx)							
Freshwater Fish	200	38	5.19		3.88	0.03	0.10

Table G-1: Aquatic Organism Risk Quotient Calculations							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (μg/L)**	**Chronic Toxicity Threshold, NOEC (μg/L)**	**Peak Water Concentration (μg/L)**	**21-day Average Water Concentration (μg/L)**	**60-day Average Water Concentration (μg/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Freshwater Invert.	80	13	5.19	4.26		0.06*	0.33
Estuarine Invert.	32	--	5.19	4.26		0.16**	--
Cotton - Mississippi (0.5 lbs ai/ac/app, 1 aerial app., 01/07/xx)							
Freshwater Fish	200	38	4.85		3.30	0.02	0.09
Freshwater Invert.	80	13	4.85	3.81		0.06*	0.29
Estuarine Invert.	32	--	4.85	3.81		0.15**	--
Cotton - Mississippi (0.5 lbs ai/ac/app, 1 ground app., 01/07/xx)							
Freshwater Fish	200	38	4.44		3.20	0.02	0.08
Freshwater Invert.	80	13	4.44	3.54		0.06*	0.27
Estuarine Invert.	32	--	4.44	3.54		0.14**	--
Cole crops - California (0.5 lbs ai/ac/app, 1 aerial app., 01/07/xx)							
Freshwater Fish	200	38	3.15		1.48	0.02	0.04
Freshwater Invert.	80	13	3.15	1.98		0.04	0.15
Estuarine Invert.	32	--	3.15	1.98		0.10**	--
Cole crops - California (0.25 lbs ai/ac/app, 1 aerial app., 01/07/xx)							
Freshwater Fish	200	38	1.58		0.74	0.01	0.02
Freshwater Invert.	80	13	1.58	0.99		0.02	0.08

Table G-1: Aquatic Organism Risk Quotient Calculations							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (µg/L)**	**Chronic Toxicity Threshold, NOEC (µg/L)**	**Peak Water Concentration (µg/L)**	**21-day Average Water Concentration (µg/L)**	**60-day Average Water Concentration (µg/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Estuarine Invert.	32	--	1.58	0.99		0.05*	--
Cole crops - California (0.25 lbs ai/ac/app, 1 ground app., 01/07/xx)							
Freshwater Fish	200	38	1.33		0.59	0.01	0.02
Freshwater Invert.	80	13	1.33	0.78		0.02	0.06
Estuarine Invert.	32	--	1.33	0.78		0.04	--

[a] * indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

[b] + indicates an exceedence of Chronic LOC.

[c] Based on the available data, acute toxicity of oxyfluorfen to freshwater fish is assumed to be similar to the acute toxicity of oxyfluorfen to estuarine/marine fish.

[d] No chronic studies submitted for estuarine fish or invertebrates.

Table G-2: Aquatic Plant Risk Quotient Calculations [a]				
Scenario	**EC_{50} (µg/L)**	**NOEC (µg/L)**	**Peak Water Concentration (µg/L)**	**Acute Risk RQ**
Citrus - Florida (2 lbs ai/ac/app, 2 ground app., 07/01/xx and 07/31/xx)				
Freshwater algae	0.29	0.10	49.76	171.59
Citrus - Florida (1.2 lbs ai/ac/app, 3 ground app., 04/01/xx, 08/01/xx, and 12/01/xx)				
Freshwater algae	0.29	0.10	40.04	138.07
Citrus - Florida (0.8 lbs ai/ac/app, 3 ground app., 04/01/xx, 08/01/xx, and 12/01/xx)				
Freshwater algae	0.29	0.10	26.89	92.72
Apples - Oregon (2 lbs ai/ac/app, 1 ground app., 01/07/xx)				
Freshwater algae	0.29	0.10	8.23	28.38
Apples - Oregon (1 lbs ai/ac/app, 1 ground app., 01/07/xx)				
Freshwater algae	0.29	0.10	4.12	14.21
Grapes - New York (2 lbs ai/ac/app, 1 ground app., 01/07/xx)				
Freshwater algae	0.29	0.10	19.60	67.59
Grapes - New York (0.9 lbs ai/ac/app, 1 ground app., 01/07/xx)				
Freshwater algae	0.29	0.10	8.82	30.41
Walnut - California (2 lbs ai/ac/app, 1 ground app., 01/07/xx)				
Freshwater algae	0.29	0.10	12.97	44.72
Walnut - California (0.8 lbs ai/ac/app, 1 ground app., 01/07/xx)				
Freshwater algae	0.29	0.10	5.19	17.90
Cotton - Mississippi (0.5 lbs ai/ac/app, 1 aerial app., 01/07/xx)				
Freshwater algae	0.29	0.10	4.85	16.72
Cotton - Mississippi (0.5 lbs ai/ac/app, 1 ground app., 01/07/xx)				
Freshwater algae	0.29	0.10	4.44	15.31
Cole crops - California (0.5 lbs ai/ac/app, 1 aerial app., 01/07/xx)				
Freshwater algae	0.29	0.10	3.15	10.86
Cole crops - California (0.25 lbs ai/ac/app, 1 aerial app., 01/07/xx)				
Freshwater algae	0.29	0.10	1.58	5.45
Cole crops - California (0.25 lbs ai/ac/app, 1 ground app., 01/07/xx)				
Freshwater algae	0.29	0.10	1.33	4.59

[a]Exceedence of Acute Risk LOC for all scenarios.

Table G-3: Avian Chronic Risk Quotient Calculations for Spray Applications [a]						
Scenario	Acute Toxicity Threshold, LC_{50} (mg/kg-diet)	Chronic Toxicity Threshold, NOEC (mg/kg-diet)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
			EEC (mg/kg-diet)	Chronic RQ [b]	EEC (mg/kg-diet)	Chronic RQ [b]
Citrus - Florida (2 lbs ai/ac/app, 2 app., ground, 30 day interval)						
Short grass	>5000	<50	745	>14.9+	264	>5.3+
Tall grass	>5000	<50	341	>6.8+	112	>2.2+
Broadleaf forage, small insects	>5000	<50	419	>8.4+	140	>2.8+
Fruit, pods, seeds, large insects	>5000	<50	47	>0.9	22	>0.4
Citrus - Florida (1.2 lbs ai/ac/app, 3 app., ground, 120 day interval)						
Short grass	>5000	<50	317	>6.3+	112	>2.2+
Tall grass	>5000	<50	145	>2.9+	48	>1.0+
Broadleaf forage, small insects	>5000	<50	178	>3.6+	59	>1.2+
Fruit, pods, seeds, large insects	>5000	<50	20	>0.4	9	>0.2
Citrus - Florida (0.8 lbs ai/ac/app, 3 app., ground, 120 day interval)						
Short grass	>5000	<50	211	>4.2+	78	>1.6+
Tall grass	>5000	<50	97	>1.9+	36	>0.7
Broadleaf forage, small insects	>5000	<50	119	>2.4+	44	>0.9
Fruit, pods, seeds, large insects	>5000	<50	13	>0.3	5	>0.1
Apples - Oregon, Walnut - California, Grapes - New York (2 lbs ai/ac/app, 1 app., ground)						
Short grass	>5000	<50	480	>9.6+	170	>3.4+
Tall grass	>5000	<50	220	>4.4+	72	>1.4+
Broadleaf forage, small insects	>5000	<50	270	>5.4+	90	>1.8+
Fruit, pods, seeds, large insects	>5000	<50	30	>0.6	14	>0.3
Grapes - New York (0.9 lbs ai/ac/app, 1 app., ground)						
Short grass	>5000	<50	216	>4.3+	77	>1.5+
Tall grass	>5000	<50	99	>2.0+	32	>0.6
Broadleaf forage, small insects	>5000	<50	122	>2.4+	41	>0.8
Fruit, pods, seeds, large insects	>5000	<50	13.5	>0.3	6	>0.1
Apples - Oregon (1 lbs ai/ac/app, 1 app., ground)						
Short grass	>5000	<50	240	>4.8+	85	>1.7+

Table G-3: Avian Chronic Risk Quotient Calculations for Spray Applications [a]						
Scenario	**Acute Toxicity Threshold, LC_{50} (mg/kg-diet)**	**Chronic Toxicity Threshold, NOEC (mg/kg-diet)**	**Predicted Maximum Residue Levels**		**Predicted Mean Residue Levels**	
			EEC (mg/kg-diet)	**Chronic RQ [b]**	**EEC (mg/kg-diet)**	**Chronic RQ [b]**
Tall grass	>5000	<50	110	>2.2+	36	>0.7
Broadleaf forage, small insects	>5000	<50	135	>2.7+	45	>0.9
Fruit, pods, seeds, large insects	>5000	<50	15	>0.3	7	>0.2
Walnut - California (0.8 lbs ai/ac/app, 1 app., ground)						
Short grass	>5000	<50	192	>3.8+	68	>1.4+
Tall grass	>5000	<50	88	>1.8+	29	>0.6
Broadleaf forage, small insects	>5000	<50	108	>2.2+	36	>0.7
Fruit, pods, seeds, large insects	>5000	<50	12	>0.2	6	>0.1
Cotton - Mississippi, Cole crops - California (0.5 lbs ai/ac/app, 1 app., ground or aerial)						
Short grass	>5000	<50	120	>2.4+	43	>0.9
Tall grass	>5000	<50	55	>1.1+	18	>0.4
Broadleaf forage, small insects	>5000	<50	68	>1.4+	23	>0.5
Fruit, pods, seeds, large insects	>5000	<50	8	>0.2	4	>0.08
Cole crops - California (0.25 lbs ai/ac/app, 1 app., ground or aerial)						
Short grass	>5000	<50	60	>1.2+	22	>0.4
Tall grass	>5000	<50	28	>0.6	9	>0.2
Broadleaf forage, small insects	>5000	<50	34	>0.7	12	>0.2
Fruit, pods, seeds, large insects	>5000	<50	4	>0.1	2	>0.04

[a] RQs were not calculated to evaluate the potential acute risks (i.e., Acute Endangered, Acute Restricted Use, and Acute Risk) to birds because of a high, unquantified LC_{50} (>5000 mg/kg-diet). Minimal acute risk is assumed with currently labeled application rates.
[b] + indicates an exceedence of Chronic LOC.

Table G-4: Herbivorous/Insectivorous Mammal Chronic Risk Quotient Calculations for Spray Applications [a]						
Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Chronic Toxicity Threshold, NOEC (mg/kg-diet)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
			EEC (mg/kg-diet)	Chronic RQ [b]	EEC (mg/kg-diet)	Chronic RQ [b]
Citrus - Florida (2 lbs ai/ac/app, 2 app., ground, 30 day interval)						
Short grass	>5000	400	745	1.86+	264	0.66
Broadleaf forage, small insects	>5000	400	419	1.05+	140	0.35
Citrus - Florida (1.2 lbs ai/ac/app, 3 app., ground, 120 day interval)						
Short grass	>5000	400	317	0.79	112	0.28
Broadleaf forage, small insects	>5000	400	178	0.45	59	0.15
Citrus - Florida (0.8 lbs ai/ac/app, 3 app., ground, 120 day interval)						
Short grass	>5000	400	211	0.53	78	0.20
Broadleaf forage, small insects	>5000	400	119	0.30	44	0.11
Apples - Oregon, Walnut - California, Grapes - New York (2 lbs ai/ac/app, 1 app., ground)						
Short grass	>5000	400	480	1.20+	170	0.43
Broadleaf forage, small insects	>5000	400	270	0.68	90	0.23
Grapes - New York (0.9 lbs ai/ac/app, 1 app., ground)						
Short grass	>5000	400	216	0.60	77	0.19
Broadleaf forage, small insects	>5000	400	122	0.31	41	0.10
Apples - Oregon (1 lbs ai/ac/app, 1 app., ground)						
Short grass	>5000	400	240	0.60	85	0.21
Broadleaf forage, small insects	>5000	400	135	0.34	45	0.11
Walnut - California (0.8 lbs ai/ac/app, 1 app., ground)						
Short grass	>5000	400	192	0.48	68	0.17
Broadleaf forage, small insects	>5000	400	108	0.27	36	0.09
Cotton - Mississippi, Cole crops - California (0.5 lbs ai/ac/app, 1 app., ground or aerial)						
Short grass	>5000	400	120	0.30	43	0.11
Broadleaf forage, small insects	>5000	400	68	0.17	23	0.06
Cole crops - California (0.25 lbs ai/ac/app, 1 app., ground or aerial)						
Short grass	>5000	400	60	0.15	22	0.06

Table G-4: Herbivorous/Insectivorous Mammal Chronic Risk Quotient Calculations for Spray Applications [a]						
Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Chronic Toxicity Threshold, NOEC (mg/kg-diet)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
			EEC (mg/kg-diet)	Chronic RQ [b]	EEC (mg/kg-diet)	Chronic RQ [b]
Broadleaf forage, small insects	>5000	400	34	0.09	12	0.03

[a] RQs were not calculated to evaluate the potential acute risks (i.e., Acute Endangered, Acute Restricted Use, and Acute Risk) to mammals because of a high, unquantified LD_{50} (>5000 mg/kg-bodyweight). Minimal acute risk is assumed with currently labeled application rates.
[b] + indicates an exceedence of Chronic LOC.

Table G-5: Granivorious Mammal Chronic Risk Quotient Calculations for Spray Applications [a]						
Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Chronic Toxicity Threshold, NOEC (mg/kg-diet)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
			EEC (mg/kg-diet)	Chronic RQ [b]	EEC (mg/kg-diet)	Chronic RQ [b]
Citrus - Florida (2 lbs ai/ac/app, 2 app., ground, 30 day interval)						
Seeds	5000	400	47	0.12	55	0.14
Citrus - Florida (1.2 lbs ai/ac/app, 3 app., ground, 120 day interval)						
Seeds	5000	400	20	0.05	9	0.02
Citrus - Florida (0.8 lbs ai/ac/app, 3 app., ground, 120 day interval)						
Seeds	5000	400	13	0.03	5	0.01
Apples - Oregon, Walnut - California, Grapes - New York (2 lbs ai/ac/app, 1 app., ground)						
Seeds	5000	400	30	0.08	14	0.04
Grapes - New York (0.9 lbs ai/ac/app, 1 app., ground)						
Seeds	5000	400	13.5	0.03	6	0.02
Apples - Oregon (1 lbs ai/ac/app, 1 app., ground)						
Seeds	5000	400	15	0.04	7	0.02
Walnuts - California (0.8 lbs ai/ac/app, 1 app., ground)						
Seeds	5000	400	12	0.03	6	0.02
Cotton - Mississippi, Cole crops - California (0.5 lbs ai/ac/app, 1 app., ground or aerial)						
Seeds	5000	400	8	0.02	4	0.01
Cole crops - California (0.25 lbs ai/ac/app, 1 app., ground or aerial)						
Seeds	5000	400	4	0.01	2	0.01

[a] RQs were not calculated to evaluate the potential acute risks (i.e., Acute Endangered, Acute Restricted Use, and Acute Risk) to mammals because of a high, unquantified LD_{50} (>5000 mg/kg-bodyweight). Minimal acute risk is assumed with currently labeled application rates.
[b] + indicates an exceedence of Chronic LOC.

Table G-6: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (lb ai/ac)	RQ[a]
Citrus - Florida (2 lbs ai/ac/app, 2 app., ground)								
Seed Emerg.	Monocot	0.0058		0.08	13.79*		0.44	75.86*
	Dicot	0.0026		0.08	30.77*		0.44	169.23*
Veg Vigor	Monocot	0.007	0.04		5.71*	0.04		5.71*
	Dicot	0.00043	0.04		93.02*	0.04		93.02*
Citrus - Florida (1.2 lbs ai/ac/app, 3 app., ground)								
Seed Emerg.	Monocot	0.0058		0.07	12.07*		0.40	68.97*
	Dicot	0.0026		0.07	26.92*		0.40	153.85*
Veg Vigor	Monocot	0.007	0.04		5.71*	0.04		5.71*
	Dicot	0.00043	0.04		93.02*	0.04		93.02*
Citrus - Florida (0.8 lbs ai/ac/app, 3 app., ground)								
Seed Emerg.	Monocot	0.0058		0.05	8.62*		0.26	44.83*
	Dicot	0.0026		0.05	19.23*		0.26	100.00*
Veg Vigor	Monocot	0.007	0.02		2.86*	0.02		2.86*
	Dicot	0.00043	0.02		46.51*	0.02		46.51*
Apples - Oregon, Walnut - California, Grapes - New York (2 lbs ai/ac/app, 1 app., ground)								
Seed Emerg.	Monocot	0.0058		0.04	6.90*		0.22	37.93*

Table G-6: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (lb ai/ac)	RQ[a]
	Dicot	0.0026		0.04	15.38*		0.22	84.62*
Veg Vigor	Monocot	0.007	0.02		2.86*	0.02		2.86*
	Dicot	0.00043	0.02		46.51*	0.02		46.51*
Grapes - New York (0.9 lbs ai/ac/app, 1 app., ground)								
Seed Emerg.	Monocot	0.0058		0.02	3.45*		0.11	18.97*
	Dicot	0.0026		0.02	7.69*		0.11	42.31*
Veg Vigor	Monocot	0.007	0.01		1.43*	0.01		1.43*
	Dicot	0.00043	0.01		23.26*	0.01		23.26*
Apples - Oregon (1 lbs ai/ac/app, 1 app., ground)								
Seed Emerg.	Monocot	0.0058		0.02	3.45*		0.099	17.07*
	Dicot	0.0026		0.02	7.69*		0.099	38.08*
Veg Vigor	Monocot	0.007	0.009		1.29*	0.009		1.29*
	Dicot	0.00043	0.009		20.93*	0.009		20.93*
Walnut - California (0.8 lbs ai/ac/app, 1 app., ground)								
Seed Emerg.	Monocot	0.0058		0.02	3.45*		0.088	15.17*
	Dicot	0.0026		0.02	7.69*		0.088	33.85*
Veg Vigor	Monocot	0.007	0.008		1.14*	0.008		1.14*

Table G-6: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (lb ai/ac)	RQ[a]
	Dicot	0.00043	0.008		18.60*	0.008		18.60*
Cotton - Mississippi, Cole crops - California (0.5 lbs ai/ac/app, 1 app., aerial)								
Seed Emerg.	Monocot	0.0058		0.028	4.83*		0.055	9.48*
	Dicot	0.0026		0.028	10.77*		0.055	21.15*
Veg Vigor	Monocot	0.007	0.025		3.57*	0.025		3.57*
	Dicot	0.00043	0.025		58.14*	0.025		58.14*
Cotton - Mississippi (0.5 lbs ai/ac/app, 1 app., ground)								
Seed Emerg.	Monocot	0.0058		0.01	1.72*		0.055	9.48*
	Dicot	0.0026		0.01	3.85*		0.055	21.15*
Veg Vigor	Monocot	0.007	0.005		0.71	0.005		0.71
	Dicot	0.00043	0.005		11.63*	0.005		11.63*
Cole crops - California (0.25 lbs ai/ac/app, 1 app., aerial)								
Seed Emerg.	Monocot	0.0058		0.014	2.41*		0.028	4.83*
	Dicot	0.0026		0.014	5.38*		0.028	10.77*
Veg Vigor	Monocot	0.007	0.013		1.86*	0.013		1.86*
	Dicot	0.00043	0.013		30.23*	0.013		30.23*
Cole crops - California (0.25 lbs ai/ac/app, 1 app., ground)								

Table G-6: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading (lb ai/ac)**	**RQ[a]**	**Total Drift (lb ai/ac)**	**Total Loading (lb ai/ac)**	**RQ[a]**
Seed Emerg.	Monocot	0.0058		0.005	0.86		0.028	4.83*
	Dicot	0.0026		0.005	1.92*		0.028	10.77*
Veg Vigor	Monocot	0.007	0.003		0.43	0.003		0.43
	Dicot	0.00043	0.003		6.98*	0.003		6.98*

[a] * indicates an exceedence of Acute Risk LOC.

Table G-7: Acute Endangered Terrestrial Plant Risk Quotient Calculations

Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
			Total Drift (lb ai/ac)	Total Loading (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (lb ai/ac)	RQ[a]
Citrus - Florida (2 lbs ai/ac/app, 2 app., ground)								
Seed Emerg.	Monocot	0.0024		0.08	33.33*		0.44	183.33*
	Dicot	0.0024		0.08	33.33*		0.44	183.33*
Veg Vigor	Monocot	0.0071	0.04		5.63*	0.04		5.63*
	Dicot	0.00066	0.04		60.61*	0.04		60.61*
Citrus - Florida (1.2 lbs ai/ac/app, 3 app., ground)								
Seed Emerg.	Monocot	0.0024		0.07	29.17*		0.40	166.67*
	Dicot	0.0024		0.07	29.17*		0.40	166.67*
Veg Vigor	Monocot	0.0071	0.04		5.63*	0.04		5.63*
	Dicot	0.00066	0.04		60.61*	0.04		60.61*
Citrus - Florida (0.8 lbs ai/ac/app, 3 app., ground)								
Seed Emerg.	Monocot	0.0024		0.05	20.83*		0.26	108.33*
	Dicot	0.0024		0.05	20.83*		0.26	108.33*
Veg Vigor	Monocot	0.0071	0.02		2.82*	0.02		2.82*
	Dicot	0.00066	0.02		30.30*	0.02		30.30*
Apples - Oregon, Walnut - California, Grapes - New York (2 lbs ai/ac/app, 1 app., ground)								
Seed Emerg.	Monocot	0.0024		0.04	16.67*		0.22	91.67*

Table G-7: Acute Endangered Terrestrial Plant Risk Quotient Calculations								
		Toxicity Threshold, NOEC (lb ai/ac)	Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario			**Total Drift (lb ai/ac)**	**Total Loading (lb ai/ac)**	**RQ[a]**	**Total Drift (lb ai/ac)**	**Total Loading (lb ai/ac)**	**RQ[a]**
	Dicot	0.0024		0.04	16.67*		0.22	91.67*
Veg Vigor	Monocot	0.0071	0.02		2.82*	0.02		2.82*
	Dicot	0.00066	0.02		30.30*	0.02		30.30*
Grapes - New York (0.9 lbs ai/ac/app, 1 app., ground)								
Seed Emerg.	Monocot	0.0024		0.02	7.50*		0.11	41.25*
	Dicot	0.0024		0.02	7.50*		0.11	41.25*
Veg Vigor	Monocot	0.0071	0.01		1.27*	0.01		1.27*
	Dicot	0.00066	0.01		13.64*	0.01		13.64*
Apples - Oregon (1 lbs ai/ac/app, 1 app., ground)								
Seed Emerg.	Monocot	0.0024		0.02	8.33*		0.11	45.83*
	Dicot	0.0024		0.02	8.33*		0.11	45.83*
Veg Vigor	Monocot	0.0071	0.01		1.41*	0.01		1.41*
	Dicot	0.00066	0.01		15.15*	0.01		15.15*
Walnut - California (0.8 lbs ai/ac/app, 1 app., ground)								
Seed Emerg.	Monocot	0.0024		0.02	8.33*		0.088	36.67*
	Dicot	0.0024		0.02	8.33*		0.088	36.67*
Veg Vigor	Monocot	0.0071	0.008		1.13*	0.008		1.13*

Table G-7: Acute Endangered Terrestrial Plant Risk Quotient Calculations								
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
			Total Drift (lb ai/ac)	Total Loading (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (lb ai/ac)	RQ[a]
	Dicot	0.00066	0.008		12.12*	0.008		12.12*
Cotton - Mississippi, Cole crops - California (0.5 lbs ai/ac/app, 1 app., aerial)								
Seed Emerg.	Monocot	0.0024		0.028	11.67*		0.055	22.92*
	Dicot	0.0024		0.028	11.67*		0.055	22.92*
Veg Vigor	Monocot	0.0071	0.025		3.52*	0.025		3.52*
	Dicot	0.00066	0.025		37.88*	0.025		37.88*
Cotton - Mississippi (0.5 lbs ai/ac/app, 1 app., ground)								
Seed Emerg.	Monocot	0.0024		0.01	4.17*		0.055	22.92*
	Dicot	0.0024		0.01	4.17*		0.055	22.92*
Veg Vigor	Monocot	0.0071	0.005		0.70	0.005		0.70
	Dicot	0.00066	0.005		7.58*	0.005		7.58*
Cole crops - California (0.25 lbs ai/ac/app, 1 app., aerial)								
Seed Emerg.	Monocot	0.0024		0.014	5.83*		0.028	11.67*
	Dicot	0.0024		0.014	5.83*		0.028	11.67*
Veg Vigor	Monocot	0.0071	0.013		1.83*	0.013		1.83*
	Dicot	0.00066	0.013		19.70*	0.013		19.70*
Cole crops - California (0.25 lbs ai/ac/app, 1 app., ground)								

Table G-7: Acute Endangered Terrestrial Plant Risk Quotient Calculations								
Scenario		**Toxicity Threshold, NOEC (lb ai/ac)**	**Plants Adjacent to Treated Sites**			**Plants in Semi-aquatic Areas**		
			Total Drift (lb ai/ac)	**Total Loading (lb ai/ac)**	**RQ[a]**	**Total Drift (lb ai/ac)**	**Total Loading (lb ai/ac)**	**RQ[a]**
Seed Emerg.	Monocot	0.0024		0.005	2.08*		0.028	11.67*
	Dicot	0.0024		0.005	2.08*		0.028	11.67*
Veg Vigor	Monocot	0.0071	0.003		0.42	0.003		0.42
	Dicot	0.00066	0.003		4.55*	0.003		4.55*

[a] * indicates exceedence of Acute Endangered Species LOC.

APPENDIX H: Status of Fate and Ecological Effects Data Requirements for Oxyfluorfen

Table H-1: Environmental Fate Data Requirements for Oxyfluorfen					
Guideline #		Data Requirement	Is Data Requirement Satisfied?	MRID #'s	Study Classification
161-1	835.2120	Hydrolysis	yes	96882	acceptable
161-2	835.2240	Photodegradation in Water	yes	421423-07 421291-01	supplemental supplemental
161-3	835.2410	Photodegradation on Soil	yes	419999-01	acceptable
161-4	835.2370	Photodegradation in Air			
162-1	835.4100	Aerobic Soil Metabolism	yes	421423-09	acceptable
162-2	835.4200	Anaerobic Soil Metabolism	yes	421423-10	supplemental
162-3	835.4400	Anaerobic Aquatic Metabolism			
162-4	835.4300	Aerobic Aquatic Metabolism			
163-1	835.1240 835.1230	Leaching-Adsorption/Desorption	yes	94336 421423-11	supplemental supplemental
163-2	835.1410	Laboratory Volatility			
163-3	835.8100	Field Volatility			
164-1	835.6100	Terrestrial Field Dissipation	yes	438401-01	supplemental
164-2	835.6200	Aquatic Field Dissipation			
164-3	835.6300	Forestry Dissipation			
164-4	835.6400	Combination Products and Tank Mixes Dissipation			
165-4	850.1730	Accumulation in Fish	yes	96883	supplemental
165-5	850.1950	Accumulation- aquatic non-target			
166-1	835.7100	Ground Water- small prospective			
201-1	840.1100	Droplet Size Spectrum	waived [a]		
202-1	840.1200	Drift Field Evaluation	yes	144894	supplemental

[a] Member of Spray-Drift Task Force.

Table H-2: Ecological Effects Data Requirements for Oxyfluorfen					
Guideline #		Data Requirement	Is Data Requirement Satisfied?	MRID #'s	Study Classification
71-1	850.2100	Avian Oral LD_{50}	yes	921361-02[a]	core
71-2	850.2200	Avian Dietary LC_{50}	yes	921361-03 921361-04	core core
71-4	850.2300	Avian Reproduction	no	4153012-06 4153012-05	supplemental supplemental
72-1	850.1075	Freshwater Fish LC_{50}	yes	421298-01 95583 421298-02 95583 96881	core core core core core
72-2	850.1010	Freshwater Invertebrate Acute LC_{50}	yes	96881 452713-01 98881	core supplemental see footnote b
72-3(a)	850.1075	Estuarine/Marine Fish LC_{50}	yes	416988-01	core
72-3(b)	850.1025	Estuarine/Marine Mollusk EC_{50}	yes	96881 423789-01	supplemental core
72-3(c)	850.1035 850.1045	Estuarine/Marine Shrimp EC_{50}	no[c]	309701-17	supplemental
72-4(a)	850.1400	Freshwater Fish Early Life-Stage	yes	921360-57[d]	core
72-4(b)	850.1300 850.1350	Aquatic Invertebrate Life-Cycle	no	921361-06[e]	supplemental
72-5	850.1500	Freshwater Fish Full Life-Cycle	reserved		
122-1(a)	850.4100	Seed Germ./Seedling Emergence	not required		
122-1(b)	850.4150	Vegetative Vigor	not required		
122-2	850.4400	Aquatic Plant Growth	not required		
123-1(a)	850.4225	Seed Germ./Seedling Emergence	no	416440-01	supplemental
123-1(b)	850.4250	Vegetative Vigor	no	416440-01	supplemental
123-2	850.4400	Aquatic Plant Growth	no	452713-02[f]	core
141-1	850.3020	Honey Bee Acute Contact LD_{50}	yes	423681-01	core
141-2	850.3030	Honey Bee Residue on Foliage	not required		

[a] Also reviewed under MRID 422559-01.

[b] The acute toxicity of oxyfluorfen to the freshwater clam was evaluated in this study, and it was initially classified as supplemental in 1979. Upon recent review of the study, its classification was changed to invalid due to the high test concentrations used (much greater than the level of solubility); and a film on the surface and a precipitate were noted in the original study summary.

Since nominal test concentrations were used to calculate the LC_{50}, the actual concentrations of oxyfluorfen in the test water were unknown; therefore, tested exposure levels were unknown.
[c] No additional data are required since core studies are provided for Guidelines 72-3(a) and 72-3(b).
[d] Also reviewed under Accession # 99270.
[e] Also reviewed under MRID 421423-05. May be upgraded to core if raw data are submitted to the Agency and review is satisfactory.
[f] In this study, toxicity of Goal 2XL to *Selenastrum capricornutum* was examined. Toxicity studies for *Anabaena flos-aquae*, *Navicula pelliculosa*, *Skeletonema costatum*, and *Lemna gibba* are also required for this Guideline to be fulfilled.