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OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

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D315450
PC Code: 128849

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SUBJECT: Transmittal of the Environmental Fate and Effects Division's (EFED) Section 3 Ecological Risk Assessment of Hexythiazox Registered for New Uses on Grapes, Citrus, and Indoor Greenhouse Use on Tomatoes, and Addition of an Emulsifiable Concentrate Formulation for Use on Apples

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Executive Summary

EFED has completed a review of an Section 3 request for new uses of hexythiazox on citrus, grapes, indoor nursery use on tomatoes, and the addition of an emulsifiable concentrate formulation for use on apples. Hexythiazox (5-(4-chlorophenyl)-N-cyclohexyl-4-methyl-2-oxo-3-thiazolidenecarboxamide (DPX-Y5893) is an insecticide currently registered for controls of mites on stone fruits, caneberries, tree nuts, pome fruits, Christmas trees, non-bearing trees & vines, strawberries, cotton, hops, mint, ornamental landscape plantings, orchids, and alfalfa. The proposed new use for citrus and grapes is for ground spray application in the field at a maximum single application per year at a rate of 0.1875 lb a.i./acre. Hexythiazox is also proposed for an emulsifiable concentrate formulation by aerial

application on apples at a one time application rate of 0.1875 lbs a.i./acre which is the same as the currently registered wettable powder formulation. Finally, hexythiazox is also proposed for an indoor greenhouse use on tomatoes at 0.1875 lbs a.i./acre. The proposed use of hexythiazox in greenhouses is considered an indoors use and, thus, exposure to non-target organisms is limited and not considered in this assessment.

Based on all available data and the expected exposures due to the new uses cited above, EFED does not believe that Hexythiazox poses an acute risk to freshwater fish and invertebrates, birds and mammals and does not pose a chronic risk to freshwater invertebrates and mammals. However, EFED is unable to assess the potential risk to freshwater fish on a chronic basis, estuarine/marine fish and invertebrates on either an acute or chronic basis, or birds on a chronic basis due to lack of data and therefore cannot conclude that potential risk to these taxa (and the taxa which they are surrogates) does not exist. Also, EFED cannot evaluate the potential risk to aquatic and terrestrial plants because of a lack of toxicity data for these taxa. Currently, these data are not required for insecticides, however, EFED notes that the proposed revisions to 40 CFR Part 158 data requirements include plant testing and therefore, these data should be considered for future testing.

The following data gaps are identified and should be considered for submission in order to address the uncertainties identified in this and all previous risk assessments for hexythiazox.

- freshwater fish early life-stage study (72-4(a))
- freshwater fish full life-cycle study (72-5)
- avian reproduction (71-4)
- estuarine/marine fish LC_{50} study (72-3(a))
- estuarine/marine mollusk LC_{50} study (72-3(b))
- estuarine/marine shrimp LC_{50} study (72-3(c))
- estuarine/marine fish full life-cycle study (72-5)
- estuarine/marine invertebrate life-cycle study (72-4(b))
- aquatic vascular plant study (122-2)
- aquatic non-vascular plant study (123-2)
- Tier I terrestrial plant studies (122-1(a) & 122-1(b))

In particular, because hexythiazox is an ovicide, reproduction studies including the chronic freshwater fish studies and the avian reproduction study should be submitted to determine whether chronic effects associated with hexythiazox use are significant. Since hexythiazox can be used on a wide variety of crops (both existing uses and the proposed new uses evaluated in this assessment) EFED believes that the potential for exposure to estuarine/marine organisms is likely and therefore estuarine/marine ecotoxocity testing is needed. Finally, because hexythiazox is an insecticide, EFED does not currently require plant testing. However, current proposed revisions to EFED's data requirements will change this requirement and consideration should be given to conducting these studies. Until such time as these data become available, EFED cannot assess the potential risk to plants.

Introduction

Based on the available environmental fate data, degradation of hexythiazox would be expected to occur primarily through microbial-mediated metabolism under aerobic conditions and by photolysis in water and on soils. Hexythiazox was stable to hydrolysis at pH 5, 7, and 9. Aerobic soil metabolism half-life values were 29.2 and 34.8 days @ 15°C and 16.8 and 20.5 days @ 25°C for a sandy loam and clay loam, respectively. The reported aqueous photolysis half-life was about 17 days and the soil photolysis half-life value 116 days. Hexythiazox K_{oc} values of 2589, 3234, 5747 and 13,621 in clay loam, sandy loam, silt loam, and sand are reported. In summary, in aerobic environments, parent hexythiazox is a relatively immobile compound with a moderately short degradation half life.

In addition, as part of the process for assessing potential risk to human health the Health Effects Division (HED) of the Office of Pesticide Programs (OPP) has determined that six of the identified environmental fate degradates are of toxicological concern. These degradates are listed below.

- 5-(4-chlorophenyl)-4-methyl-2-oxo-3-thiazolidenecarboxamide (**PT-1-2**)
- 5-(4-chlorophenyl)-4-methyl-2-thiazolidenone (**PT-1-3**)
- 5-(4-chlorophenyl)-N-(3-hydroxycylohexyl)-4-methyl-2-oxo-3-thiazolidenecarboxamide (**PT-1-4**)
- 5-(4-chlorophenyl)-4-methyl-2-oxo-N-(3-oxocyclohexyl)-3-thiazolidenecarboxamide (**PT-1-5**)
- 5-(4-chlorophenyl)-N-(4-hydroxycyclohexyl)-4-methyl-2-oxo-3-thiazolidenecarboxamide (**PT-1-8**)
- 5-(4-chlorophenyl)-4-methyl-2-oxo-N-(4-oxocyclohexyl)-3-thiazolidenecarboxamide (**PT-1-9**)

No environmental fate or ecotoxicity data has been submitted for any of these degradates. In order to address the potential for risk to non-target organisms, EFED has completed this assessment for both the parent only and the total residues of hexythiazox. The total residue approach entails revisiting each relevant environmental fate study (hydrolysis, aqueous photolysis, aerobic soil metabolism, etc..) and summing the parent and degradates identified above which are present in each study at each time interval. The summed parent plus degradates concentration (or percent applied) is used to recalculate the rate constant and half life for each study. The total residue half lives are then used within PRZM/EXAMS in accordance with EFED's current guidance for establishing model inputs. Where no study is available and the total residue approach was considered inappropriate for estimating model inputs the value was assumed to be equivalent to the parent value. For example, the solubility of the total residue was assumed to be equivalent to the solubility of hexythiazox.

Environmental Risk

Based on the environmental fate and ecological effects, EFED does not expect the proposed uses of hexythiazox to present a risk to non-target species with available data. However, EFED cannot evaluate the potential acute and chronic risk to estuarine organisms as well as risk to aquatic plants and terrestrial plants, and chronic risks to freshwater fish and birds due to a lack of data.

Risks to fish and aquatic invertebrates are expected to be minimal from the proposed applications. Hexythiazox is highly toxic to fish (LC50 = 0.53 ppm, bluegill sunfish) and aquatic invertebrates (EC50 = 0.74 ppm, daphnid), but the peak aquatic EEC is not expected to exceed 1.24 ppb.

Based on the lowest acute toxicity values and an estimated aquatic EEC of 1.24 ppb, the acute RQ for the bluegill sunfish RQ < 0.001 (1.24 ppb/530 ppb). The aquatic invertebrate (daphnid) RQ < 0.001 (1.24 ppb/742 ppb). These RQ values are well below the LOC for aquatic organisms.

Because of the low application rate (0.1875 lb ai/acre/year), maximum estimated environmental concentrations (EECs) on potential bird and mammal food items (vegetation, insects) are not expected to exceed 45 ppm.

Minimal risks to terrestrial organisms are expected. Hexythiazox is practically nontoxic to birds. The bobwhite acute LD50 is >5,000 ppm while the mallard and bobwhite LC50's were >5,000 ppm and >2,510 ppm, respectively. No avian reproduction studies were reviewed.

Hexythizaox is also practically nontoxic to small mammals (LD50 >5000 mg/kg, NOAEL ≥ 2400 mg/kg/day laboratory rat, acute and two generation), and beneficial insects (honey bee topical LD50 >200 µg/bee; LC50 >1000 ppm for honey bees exposed to treated filter paper).

There have been no reported incidents involving Hexythiazox and there is minimal risk to endangered and threatened species where acceptable data is available. However, there are significant gaps in the ecotoxicity data for hexythiazox. Because EFED does not have ecotoxicity data for any required estuarine/marine organisms (either acute or chronic studies), aquatic plants, terrestrial plants, and chronic data for freshwater fish or birds EFED cannot rule out that hexythiazox presents a potential risk to endangered species covered by these taxa. A summary of EFED's method of calculation risk quotients and the level of concern approach are described in more detail in **Appendix A**.

Problem Formulation

Registration is being requested for the use of hexythiazox on 1) citrus, 2) grapes, 3) apples for an emulsifiable concentrate formulation (wettable powder is already registered), and 4) greenhouse use on tomatoes. All proposed uses of hexythiazox are at a maximum seasonal rate of 0.1875 lb a.i./A applied in a single application. Based on several previous risk assessments (DP Barcode: D278719, D304296, and D261985) conducted using application rates equal to the proposed uses, hexythiazox was not expected to present a risk to non-target organisms, including endangered species.

Assessment Endpoints

The assessment endpoints of this ecological risk assessment include terrestrial and aquatic animal and plant mortality following acute exposure to hexythiazox and terrestrial and aquatic animal reproduction, growth, and survival effects from chronic exposure to hexythiazox. The valued entities are terrestrial and aquatic vertebrates and invertebrates and aquatic vascular and nonvascular plants. The attributes used to gauge the effects of hexythiazox on the valued entities are acute mortality and chronic reproductive, growth, and survival effects. The most sensitive toxicity endpoints are used from surrogate test species to estimate treatment-related direct effects on acute mortality and chronic reproductive, growth, and survival assessment endpoints.

The risk assessment does not take into account atmospheric transport in estimating environmental concentrations, nor does it account for ingestion of hexythiazox residues by animals in drinking water or contaminated grit, ingestion through preening activities, or uptake through inhalation or dermal absorption by terrestrial animals. Exposure to terrestrial animals is based primarily on dietary consumption of foliar residues while aquatic assessments assume that all potential routes of direct exposure are accounted for.

Since application to greenhouse tomatoes is expected to occur indoors (as opposed to applications in shadehouses), feed items for terrestrial animals are not expected to be exposed; thus, risk to terrestrial animals is not expected to occur via this use. The Agency does not anticipate contamination of surface water sources through run-off or spray drift from this proposed use. The potential for aquatic exposure to hexythiazox depends instead on the methods by which excess irrigation water is disposed from the greenhouse. There is a potential for surface-water contamination from greenhouses which direct excess irrigation water to nearby soil or holding ponds.

The Agency's environmental transport models PRZM and EXAMS do not simulate this type of point source drainage. Therefore, the Agency cannot estimate the concentrations to which aquatic animals might be exposed. It is not clear how common this exposure scenario might be. However, if waste-water containing hexythiazox is not released to the outside of greenhouses, exposure and risk to aquatic organisms would not be expected.

Conceptual Model

The conceptual model used to depict the potential ecological risk associated with hexythiazox is fairly generic and assumes that hexythiazox is capable of affecting terrestrial and aquatic animals provided environmental concentrations are sufficiently elevated as a result of proposed label uses (**Figure 1**). Previous risk assessments did not find risk to any non-target organisms at application rates equal to the proposed rates. However, EFED has revised risk assessment methods since the original risk assessment was conducted to the point that an updated risk assessment is appropriate. For example, dose-based acute risk quotients (RQs) are calculated for birds and mammals and dose-based chronic RQs are calculated for mammals in the current risk assessment. In the previous risk assessments, only dietary-based RQs were calculated.

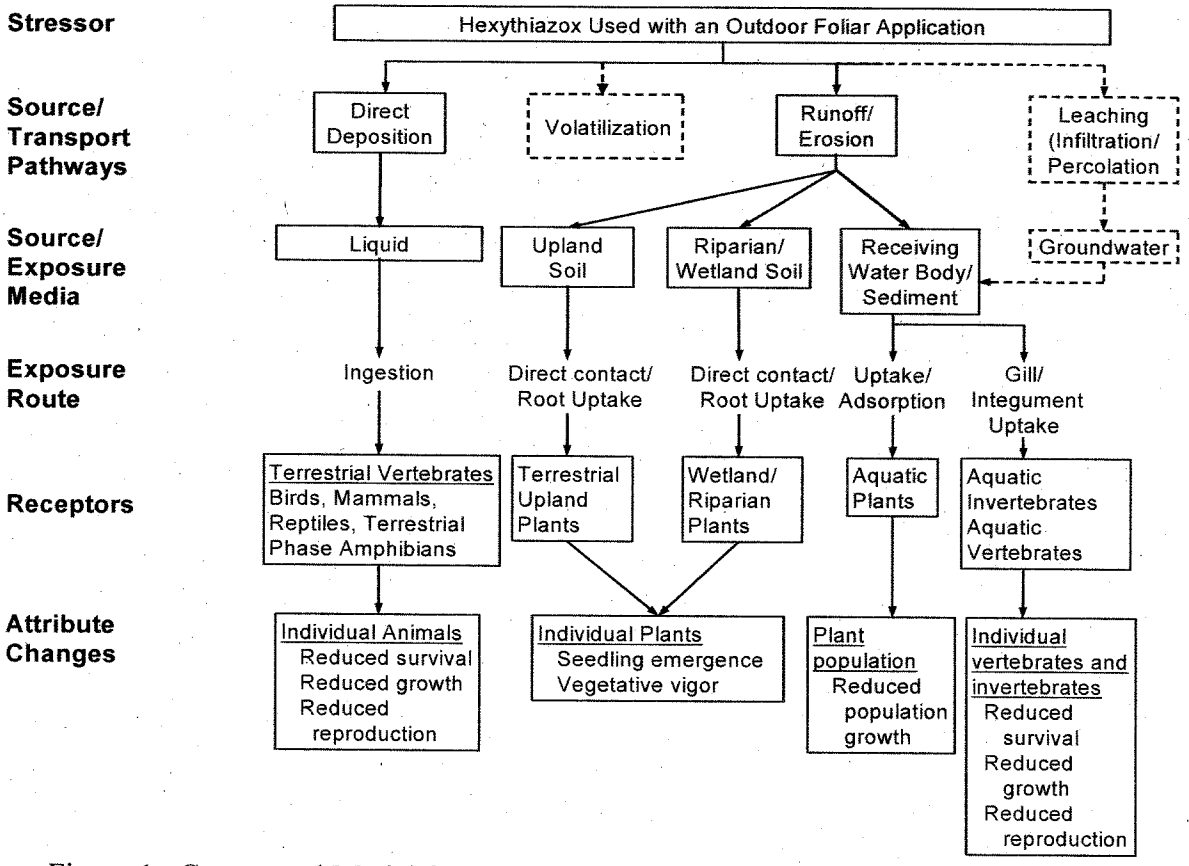

Figure 1. Conceptual Model for Outdoor Use of Hexythiazox on Citrus, Grapes, and Apples Considered in this Risk Assessment

Analysis Plan

In the following sections, the use, environmental fate, and ecological effects of hexythiazox are characterized and, using a risk quotient (ratio of exposure concentration to effects concentration) approach, the likelihood of adverse effects on non-target terrestrial and aquatic animals are estimated. Although risk, in the context intended here, is often defined as the likelihood and magnitude of adverse ecological effects, the risk quotient-based approach does not provide a quantitative estimate of likelihood and/or magnitude of an adverse effect. Such estimates may be possible through a more refined, probabilistic assessment; however, it is beyond the scope of this screening-level assessment.

In order to evaluate the potential effects hexythiazox's use may pose to non-target animals and plants, this assessment characterizes the environmental fate of hexythiazox to determine whether proposed label uses provide a means of exposure. Additionally, the toxicity of hexythiazox is characterized, then both potential exposure and effects are integrated to provide an estimate whether there is a likelihood of adverse effects (risk) to non-target endangered/threatened and non-endangered animals and plants that could potentially impact the registration decision of hexythiazox under the Federal Insecticide, Fungicide and Rodenticide Act, the Food Quality Protection Act and the Endangered Species Act.

Measures of Exposure

Maximum application rates for all of the proposed new uses of hexythiazox are selected for modeling environmental concentrations for this screening-level deterministic (risk quotient-based) assessment. Measures of exposure are derived using screening level models. This assessment will rely on Tier II aquatic exposure estimates using PRZM/EXAMS and input parameters derived from registrant-submitted environmental fate laboratory studies. Terrestrial exposure will be estimated using T-REX version 1.1. This assessment however, is not intended to represent a site or time-specific analysis, i.e., assessments are intended to represent a national-level exposure as opposed to being a regionally specific exposure assessment.

Measures of Effect

Measures of effects are obtained from a suite of registrant-submitted guideline studies conducted with a limited number of surrogate species. The test species are not intended to be representative of the most sensitive species but rather were selected based on their ability to thrive under laboratory conditions. Acute measures of effect are the concentrations that produce 50% mortality or growth reduction in the test organisms (LC50s and EC50s, respectively). The measure of effect for terrestrial plants is the EC25. Chronic effects endpoints are the lowest test concentration where there is no observed adverse effect (NOAECs) on survival, growth or reproduction

Introduction

Mode of Action

Hexythiazox (5-(4-chlorophenyl)-N-cyclohexyl-4-methyl-2-oxo-3-thiazolidenecarboxamide (DPX-Y5893) is an insecticide used for controls of mites (CAS No.: 78587-05-0)]. Specifically, hexythiazox is a ovicide whose mode of action is unknown but is used for the control of mite growth through activity on eggs or early stages of development.

Use Characterization

Hexythiazox is proposed for use as an insecticide on citrus, grapes, apples, and tomatoes (greenhouse use only). The maximum application rate for all proposed uses is specified in **Table 1**.

Table 1 Summary of Hexythiazox Registered Use Information

Crop/Site	Maximum Application Rate	Application Method	Maximum No. of Applications	Yearly Maximum Rate
Citrus	0.1875	ground	1	NA
Grapes	0.1875	ground	1	NA
Apples	0.1875	aerial	1	NA
Tomatoes	0.1875	ground	1	NA

Exposure Characterization

Environmental Fate and Transport Characterization

In aqueous solutions hexythiazox is hydrolytically stable and is moderately persistent when exposed to light. The predicted environmental photolytic half-life, derived from the measured sterile buffer solution half-life was calculated to be 16.6 days. Photolytic degradation on soil surfaces does not significantly contribute to the dissipation of hexythiazox in the environment because with a soil photolysis half life of 116 days. Hexythiazox is considered non-persistent in terrestrial systems. In aerobic soil systems hexythiazox undergoes moderate metabolism with subsequent irreversible binding to the soil matrix and eventual mineralization with half lives ranging from 8 to 25 days depending on soil type. Under laboratory anaerobic aquatic conditions (no aerobic aquatic data were available), a whole system half life was reported to be 120 days. Under field conditions, hexythiazox degraded with reported half lives of 5 to 26 days.

Several degradates were identified under both phtolytic and aerobic degradation. Degradates PT-1-2, PT-1-3, PT-1-4, PT-1-5, PT-1-8, and PT-1-9 were generally found in greater quantities in the aerobic soil metabolism studies with only PT-1-3 reported a values less than 10% of applied (PT-1-4 and PT-1-8 were reported together as were PT-1-5 and PT-1-9).

Batch equilibrium studies for hexythiazox resulted in K_d values of 15.8, 30.0, 31.9, and 63.3 and with corresponding K_{oc} values of 2589, 3234, 5747, and 13621. Finally, hexythiazox has a bioconcentration factors (BCF) of 300-510x in muscle, 550-750x in remaining carcass, 1000-1600 in whole fish, and 12900-17500 in viscera. The BCF factor for viscera suggests a potential for bioaccumulation which could indicate a potential for impacts on higher trophic level species which rely on fish for food. However, the fact that the whole fish BCF is lower and the log Kow of this compound is less than 3 suggests that the likelihood of trophic level effects is low.

Taking into account the results of the laboratory fate and field dissipation studies, it does not appear hexythiazox will leach in the environment, though it may be transported to surface water through erosion of soil particles containing bound hexythiazox.

Table 2 summarizes the physico-chemical properties of hexythiazox. For further details on the environmental fate of hexythiazox, please refer to the risk assessment for the original registration of hexythiazox dated 4/15/99 (DP Barcode: D244921).

Table 2 Summary of Environmental Chemistry and Fate Properties of Hexythiazox

Parameter	Value	Reference/Comments
	Selected Physical/Chemical Parameters	
PC code	128849	
CAS No.	78587-05-0	
Physical state	White Powder, Crystalline Solid	http://pmep.cce.cornell.edu/
Odor	Odorless	http://pmep.cce.cornell.edu/
Chemical name	*rel*-(4*R*,5*R*)-5-(4-chlorophenyl)-*N*-cyclohexyl-4-methyl-2-oxo-3-thiazolidinecarboxamide (DPX-Y5893)	
Chemical formula	$C_{17}H_{21}ClN_2O_2S$	MRID 44006301
Molecular weight	352.5	MRID 44006301
Water solubility	120 ug/l	MRID 44006301

Table 2 Summary of Environmental Chemistry and Fate Properties of Hexythiazox

Parameter	Value	Reference/Comments
Solubilities	3.9 g/l in hexane 20.6 g/l in methanol 28.6 g/l in acetonitrile 160 g/l in acetone 362 g/l in xylene 1379 g/l in chloroform	MRID 44006301
Vapor pressure (25 °C)	1 x 10^{-8} mmHg at 20°C	Procuct Chemistry
Henry's Law Constant	3.87 x 10^{-8} m^3 atm g/mol	calculated
Kow	478 - 659	MRID 00143533
log K_{ow}	2.68 - 2.82	calculated
	Persistence	
Hydrolysis $t_{1/2}$		
pH 5 pH 7 pH 9	stable stable stable	MRID 453501028
Photolysis $t_{1/2}$ in water	16.6 days	MRID 460082013
Photolysis $t_{1/2}$ on soil	116 days	MRID
Soil metabolism aerobic $t_{1/2}$ 24–25 °C	8 to 25 days	MRID 453501027
Soil metabolism anaerobic $t_{1/2}$	NA	NA
Aquatic metabolism aerobic $t_{1/2}$	NA	NA
Aquatic metabolism anaerobic $t_{1/2}$	120 days	MRID 00146542
	Mobility/Adsorption-Desorption	
Batch equilibrium – unaged	Soil Type Kd Koc	
	clay loam 2,589	MRID 460082018
	sandy loam 3234	MRID 460082018
	silt loam 5747	MRID 460082018

Table 2 Summary of Environmental Chemistry and Fate Properties of Hexythiazox			
Parameter	**Value**		**Reference/Comments**
	sand	13,621	MRID 460082018
Laboratory volatility	NA		NA
	Field Dissipation		
Terrestrial field dissipation	5 to 26 days		MRID 00146545
Aquatic field dissipation	NA		NA
	Bioaccumulation		
Accumulation in fish, maximum BCF	300-510x in muscle 550-750x in remaining carcass 1000-1600 in whole fish 12900-17500 in viscera 95-97% depuration in 14 days		MRID 00152899

Measures of Aquatic Exposure

This section provides a synthesized interpretation of all available data related to aquatic exposure, including modeling, monitoring, field studies, and geographic information system analysis.

Aquatic Exposure Modeling

To estimate concentrations of hexythiazox in surface water or groundwater, modeling was used in the absence of surface water or groundwater monitoring data. Previously, EFED has conducted several Tier I drinking water assessments using Sci-Grow for groundwater, and GENECC and FIRST for surface water. In this case, the Registration Division (RD) of OPP has requested an assessment of the potential ecological risks due to proposed use of hexythiazox on citrus, grapes, a greenhouse use on tomatoes, and the addition of an emulsifiable concentrate formulation (a wettable powder is already registered). As noted above, previous modeling was performed using EFED's Tier I models. However, higher tierred modeling was completed for the drinking water assessment for the human health risk assessment and in order to remain consistent with this approach Tier II modeling has been conducted for this ecological risk assessment.

Surface water concentrations were estimated using the Tier II model PRZM version 3.12/ EXAMS version 2.98.04. A total of 6 scenarios were modeled for hexythiazox use based on individual EFED standard surface water scenarios. The scenarios modeled were citrus in

California, grapes in New York and California, and apples in North Carolina, Oregon and Pennsylvania. The scenarios selected for use in this assessment were chosen to estimate the concentration of hexythiazox in surface water over a geographically dispersed range of areas representative of crops proposed for this new hexythiazox use. The scenarios chosen for this assessment represent all available PRZM/EXAMS scenarios for the proposed use of hexythiazox being evaluated in this risk assessment, including the several which were developed specifically for the cumulative OP assessment. The scenarios developed for the cumulative OP assessment were developed in order to represent the maximum use area for the OP's and may not necessarily represent the most vulnerable setting for a particular crop. However, EFED believes that for this particular assessment the use of this OP scenario, in conjunction with selected standard scenarios, provide a reasonable representation of the potential hexythiazox use pattern. Hexythiazox may be applied by aerial or ground equipment depending on the use. In this assessment, apple scenarios were modeled with aerial application which results in the highest amount of spray drift, while the grape and citrus uses were modeled using ground application spray drift values.

The Interregional Research Project Number 4 (IR-4) has submitted a petition requesting registration of hexythiazox for use on greenhouse-grown tomatoes (D313192). Since application to greenhouse tomatoes would occur indoors (as opposed to applications in shade houses), EFED does not anticipate contamination of surface water sources through run-off or spray drift from this proposed use. The potential for aquatic exposure to hexythiazox depends instead on the methods by which excess irrigation water is disposed from the greenhouse. There is a potential for surface-water contamination from greenhouses when excess irrigation water is discharged directly to nearby soil or holding ponds. EFED's environmental transport models PRZM and EXAMS do not simulate this type of point source drainage. Therefore, EFED cannot estimate the concentrations to which aquatic organisms might be exposed and it is not clear how common this exposure scenario might be. However, if waste-water containing hexythiazox is not released to the outside of greenhouses, exposure via surface water and groundwater would not be expected.

Input parameters used in Tier II surface water modeling (PRZM/EXAMS) were selected using EFED guidance ("*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides*" dated February 28, 2002 with an interim update dated November 11, 2004).

Estimated exposure concentrations (EECs) for hexythiazox in surface water are presented in **Table 3**, while model inputs are presented in **Table 4**. Representative copies of PRZM/EXAMS model input and output files are presented in **Appendix B.**

Table 3 Tier II Concentrations of Hexythiazox in Surface Water Using PRZM/EXAMS Scenarios						
Crop	**Application Rate per Acre lbs/acre (label #)**	**# of Applications (intervals)**	**First Application**	**1/10 Peak Annual (ug/l)**	**21-Day Average (ug/l)**	**60-Day Average (ug/l)**
CA citrus	0.1875	1 by ground	June 1	0.13	0.12	0.09
NY grapes	0.1875	1 by ground	June 1	1.42	1.34	1.18
CA grapes	0.1875	1 by ground	June 1	0.12	0.11	0.08
OR apples	0.1875	1 by aerial application	July 1	0.71	0.65	0.50
NC apples	0.1875	1 by aerial application	June 1	1.70	1.56	1.16
PA apples	0.1875	1 by aerial application	June 1	1.64	1.53	1.24

Table 4. PRZM/EXAMS Input Parameters for Hexythiazox for Ecological Exposure Assessment			
Model Parameter	**Value**	**Comments**	**Source**
Application Information	see Table 1		Product Labels
Spray Drift by Scenario	aerial - 5% ground - 1%	Default Assumption[1]	
Aerobic Soil Metabolism $t_{½}$	40.55 days	90th percent upper bound @ 15°C	MRID 453501027
Anaerobic Soil Metabolism $t_{½}$	NA		
Aerobic Aquatic Degradation $t_{½}$ (KBACW)	81.10 days	2 times 40.55 days	
Anaerobic Aquatic Degradation $t_{½}$ (KBACS)	240 days	2 times 120 days	
Aqueous Photolysis $t_{½}$	16.6 days		MRID 460082013
Hydrolysis $t_{½}$	stable		MRID 453501028
Kd/Koc	2589 ml/g	lowest non-sand Koc due to >3 x variation in all Koc values	MRID 460082018
Molecular Weight	352.5 g/mole		MRID 44006301
Foliar Extraction (FEXTR)	0.5	Default Value	
Foliar Decay Rate	NA	Default Value	
Water Solubility	1.2 mg/l	10 times value of 0.12 ppm	MRID 44006301
Vapor Pressure	1 x 10^{-8} mm Hg @ 25 °C		MRID 44006301

1- From "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides*" dated February 28, 2002.

In order to further evaluate the importance of spray drift on potential exposures (and hence risk) EFED remodeled all the total residue scenarios assuming that no spray drift would occur. This provides a maximum estimate of the importance of spray drift and provides useful information for the evaluation of the utility of applying spray drift and runoff buffers. As with the previous assessment, EFED remodeled all scenarios and set the spray drift fraction to 0%. This essentially provides an estimate of the amount of exposure resulting exclusively from runoff. For the modeled scenarios the EECs were reduced from the no-drift values (**Table 3**) by as much as 75% for the California grape scenario to as little as 7% for the New York grape scenario. These no-drift EECs are presented in **Table 5.** This analysis suggests that implementation of spray drift buffers can be important for reducing aquatic exposure to hexythiazox depending on the intended use site and geographic location.

Table 5 Tier II Concentrations of Parent Hexythiazox in Surface Water Using PRZM/EXAMS Scenarios Assuming No Spray Drift

Crop	Application Rate per Acre lbs/acre (label #)	# of Applications (intervals)	First Application	1/10 Peak Annual (ug/l)	21-Day Average (ug/l)	60-Day Average (ug/l)
CA citrus	0.1875	1 by ground	June 1	0.08	0.07	0.05
NY grapes	0.1875	1 by ground	June 1	1.32	1.24	1.10
CA grapes	0.1875	1 by ground	June 1	0.03	0.03	0.02
OR apples	0.1875	1 by aerial application	July 1	0.17	0.16	0.13
NC apples	0.1875	1 by aerial application	June 1	1.22	1.11	0.83
PA apples	0.1875	1 by aerial application	June 1	1.37	1.28	1.01

Modeling Assessment for Total Residues of Hexythiazox

HED has determined, based on structural similarity to hexythiazox, that six environmental fate degradates are of toxicological concern for human health. These degradates are identified in **Table 6**. EFED does not currently have ecotoxicity data for any of these data and therefore, in order to remain consistent with this assessment EFED has conducted modeling of the total residues of hexythiazox. Although no ecotoxicity data are available for these degradates, it is assumed that non-target organisms will be exposed to parent plus these degradates and thus the total residue EECs are used for risk assessment.

Table 6. Chemical Names for Hexythiazox and it's Degradation Products.

Chemical Name	Structure
Hexythiazox (parent) (NA-73)	5-(4-chlorophenyl)-N-cyclohexyl-4-methyl-2-oxo-3-thiazolidinecarboxamide
Degradates	
PT-1-2	5-(4-chlorophenyl)-4-methyl-2-oxo-3-thiazolidinecarboxamide
PT-1-3	5-(4-chlorophenyl)-4-methyl-2-thiazolidinone
PT-1-4a (trans 1) PT-1-4b (trans 2)	5-(4-chlorophenyl)-N-(3-hydroxycyclohexyl)-4-methyl-2-oxo-3-thiazolidinecarboxamide
PT-1-5	5-(4-chlorophenyl)-4-methyl-2-oxo-N-(3-oxocyclohexyl)-3-thiazolidinecarboxamide
PT-1-6	5-(4-chlorophenyl)-N-(2-hydroxycyclohexyl)-4-methyl-2-oxo-3-thiazolidinecarboxamide
PT-1-8a (cis) PT-1-8b (trans)	5-(4-chlorophenyl)-N-(4-hydroxycyclohexyl)-4-methyl-2-oxo-3-thiazolidinecarboxamide
PT-1-9	5-(4-chlorophenyl)-4-methyl-2-oxo-N-(4-oxycyclohexyl)-thiazolidinecarboxamide

No environmental fate data is currently available for the degradates of hexythiazox. Therefore, EFED has employed the total residue approach for predicting exposure to hexythiazox and the degradates identified above. The total residue approach involves re-visiting each relevant environmental fate study and summing at each time interval the amount (either concentration or percent of applied) of parent and relevant degradates from

the list above. For example, in the aqueous photolysis and aerobic soil metabolism studies the percent of parent hexythiazox plus PT-1-2, PT-1-3, PT-1-4/PT-1-8 (reported together), and PT-1-5/PT-1-9 (reported together) were summed at each interval because these were the only identified compounds present in those studies. Once summed, the data were used in accordance with EFED's current guidance for calculating rate constants and model inputs to derive a rate constant and half life for the individual study. This half live was then used as a model input in accordance with EFED's current guidance. Finally, where environmental fate and physical chemical property data was lacking for the identified degradates, EFED estimated values for modeling. For hexythiazox, an assumption was made that where no data was available the model input from the parent only modeling would be used. **Table 7** presents a summary of the predicted total residue EECs while **Table 8** presents a summary of the model inputs used.

Table 7 Tier II Concentrations of Total Residues of Hexythiazox in Surface Water Using PRZM/EXAMS Scenarios

Crop	Application Rate per Acre lbs/acre (label #)	# of Applications (intervals)	First Application	1/10 Peak Annual (ug/l)	21-Day Average (ug/l)	60-Day Average (ug/l)
CA citrus	0.1875	1 by ground	June 1	0.18	0.17	0.14
NY grapes	0.1875	1 by ground	June 1	2.64	2.58	2.44
CA grapes	0.1875	1 by ground	June 1	0.22	0.21	0.19
OR apples	0.1875	1 by aerial application	July 1	1.39	1.34	1.19
NC apples	0.1875	1 by aerial application	June 1	2.59	2.47	2.17
PA apples	0.1875	1 by aerial application	June 1	2.77	2.67	2.47

Table 8. PRZM/EXAMS Input Parameters for Total Residues of Hexythiazox (Parent plus Degradates)			
Model Parameter	**Value**	**Comments**	**Source**
Application Information	see Table 4.		Product Labels
Spray Drift by Scenario	aerial - 5% ground - 1%	Default Assumption[1]	
Aerobic Soil Metabolism $t_{½}$	145.2 days	90th percent upper bound @ 15°C	MRID 453501027
Anaerobic Soil Metabolism $t_{½}$	NA		
Aerobic Aquatic Degradation $t_{½}$ (KBACW)	291 days	2 times 145.2 days	
Anaerobic Aquatic Degradation $t_{½}$ (KBACS)	582 days	2 times 291 days	
Aqueous Photolysis $t_{½}$	24.6 days		MRID 460082013
Hydrolysis $t_{½}$	stable		MRID 453501028
Kd/Koc	2589 ml/g	assumed equal to parent	MRID 460082018
Molecular Weight	352.5 g/mole	assumed equal to parent	MRID 44006301
Foliar Extraction (FEXTR)	0.5		
Foliar Decay Rate	NA		
Water Solubility	1.2 mg/l	assumed equal to parent	MRID 44006301
Vapor Pressure	2.54×10^{-8} mm Hg @ 25 °C	assumed equal to parent	MRID 44006301

1- From "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides*" dated February 28, 2002.

As with the parent only assessment, EFED further evaluated the importance of spray drift on potential exposures (and hence risk) EFED remodeled all the total residue scenarios assuming that no spray drift would occur. This provides a maximum estimate of the importance of spray drift and provides useful information for the evaluation of the utility of applying spray drift and runoff buffers. As with the previous assessment, EFED remodeled all scenarios and set the spray drift fraction to 0%. This essentially provides an estimate of the amount of exposure resulting exclusively from runoff. For the modeled scenarios the EECs were reduced from the no-drift values (**Table 3**) by as much as 50% for the California scenarios to as little as 5% for the New York grape scenario. These no-drift EECs are presented in **Table 9.** This analysis suggests that implementation of spray drift buffers can be important for reducing aquatic exposure to the total residues of hexythiazox depending on the intended use site and geographic location.

Table 9 Tier II Concentrations of Total Residues of Hexythiazox in Surface Water Using PRZM/EXAMS Scenarios Assuming No Spray Drift

Crop	Application Rate per Acre lbs/acre (label #)	# of Applications (intervals)	First Application	1/10 Peak Annual (ug/l)	21-Day Average (ug/l)	60-Day Average (ug/l)
CA citrus	0.1875	1 by ground	June 1	0.09	0.09	0.07
NY grapes	0.1875	1 by ground	June 1	2.51	2.45	2.30
CA grapes	0.1875	1 by ground	June 1	0.15	0.14	0.09
OR apples	0.1875	1 by aerial application	July 1	0.70	0.68	0.61
NC apples	0.1875	1 by aerial application	June 1	2.06	1.97	1.68
PA apples	0.1875	1 by aerial application	June 1	2.15	2.03	1.82

Aquatic Exposure Monitoring and Field Data

For hexythiazox, no monitoring data were available for use in this drinking water assessment. Therefore, potential human exposure to hexythiazox in drinking water was evaluated through modeling.

Measures of Terrestrial Exposure

Hexythiazox exposure to terrestrial animals is likely considering that the proposed application methods include outdoor spray to

Terrestrial Exposure Modeling

Estimation of hexythiazox residues on wildlife food items focuses on quantifying possible dietary ingestion of residues on vegetation and insects. Residue estimates are based on a nomogram that relates food item residues to pesticide application rate. Estimated environmental concentrations (EECs) are generated from a spreadsheet-based model (TREX) that calculates the decay of a chemical applied to foliar surfaces for single or multiple applications.

The terrestrial exposure assessment is based on the methods of Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994). Terrestrial EECs for non-granular formulations were derived for the proposed terrestrial food crops and ornamentals using the highest proposed application rate (0.1875 lbs a.i./acre) with a single application. Uncertainties in the terrestrial EECs are primarily associated with a lack of data on interception and subsequent dissipation from foliar surfaces. When data are absent, as in this case, EFED assumes a 35-day foliar dissipation half life, based on the work of Willis and McDowell (1987).

Terrestrial EECs may be compared directly with dietary toxicity data or converted to an oral dose, as is the case for small mammals. The screening-level risk assessment for hexythiazox uses upper bound predicted residues as the measure of exposure.

Because of the low application rate (0.1875 lb ai/acre/year), maximum estimated environmental concentrations (EECs) on potential bird and mammal food items (vegetation, insects) are not expected to exceed 45 ppm.

The predicted maximum and mean residues of hexythiazox that may be expected to occur on selected avian or mammalian food items immediately following application (at the maximum annual or seasonal label rate) for the proposed terrestrial food crops are presented in **Table 10.** For mammals, the residue concentration is converted to a daily oral dose based on the fraction of body weight consumed daily as estimated through mammalian allometric relationships. A detailed discussion of TREX modeling as well as model inputs are presented in **Appendix C**.

Table 10 Kenaga Values for Terrestrial Organism Food Items Estimated Using TREX for Hexythiazox		
Food Type	**Maximum Kenaga Values for Citrus/Grape/Apple Crop Use (0.1875 lb/acre)**	**Mean Kenaga Values for Citrus/Grape/Apple Crop Use (0.1875 lb/acre)**
Short Grass	45.00	15.94
Tall Grass	20.63	6.75
Broadleaf Plants/Small Insects	25.31	8.44
Fruits/Pods/Seeds/ Large Insects	2.81	1.31

Residue Studies

EFED contacted the Health Effects Division (HED) of the Office of Pesticide Programs (OPP) to determine if any relevant and acceptable data are available to estimate exposure concentrations on plant material and to determine if foliar half lives could be estimated. There is no suitable data available to provide these estimates.

Ecological Effects Characterization

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

Aquatic Effects Characterization

Freshwater Acute and Chronic

Hexythiazox is highly toxic to fish (LC50 = 0.53 ppm for bluegill sunfish) and aquatic invertebrates (EC50 = 0.74 ppm for daphnids) on an acute basis. The *Daphnia magna* life-cycle study found an NOAEC of < 0.001 ppm.

Estuarine/Marine Acute

No acceptable estuarine or marine studies have been received. A summary of all available aquatic organism data is presented in **Table 11.**

Table 11. Summary of most sensitive acute and chronic toxicity data for aquatic organisms exposed to hexythiazox.

Species	Study type	LC_{50} or EC_{50} (ppm)	NOAEC & LOAEC (ppm)	Source (MRID)
Bluegill sunfish	Freshwater fish acute	0.53		260839 1986
Rainbow trout	Freshwater fish acute	>1		260839 1986
Daphnia carinata	Freshwater invert. acute	0.742		072940 1984
Daphnia magna	Freshwater invert. life-cycle		.0006 / 0.012	439447-01 1996
Sheepshead minnow	Estuarine/marine fish acute	none		
Mysid shrimp	Estuarine/marine invert. acute	none		

Terrestrial Effects Characterization

Avian Acute Oral, Dietary, and Chronic

Minimal risks to terrestrial organisms are expected. Hexythiazox is practically nontoxic to birds (bobwhite acute oral LD50 >2510 mg/kg; LC50s >5000 ppm, mallard and bobwhite). No chronic avian studies were reviewed. A summary of the available avian data is presented in **Table 12.**

Table 12. Summary of avian acute and chronic toxicity data for terrestrial organisms exposed to hexythiazox

Species	Study type	LC_{50} or EC_{50} (ppm)	NOAEC & LOAEC (ppm)	Source (MRID)
Northern Bobwhite	Acute oral	>5,000		07294 1986
Northern Bobwhite	Acute dietary	>5,000		072940 1984
Mallard Duck	Acute dietary	>2,510		072940 1984
Northern Bobwhite	Reproductive	none		

Mammals, Acute and Chronic

Hexythizox is practically nontoxic to small mammals (LD50 >5000 mg/kg, NOAEL $\geq$ 2400 mg/kg/day laboratory rat, acute and two generation), and beneficial insects (honey bee topical LD50 >200 µg/bee; LC50 >1000 ppm for honey bees exposed to treated filter paper). A summary of available mammalian data is presented in **Table 13.**

Table 13. Summary of acute and chronic mammalian toxicity tests[1] for hexythiazox.

Species	Study type	LD_{50} or ED_{50} (mg/kg)	NOAEL (ppm)	Source (MRID)
Norway rat (*Rattus norvegicus*)	Acute oral	> 5,000		072941
Norway rat (*Rattus norvegicus*)	2-Generation reproduction		> 2400	00147578

[1]Mammalian toxicity data provided and reviewed by EPA Health Effects Division.

Insects

Topical LD50 of technical hexythiazox was greater than 200 micrograms per honey bee. When bees were exposed to treated filter paper, the LC50 was greater than 100 ppm. (MRID 072939, 1984).

Risk Characterization

Risk Estimation

To evaluate the potential risk to non-target organisms from the proposed uses of hexythiazox, risk quotients (RQs) are calculated from the ratio of estimated environmental concentrations (EECs) to toxicity values. This is a screening level examination of the risk of using hexythiazox, therefore, the highest EECs (the "Peak EECs") and the lowest toxicity values were used. RQs are then compared to levels of concern (LOCs) used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action.

Aquatic

Acute and Chronic Aquatic Plants

Because hexythiazox is an insecticide and miticide, no aquatic plant studies have been required. Therefore, EFED cannot evaluate the potential risk to aquatic plants due to use of hexythiazox and cannot preclude that risk exists. However, proposed revisions to CFR Part 158 for EFED's data requirements include recommendations for plant testing. Ultimately, submission of this data will clarify this uncertainty.

Acute Aquatic Animals

This is a screening level examination of the the acute risk of using hexythiazox, therefore, the highest EECs (the use pattern with the highest "Peak EECs") and the lowest toxicity values were used. A summary of aquatic acute RQs is presented in Table 14.

Table 14. Estimated acute risk quotients for aquatic animals exposed to hexythiazox. Only the highest EECs and lowest LC50s are used. One application of 0.1875 lbs a.i. per acre is used in all cases.

State and Crop	Peek EECs[1] (mg/L)	LC_{50} mg/kg	Acute RQ (EEC / LC_{50}	LOCs Exceeded
Freshwater fish (warmwater) Blue gill sunfish				
PA grapes	0.003	0.53	<0.01	None
Aquatic invertebrate: *Daphnia caranita*				
PA apples	0.003	0.742	<0.01	None

[1] Calculated using PRZM/EXAMS.

Chronic Aquatic Animals

This is a screening level examination of the chronic risk of using hexythiazox, therefore, the highest EECs (the use pattern with the highest "21-day EECs") and the lowest toxicity values were used. Chronic fish data were not available. A summary of chronic invertebrate RQs is presented in Table 15.

Table 15. Estimated chronic risk quotients for aquatic invertebrates (*Daphnia magna*) exposed to hexythiazox. In this screening analysis only the highest EECs and lowest NOAECs were used. One application of 0.1875 a.i. per acre is used in all cases.

Crop	21-Day EECs[1] (mg/L)	NOAEC (ppm)	RQ	LOCs Exceeded
Pennsylvania grapes	< 0.003	< 0.01	0.3	None
Pennsylvania apples	< 0.003	< 0.01	0.3	None

[1] Calculated using PRZM/EXAMS.

Terrestrial

Avian Acute and Chronic Risk

The EFED program "T-Rex" was used to calculate the RQ values for small- (20 g), intermediate- (100 g) and large sized- (1,000 g) birds separately. In this screening examination, only the highest exposure and lowest toxicity numbers are used. The maximum Kenaga vaules for each type of food are used to estimate the exposure to hexythiazox. The Kenaga values are 45.00 (for birds feeding on short grass), 20.63 (tall grass), 25.31 (broadleaf plants/small insects), and 2.81 (fruits/pods/large insects or seeds). A summary of avian acute RQs is presented in Table 16.

There were no acceptable sudies on avian chronic toxicity with hexythiazox, therefore, a chronic RQ could not be calculated.

Table 16. Avian Dose-Based Acute Risk Quotients Screening examination of the acute risk to birds. The toxicity number is the mallard duck acute LD50 of >2,510 ppm..

Size of Animal	Body weight (g)	Short Grass	Tall Grass	Broadleaf Plants / Small Insects	Fruits/pods/seeds/ large insects
Small	20	<0.01	<0.01	<0.01	<0.01
Intermediate	100	<0.01	<0.01	<0.01	<0.01
Large	1000	<0.01	<0.01	<0.01	<0.01

Mammalian Acute and Chronic Risk

Mammalian Acute and Chronic RQs

The EFED program "T-Rex" was used to calculate the RQ values for small- (20 g), intermediate- (35 g) and large sized- (1,000 g) mammals separately. In this screening examination, only the highest exposure and lowest toxicity numbers are used. If no risk is predicted, further consideration is not needed. The maximum Kenaga vaules for each type of food are used to estimate the exposure to hexythiazox. The Kenaga values are 45.00 (for mammals feeding on short grass), 20.63 (tall grass), 25.31 (broadleaf plants/small insects), and 2.81 (fruits/pods/large insects or seeds).

Acute Dosed-Based Mammallian RQs

A summary of acute mammalian RQs is presented in Table 17.

Table 17. Mammalian Dose-Based Acute Risk Quotients Screening examination of the acute risk to mammals. The toxicity number of the laboratory rat acute LD50 of >2,510 ppm..

Size of animal	Body weight (g)	Short Grass	Tall Grass	Broadleaf Plants/ Small Insects	Fruits/pods/seeds/ large insects
Small	15	<0.01	<0.01	<0.01	<0.01
Intermediate	35	<0.01	<0.01	<0.01	<0.01
Large	1,000	<0.01	<0.01	<0.01	<0.01

Chronic Dietary-Based Mammalian RQs

A summary of dietary mammalian RQs is presented in Table 18.

Table 18. Mammalian Diet-Based Chronic Risk Quotients. Screening examination of the acute risk to mammals. The toxicity number is the laboratory rat chronic LD50 of >5,000 ppm.

Size of animal	Body Weight (g)	Short Grass	Tall Grass	Broadleaf Plants/ Small Insects	Fruits/pods/seeds/ large insects
Small	15	<0.01	<0.01	<0.01	<0.01
Intermediate	35	<0.01	<0.01	<0.01	<0.01
Large	1000	<0.01	<0.01	<0.01	<0.01

Risk Description

Risks to Aquatic Organisms

Risks to fish and aquatic invertebrates are expected to be minimal from the proposed applications. Hexythiazox is highly toxic to fish (LC50 = 0.53 ppm, bluegill sunfish) and aquatic invertebrates (EC50 = 0.74 ppm, Daphnid), but the peak aquatic EEC is not expected to exceed 1.24 ppb. Based on the lowest acute toxicity values, the RQ for the bluegill sunfish the estimated aquatic EEC of 1.24 ppb, the fish acute RQ < 0.01 (1.24 ppb/530 ppb). The aquatic invertebrate (daphnid) RQ < .001 (1.24 ppb/742 ppb). These RQ values are well below the LOC for aquatic organisms.

Risks to Terrestrial Organisms

Minimal risks to terrestrial organisms are expected. The laboratory rat had an LD50 >5000 mg/kg and the honey bee had a topical LD50 > 200 µg/bee and an LC50 >1000 ppm for

honey bees exposed to treated filter paper. Because of the low application rate (0.1875 lb ai/acre/year), maximum estimated environmental concentrations (EECs) on potential bird and mammal food items (vegetation, insects) are not expected to exceed 45 ppm.

Avian Risk

Hexythiazox is practically nontoxic to birds (LD50 >2510 mg/kg; LC50s >5000 ppm, mallard and northern bobwhite). Risk quotients for hexythiazox do not exceed the Level of Concern for acute exposures. There is no data available to assess the potential risk to birds on a chronic basis.

Mammalian Risk

Hexythiazox is practically nontoxic to small mammals (acute LD50 >5000 mg/kg and chronic NOAEL > 2400 ppm in the laboratory rat). Risk quotients for hexythiazox do not exceed the Level of Concern for either acute or chronic exposures.

Beneficial Insects

Hexythiazox is practically nontoxic to beneficial insects. Then honey bee acute when exposed to treated filter paper the LD50 was >1000 mg/kg and the topical LD50 was >200 µg/bee). It's Risk Quotients do not exceed the Level of Concern in any category.

Review of Incident Data

There are no recorded nontarget incidents involving Hexythiazox.

Federally Threatened and Endangered (Listed) Species Concerns

Minimal risk is expected for all taxa with acceptable data, therefore no endangered species within these taxa (and those they represent surrogates for) are expected to be at risk. However, there are significant gaps in the ecotoxicity data for hexythiazox. Because EFED does not have ecotoxicity data for any required estuarine/marine organisms (either acute or chronic studies), aquatic plants, terrestrial plants, and chronic data for freshwater fish or birds EFED cannot rule out that hexythiazox presents a potential risk to endangered species covered by these taxa.

Uncertainties

Registration of chemicals for use in citrus groves and the previous registration for cotton require studies on estuarine animals, but none have been submitted. Therefore, EFED is

unable to assess the potential risk to any estuarine/marine organisms and as such cannot rule out that a potential risk exists.

No chronic fish or avian reproduction studies have been submitted, therefore EFED cannot rule out the potential for chronic and reproductive effects due to use of hexythiazox. This is particulary significant because hexythiazox is an "ovicide" suggesting that it's mode of action is designed to kill eggs. Typically, ovicides require studies on possible reproductive effects, and thus without this data EFED cannot evaluate the potential effect of hexythiazox use upon reproduction.

Literature Cited

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

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

Willis, G. H., and L. L. McDowell, 1987. Pesticide Persistence on Foliage. in *Reviews of Environmental Contamination and Toxicology*. 100:23-73.

APPENDIX A
EFED's Risk Quotient Method & Levels of Concern

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 A-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 B
PRZM INPUT & OUTPUT FILES

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PA Apple; 8/08/2001

"Lancaster County; MLRA 148; Metfile: W14737.dvf (old: Met148.met),"

*** Record 3:
    0.76      0.2        0       17        1        3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.42      3.6        1       10                 3       12      354
*** Record 8
       1
*** Record 9
       1    0.25      100       90        3  84  79  82        0      425
*** Record 9a-d
       1       26
0101 1601 0102 1602 0103 1603 0104 1504 1604 0105 1605 0106 1606 0107
1507 1607
.134 .144 .153 .156 .247 .261 .279 .320 .334 .357 .378 .419 .439 .453
.459 .463
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
.014 .014
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.478 .493 .503 .504 .509 .515 .103 .115 .121 .128
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  200461  100561  151061        1
  200462  100562  151062        1
  200463  100563  151063        1
  200464  100564  151064        1
  200465  100565  151065        1
  200466  100566  151066        1
  200467  100567  151067        1
  200468  100568  151068        1
  200469  100569  151069        1
  200470  100570  151070        1
  200471  100571  151071        1
  200472  100572  151072        1
  200473  100573  151073        1
  200474  100574  151074        1
  200475  100575  151075        1
  200476  100576  151076        1
  200477  100577  151077        1
  200478  100578  151078        1
  200479  100579  151079        1
  200480  100580  151080        1
  200481  100581  151081        1
  200482  100582  151082        1
  200483  100583  151083        1
  200484  100584  151084        1
  200485  100585  151085        1
  200486  100586  151086        1
  200487  100587  151087        1
  200488  100588  151088        1
  200489  100589  151089        1
  200490  100590  151090        1
```

```
*** Record 12 -- PTITLE
Hexythiazox - 1 applications @ 0.21 kg/ha

*** Record 13
     30        1        0        0
*** Record 15 -- PSTNAM
Hexythiazox
*** Record 16
  010661   0 2   0.0   0.21 0.95     0
  010662   0 2   0.0   0.21 0.95     0
  010663   0 2   0.0   0.21 0.95     0
  010664   0 2   0.0   0.21 0.95     0
  010665   0 2   0.0   0.21 0.95     0
  010666   0 2   0.0   0.21 0.95     0
  010667   0 2   0.0   0.21 0.95     0
  010668   0 2   0.0   0.21 0.95     0
  010669   0 2   0.0   0.21 0.95     0
  010670   0 2   0.0   0.21 0.95     0
  010671   0 2   0.0   0.21 0.95     0
  010672   0 2   0.0   0.21 0.95     0
  010673   0 2   0.0   0.21 0.95     0
  010674   0 2   0.0   0.21 0.95     0
  010675   0 2   0.0   0.21 0.95     0
  010676   0 2   0.0   0.21 0.95     0
  010677   0 2   0.0   0.21 0.95     0
  010678   0 2   0.0   0.21 0.95     0
  010679   0 2   0.0   0.21 0.95     0
  010680   0 2   0.0   0.21 0.95     0
  010681   0 2   0.0   0.21 0.95     0
  010682   0 2   0.0   0.21 0.95     0
  010683   0 2   0.0   0.21 0.95     0
  010684   0 2   0.0   0.21 0.95     0
  010685   0 2   0.0   0.21 0.95     0
  010686   0 2   0.0   0.21 0.95     0
  010687   0 2   0.0   0.21 0.95     0
  010688   0 2   0.0   0.21 0.95     0
  010689   0 2   0.0   0.21 0.95     0
  010690   0 2   0.0   0.21 0.95     0
*** Record 17
       0        1        0
*** Record 18
       0        0      0.5
*** Record 19 -- STITLE
Elioak Silt Loam; HYDG: C

*** Record 20
     100             0   0   1   0   0   0   0   0   0
*** Record 26
       0        0        0
*** Record 30
       4     2589
*** Record 33
       3
       1       10      1.7   0.218        0        0        0
        0.017094 0.017094        0
             0.1   0.218   0.098     1.16        0
       2       28      1.7   0.218        0        0        0
        0.017094 0.017094        0
```

```
              7   0.218   0.098    1.16       0
      3      62     1.8   0.243       0       0       0
       0.0170940.017094       0
             7.75   0.243   0.163   0.174       0
***Record 40
      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
```

stored as PAapple.out
Chemical: Hexythiazox
PRZM environment: PAappleC.txt modified Satday, 12 October 2002 at 17:24:46
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14737.dvf modified Wedday, 3 July 2002 at 09:06:12
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.6849	0.6316	0.5489	0.4048	0.3542	0.1667
1962	1.143	1.063	0.8371	0.6463	0.5966	0.3748
1963	0.833	0.7784	0.6235	0.4823	0.4468	0.3796
1964	0.7821	0.7282	0.6283	0.5035	0.4502	0.336
1965	0.7421	0.6983	0.5469	0.4044	0.3656	0.2845
1966	0.7182	0.6639	0.5108	0.3689	0.342	0.2769
1967	1.909	1.767	1.42	1.084	0.9646	0.5561
1968	1.02	0.9646	0.8114	0.6512	0.6089	0.5167
1969	0.8981	0.8452	0.7049	0.5628	0.5648	0.4251
1970	0.8347	0.7807	0.6291	0.5071	0.4769	0.3814
1971	0.78	0.7261	0.5928	0.4458	0.4504	0.3536
1972	1.783	1.659	1.292	0.9917	0.8771	0.5379
1973	1.644	1.538	1.242	0.9506	0.8695	0.6396
1974	0.9891	0.9343	0.8469	0.7482	0.7146	0.5815
1975	1.358	1.277	1.08	0.8775	0.7943	0.5684
1976	0.9184	0.8617	0.7179	0.5742	0.5563	0.4712
1977	0.9538	0.8965	0.7713	0.62	0.5619	0.4159
1978	0.8027	0.7477	0.5935	0.5045	0.4956	0.3797
1979	0.7881	0.7345	0.5824	0.4991	0.4866	0.3825
1980	0.804	0.7656	0.6182	0.4648	0.4096	0.3236
1981	0.7124	0.6584	0.5725	0.4788	0.4238	0.2877
1982	1.604	1.491	1.191	0.906	0.8445	0.4987
1983	0.9664	0.919	0.7877	0.7104	0.6481	0.5104
1984	1.055	0.9969	0.8555	0.7515	0.7023	0.4953
1985	0.9153	0.8618	0.8024	0.6776	0.6379	0.486
1986	0.8586	0.8039	0.6544	0.5108	0.4752	0.3933
1987	0.7672	0.7124	0.5596	0.5341	0.5108	0.3813
1988	0.8127	0.7583	0.6042	0.5044	0.486	0.3827
1989	1.052	0.984	0.8629	0.7211	0.6517	0.4396
1990	0.8467	0.7916	0.6399	0.5442	0.537	0.4214

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	1.909	1.767	1.42	1.084	0.9646	0.6396
0.064516	1.783	1.659	1.292	0.9917	0.8771	0.5815
0.096774	1.644	1.538	1.242	0.9506	0.8695	0.5684
0.129032	1.604	1.491	1.191	0.906	0.8445	0.5561
0.16129	1.358	1.277	1.08	0.8775	0.7943	0.5379

0.193548	1.143	1.063	0.8629	0.7515	0.7146	0.5167
0.225806	1.055	0.9969	0.8555	0.7482	0.7023	0.5104
0.258065	1.052	0.984	0.8469	0.7211	0.6517	0.4987
0.290323	1.02	0.9646	0.8371	0.7104	0.6481	0.4953
0.322581	0.9891	0.9343	0.8114	0.6776	0.6379	0.486
0.354839	0.9664	0.919	0.8024	0.6512	0.6089	0.4712
0.387097	0.9538	0.8965	0.7877	0.6463	0.5966	0.4396
0.419355	0.9184	0.8618	0.7713	0.62	0.5648	0.4251
0.451613	0.9153	0.8617	0.7179	0.5742	0.5619	0.4214
0.483871	0.8981	0.8452	0.7049	0.5628	0.5563	0.4159
0.516129	0.8586	0.8039	0.6544	0.5442	0.537	0.3933
0.548387	0.8467	0.7916	0.6399	0.5341	0.5108	0.3827
0.580645	0.8347	0.7807	0.6291	0.5108	0.4956	0.3825
0.612903	0.833	0.7784	0.6283	0.5071	0.4866	0.3814
0.645161	0.8127	0.7656	0.6235	0.5045	0.486	0.3813
0.677419	0.804	0.7583	0.6182	0.5044	0.4769	0.3797
0.709677	0.8027	0.7477	0.6042	0.5035	0.4752	0.3796
0.741935	0.7881	0.7345	0.5935	0.4991	0.4504	0.3748
0.774194	0.7821	0.7282	0.5928	0.4823	0.4502	0.3536
0.806452	0.78	0.7261	0.5824	0.4788	0.4468	0.336
0.83871	0.7672	0.7124	0.5725	0.4648	0.4238	0.3236
0.870968	0.7421	0.6983	0.5596	0.4458	0.4096	0.2877
0.903226	0.7182	0.6639	0.5489	0.4048	0.3656	0.2845
0.935484	0.7124	0.6584	0.5469	0.4044	0.3542	0.2769
0.967742	0.6849	0.6316	0.5108	0.3689	0.342	0.1667
0.1	1.64	1.5333	1.2369	0.94614	0.867	0.56717
					Average of yearly averages:	0.421603

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: PAapple

Metfile:	w14737.dvf
PRZM scenario:	PAappleC.txt
EXAMS environment file:	pond298.exv
Chemical Name:	Hexythiazox

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	352.9	g/mol	
Henry's Law Const.	henry	3.87E-08	atm-m^3/mol	
Vapor Pressure	vapr	2.50E-08	torr	
Solubility	sol	1.2	mg/L	

Kd	Kd		mg/L	
Koc	Koc		2589 mg/L	
Photolysis half-life	kdp		16.6 days	Half-life
Aerobic Aquatic Metabolism	kbacw		81.1 days	Halfife
Anaerobic Aquatic Metabolism	kbacs		240 days	Halfife
Aerobic Soil Metabolism	asm		40.55 days	Halfife
Hydrolysis:	pH 7		0 days	Half-life
Method:	CAM		2 integer	See PRZM manual
Incorporation Depth:	DEPI		0 cm	
Application Rate:	TAPP		0.21 kg/ha	
Application Efficiency:	APPEFF		0.95 fraction	
Spray Drift	DRFT		0.05 fraction of application rate applied to pond	
Application Date	Date		6-Jan dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND		1	
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC		0.5	
Flag for Index Res. Run	IR	Pond		
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)	

```
PA Apple; 8/08/2001

"Lancaster County; MLRA 148; Metfile: W14737.dvf (old: Met148.met),"

*** Record 3:
    0.76      0.2        0       17        1        3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.42      3.6        1       10                 3       12      354
*** Record 8
       1
*** Record 9
       1     0.25      100       90        3  84   79   82        0      425
*** Record 9a-d
       1       26
0101 1601 0102 1602 0103 1603 0104 1504 1604 0105 1605 0106 1606 0107
1507 1607
.134 .144 .153 .156 .247 .261 .279 .320 .334 .357 .378 .419 .439 .453
.459 .463
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
.014 .014
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.478 .493 .503 .504 .509 .515 .103 .115 .121 .128
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
       30
*** Record 11
  200461  100561  151061        1
  200462  100562  151062        1
  200463  100563  151063        1
  200464  100564  151064        1
  200465  100565  151065        1
  200466  100566  151066        1
  200467  100567  151067        1
  200468  100568  151068        1
  200469  100569  151069        1
  200470  100570  151070        1
  200471  100571  151071        1
  200472  100572  151072        1
  200473  100573  151073        1
  200474  100574  151074        1
  200475  100575  151075        1
  200476  100576  151076        1
  200477  100577  151077        1
  200478  100578  151078        1
  200479  100579  151079        1
  200480  100580  151080        1
  200481  100581  151081        1
  200482  100582  151082        1
  200483  100583  151083        1
  200484  100584  151084        1
  200485  100585  151085        1
  200486  100586  151086        1
  200487  100587  151087        1
  200488  100588  151088        1
  200489  100589  151089        1
  200490  100590  151090        1
```

```
*** Record 12 -- PTITLE
HexythiazoxTTR - 1 applications @ 0.21 kg/ha

*** Record 13
     30       1       0       0
*** Record 15 -- PSTNAM
HexythiazoxTTR
*** Record 16
  010661  0 2  0.0  0.21 0.95    0
  010662  0 2  0.0  0.21 0.95    0
  010663  0 2  0.0  0.21 0.95    0
  010664  0 2  0.0  0.21 0.95    0
  010665  0 2  0.0  0.21 0.95    0
  010666  0 2  0.0  0.21 0.95    0
  010667  0 2  0.0  0.21 0.95    0
  010668  0 2  0.0  0.21 0.95    0
  010669  0 2  0.0  0.21 0.95    0
  010670  0 2  0.0  0.21 0.95    0
  010671  0 2  0.0  0.21 0.95    0
  010672  0 2  0.0  0.21 0.95    0
  010673  0 2  0.0  0.21 0.95    0
  010674  0 2  0.0  0.21 0.95    0
  010675  0 2  0.0  0.21 0.95    0
  010676  0 2  0.0  0.21 0.95    0
  010677  0 2  0.0  0.21 0.95    0
  010678  0 2  0.0  0.21 0.95    0
  010679  0 2  0.0  0.21 0.95    0
  010680  0 2  0.0  0.21 0.95    0
  010681  0 2  0.0  0.21 0.95    0
  010682  0 2  0.0  0.21 0.95    0
  010683  0 2  0.0  0.21 0.95    0
  010684  0 2  0.0  0.21 0.95    0
  010685  0 2  0.0  0.21 0.95    0
  010686  0 2  0.0  0.21 0.95    0
  010687  0 2  0.0  0.21 0.95    0
  010688  0 2  0.0  0.21 0.95    0
  010689  0 2  0.0  0.21 0.95    0
  010690  0 2  0.0  0.21 0.95    0
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Elioak Silt Loam; HYDG: C

*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    2589
*** Record 33
       3
       1      10     1.7   0.218       0       0       0
        0.0047740.004774       0
             0.1   0.218   0.098    1.16       0
       2      28     1.7   0.218       0       0       0
        0.0047740.004774       0
```

```
              7   0.218   0.098    1.16       0
        3     62     1.8   0.243       0       0       0
         0.0047740.004774       0
              7.75   0.243   0.163   0.174       0
***Record 40
        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
```

stored as PAapple.out
Chemical: HexythiazoxTTR
PRZM environment: PAappleC.txt modified Satday, 12 October 2002 at 17:24:46
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14737.dvf modified Wedday, 3 July 2002 at 09:06:12
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.9357	0.8731	0.7908	0.6109	0.5484	0.2568
1962	1.443	1.365	1.142	0.9559	0.9248	0.6733
1963	1.246	1.197	1.061	0.9865	0.9756	0.8614
1964	1.373	1.323	1.238	1.126	1.073	0.9503
1965	1.373	1.333	1.189	1.046	1.016	0.9443
1966	1.384	1.333	1.187	1.096	1.082	0.9861
1967	2.711	2.577	2.261	1.949	1.837	1.38
1968	1.94	1.888	1.742	1.583	1.532	1.439
1969	2.27	2.181	1.942	1.696	1.616	1.41
1970	1.839	1.788	1.641	1.529	1.512	1.42
1971	1.835	1.788	1.66	1.625	1.582	1.442
1972	3.053	2.922	2.534	2.221	2.097	1.71
1973	3.121	3.004	2.675	2.34	2.249	1.948
1974	2.344	2.3	2.201	2.111	2.11	1.975
1975	2.745	2.667	2.484	2.296	2.215	1.985
1976	2.288	2.235	2.096	1.961	1.959	1.884
1977	2.331	2.274	2.14	1.989	1.929	1.785
1978	2.117	2.069	1.947	1.818	1.817	1.689
1979	2.027	1.976	1.853	1.769	1.779	1.668
1980	2.022	1.986	1.842	1.675	1.629	1.525
1981	1.795	1.744	1.669	1.58	1.514	1.371
1982	2.774	2.656	2.327	2.055	2.038	1.611
1983	2.18	2.131	1.994	1.896	1.837	1.688
1984	2.377	2.311	2.141	2.005	1.94	1.703
1985	2.232	2.176	2.018	1.881	1.868	1.736
1986	2.117	2.065	1.918	1.766	1.736	1.655
1987	2.117	2.065	1.923	1.814	1.77	1.619
1988	2.022	1.97	1.837	1.742	1.729	1.625
1989	2.263	2.197	2.092	1.952	1.882	1.665
1990	2.064	2.019	1.884	1.796	1.773	1.645

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	3.121	3.004	2.675	2.34	2.249	1.985
0.064516	3.053	2.922	2.534	2.296	2.215	1.975
0.096774	2.774	2.667	2.484	2.221	2.11	1.948
0.129032	2.745	2.656	2.327	2.111	2.097	1.884
0.16129	2.711	2.577	2.261	2.055	2.038	1.785

0.193548	2.377	2.311	2.201	2.005	1.959	1.736
0.225806	2.344	2.3	2.141	1.989	1.94	1.71
0.258065	2.331	2.274	2.14	1.961	1.929	1.703
0.290323	2.288	2.235	2.096	1.952	1.882	1.689
0.322581	2.27	2.197	2.092	1.949	1.868	1.688
0.354839	2.263	2.181	2.018	1.896	1.837	1.668
0.387097	2.232	2.176	1.994	1.881	1.837	1.665
0.419355	2.18	2.131	1.947	1.818	1.817	1.655
0.451613	2.117	2.069	1.942	1.814	1.779	1.645
0.483871	2.117	2.065	1.923	1.796	1.773	1.625
0.516129	2.117	2.065	1.918	1.769	1.77	1.619
0.548387	2.064	2.019	1.884	1.766	1.736	1.611
0.580645	2.027	1.986	1.853	1.742	1.729	1.525
0.612903	2.022	1.976	1.842	1.696	1.629	1.442
0.645161	2.022	1.97	1.837	1.675	1.616	1.439
0.677419	1.94	1.888	1.742	1.625	1.582	1.42
0.709677	1.839	1.788	1.669	1.583	1.532	1.41
0.741935	1.835	1.788	1.66	1.58	1.514	1.38
0.774194	1.795	1.744	1.641	1.529	1.512	1.371
0.806452	1.443	1.365	1.238	1.126	1.082	0.9861
0.83871	1.384	1.333	1.189	1.096	1.073	0.9503
0.870968	1.373	1.333	1.187	1.046	1.016	0.9443
0.903226	1.373	1.323	1.142	0.9865	0.9756	0.8614
0.935484	1.246	1.197	1.061	0.9559	0.9248	0.6733
0.967742	0.9357	0.8731	0.7908	0.6109	0.5484	0.2568
0.1	2.7711	2.6659	2.4683	2.21	2.1087	1.9416
					Average of yearly averages:	1.475007

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: PAapple

Metfile:	w14737.dvf
PRZM scenario:	PAappleC.txt
EXAMS environment file:	pond298.exv
Chemical Name:	HexythiazoxTTR

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	352.9	g/mol	
Henry's Law Const.	henry	3.87E-08	atm-m^3/mol	
Vapor Pressure	vapr	2.50E-08	torr	
Solubility	sol	1.2	mg/L	

Kd	Kd		mg/L	
Koc	Koc		2589 mg/L	
Photolysis half-life	kdp		24.6 days	Half-life
Aerobic Aquatic Metabolism	kbacw		291 days	Halfife
Anaerobic Aquatic Metabolism	kbacs		582 days	Halfife
Aerobic Soil Metabolism	asm		145.2 days	Halfife
Hydrolysis:	pH 7		0 days	Half-life
Method:	CAM		2 integer	See PRZM manual
Incorporation Depth:	DEPI		0 cm	
Application Rate:	TAPP		0.21 kg/ha	
Application Efficiency:	APPEFF		0.95 fraction	
Spray Drift	DRFT		0.05 fraction of application rate applied to pond	
Application Date	Date		6-Jan dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND		1	
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC		0.5	
Flag for Index Res. Run	IR	Pond		
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)	

APPENDIX C - T-REX Discussion & Model Outputs

1. Introduction

This spreadsheet based model calculates the decay of a chemical applied to foliar surfaces for single or multiple applications. It calculates terrestrial estimates exposure (TEEC) concentrations on surfaces (such as plant or insect surfaces) following application. A first order decay assumption is used to determine the concentration at each day after initial application based on the concentration resulting from the initial and additional applications. The decay is calculated by from the first order rate equation:

$$C_T = C_i e^{-kT}$$

or in log form:

$$\ln (C_T/C_i) = kT$$

Where:

C_T = concentration at time T = day zero.

C_i = concentration, in parts per million (PPM) present initially (on day zero) on the surfaces. Ci is calculated based on Kenaga and Fletcher by multiplying the Ci based on the Kenaga nomogram (Hoerger and Kenaga, (1972) as modified Fletcher (1994). For maximum concentration the application rate, in pounds active ingredient per acre, is multiplied by 240 for Short Grass, 110 for Tall Grass, and 135 for Broad leafed plants/small insects and 15 for fruits/pods/lg insects. Additional applications are converted from pounds active ingredient per acre to PPM on the plant surface and the additional mass added to the mass of the chemical still present on the surfaces on the day of application.

k = If the foliar dissipation data submitted to EFED are found scientifically valid and statistically robust for a specific pesticide, the 90% upper confidence limit of the mean half-lives should be used. When scientifically valid, statistically robust data are not available TETT recommends the using a default half-life value of 35 days. The use of the 35 day half-life is based on the highest reported value (36.9 days) reported by Willis and McDowell (Pesticide persistence on foliage, Environ. Contam.Toxicol, 100:23-73, 1987).

T = time, in days, since the start of the simulation. The initial application is on day 0. The simulation is designed to run for 365 days.

The program calculates concentration on each type of surface on a daily interval for one year. The maximum concentration during the year are calculated for both maximum and mean residues. The inputs used to calculate the amount of the chemical present are in highlighted in light blue on the spread sheet. Outputs are in yellow. The inputs required are:

Application Rate: The maximum label application rate (in pounds ai/acre)
Half-life: The degradation half-life for the dominate process(in days)
Frequency of Application: The interval between repeated applications, from the label (in days)
Maximum # Applications per year: From the label

The actual input parameters used to determine terrestrial EECs on food items for **Hexythiazox** use on apples, grapes, and citrus are summarized in **Tables C-1**.

Table C-1. T-REX Model Inputs for **Hexythizox** Application to Apples, Grapes, and Citrus

Chemical Name:	**Hexythizaox**		
Use	**Apples, Grapes, & Citrus**		
Formulation	100%		
Application Rate	0.1875	lbs a.i./acre	
Half-life	35	days	
Application Interval	NA	days	
Maximum # Apps./Year	1		
Length of Simulation	1	year	
Concentration of Concern	NA	(ppm)	
Name of Concentration of Concern	Mammal chronic LOAEC		
Avian	Mallard duck LD50 (mg/kg-bw)		2510
	Bobwhite quail LC50 (mg/kg-diet)		5000
	Bobwhite quail NOAEL (mg/kg-bw)		
	Mallard duck NOAEC (mg/kg-diet)		
Mammals	LD50 (mg/kg-bw)		5000
	LC50 (mg/kg-diet)		
	NOAEL (mg/kg-bw)		
	NOAEC (mg/kg-diet)		2400

2. Avian Species

For calculating dose-based RQs in birds, the upper bound and mean Kenaga residue values are adjusted for avian class and food consumption based on the following scaling factor (USEPA, 1993):

FI (g/d) = 0.648 (g bw)^0.651

For the 3 avian weight classes considered (20, 100 and 1000 g), this results in % body weight consumption of:

Weight(g)	FI	wet FI	% bw consumed
20	4.555599463	22.77799731	114
100	12.98897874	64.94489369	65
1000	58.15338588	290.7669294	29

A. Dose-Based Acute RQs

Dose-based acute RQs are then calculated using the formula:

RQ = adjusted EEC/LD_{50} or NOAEL

where the adjusted EEC is considered to be the daily dose weighted for % body weight consumed of a given food source.

B. Dietary-Based RQs

For dietary-based RQs, two values are given for each food group. First, the consumption-weighted RQ for each weight class (20, 100, and 1000g birds) is displayed and calculated using the equation:

RQ = EEC/((LC_{50} or NOAEC)/(%bw consumed))

In the second method, no adjustment is made for consumption differences among the weight classes. This RQ is calculated:

RQ = EEC/LC_{50} or NOAEC

3. Mammalian Species

A. Dose-Based RQs

For calculating dose-based RQs in mammals, the upper bound and mean Kenaga values are adjusted for mammalian class and food consumption (0.95, 0.66 and 0.15 body weight for herbivores and insectivores and 0.21, 0.15, and 0.03 body wt. for granivores). Dose-based acute and chronic RQs are then calculated by dividing the adjusted EECs (daily dose) by the LD_{50} or NOAEL.

B. Dietary-Based RQs

Dietary-based RQs are calculated using the equation:

RQ = EEC/((LC_{50} or NOAEC)/(% bw consumed))

4. New Version Notes

A new look is used in this update in an effort to decrease confusion and increase transparency in the risk assessment process. This version of T-REX (v1.1) incorporates the ability to calculate EECs and RQs for upper bound and mean residues. Mean residues are calculated exactly as the upper bound residues are, except the corresponding Kenaga values are: 85 for Short Grass, 36 for Tall Grass, and 45 for Broad leafed plants/small insects and 7 for fruits/pods/lg insects.

5. References

Fletcher, J.S., J.E. Nellesson and T. G. Pfleeger. 1994. Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, an instrument for estimating pesticide residues on plants. Environ. Tox. and Chem. 13(9):1383-1391.

Hoerger, F. and E.E. Kenaga. 1972. Pesticide residues on plants: correlation of representative data as a basis for estimation of their magnitude in the environment. IN: F. Coulston and F. Corte, eds., Environmental Quality and Safety: Chemistry, Toxicology and Technology. Vol 1. Georg Theime Publishers, Stuttgart, Germany. pp. 9-28.

USEPA. 1993. Wildlife Exposure Factors Handbook. Volume I of II. EPA/600/R-93/187a. Office of Research and Development, Washington, D. C. 20460. Willis and McDowell. 1987.Pesticide persistence on foliage. Environ. Contam. Toxicol. 100:23-73.