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WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

September 18, 2019

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MEMORANDUM

SUBJECT: **Fenpyroximate:** Draft Ecological Risk Assessment for Registration Review

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TO: Carolyn Smith, Chemical Review Manager
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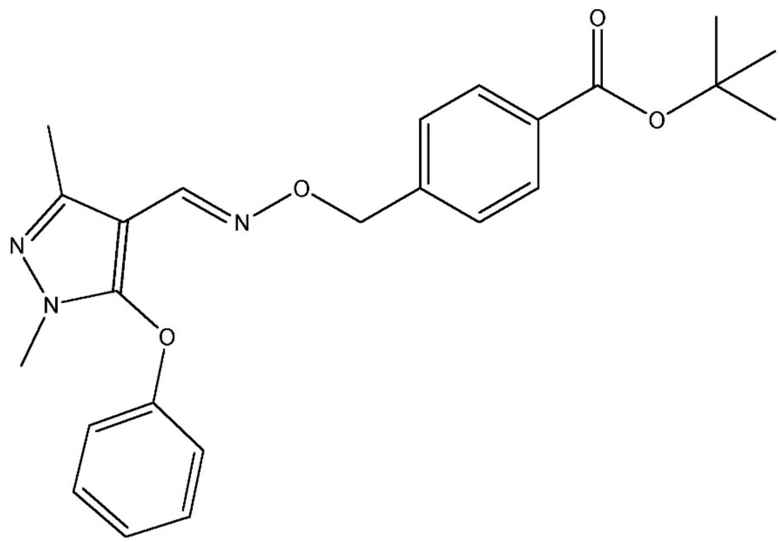
The Environmental Fate and Effects Division (EFED) has completed the draft environmental fate and ecological risk assessment in support of the Registration Review of the insecticide fenpyroximate.

Draft Ecological Risk Assessment for the Registration Review of Fenpyroximate



Fenpyroximate; CAS No 134098-61-6
USEPA PC Code: 129131

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1 Executive Summary

1.1 Overview

Fenpyroximate is a pyrazole contact insecticide and miticide that inhibits mitochondrial complex I electron transport. Fenpyroximate was first registered in 2000 with new uses added since that time.

This Draft Risk Assessment (DRA) examines the potential ecological risks associated with labeled uses of fenpyroximate on non-listed non-target organisms. The residues of concern include fenpyroximate and the degradate M-1. A total toxic residue (TTR) approach was used for the exposure assessment and estimated environmental concentrations (EECs) were compared to the toxicity endpoint of fenpyroximate. For more information on the residues of concern see **Section 4**.

1.2 Risk Conclusions Summary

There are estimated potential risks with RQs exceeding levels of concern (LOC) to certain taxa when fenpyroximate is used in accordance with the label. The potential risks include decreased survival, reduction in spawn per female and increased time to hatch in offspring for fish; decreased survival for freshwater invertebrates; decreased parental and pup weight for mammals; decreased survival and decreased female body weight in birds; decreased survival for honey bees; decreased cell density in non-vascular aquatic plants. The results of this risk assessment indicate that the labeled uses of fenpyroximate have the potential for direct adverse effects on non-listed freshwater fish and aquatic-phase amphibians. For freshwater fish, the acute risk quotient (RQ) range from 0.45 – 1.9 and 0.73 – 0.87 (cranberry use only), whereas chronic RQ range from 0.91 – 8.5 and 1.62 – 36 (cranberry use only). For freshwater invertebrates there are no acute RQs that exceed the LOC (RQ 0.09 – 0.39), except when considering potential exposure to fenpyroximate formulations from spray drift only (RQs 0.22 – 0.93). However, for use on cranberries, there are chronic LOC exceedances for water-column freshwater invertebrates (RQ 0.13 – 1.1), and freshwater and estuarine sediment dwelling invertebrates (sub-chronic RQ range: <0.01 – 0.13, 0.01 – 2.1). Additionally, there is potential for direct adverse effects on mammals (acute RQ range: <0.01 – 0.16; chronic RQ range: 0.1 – 1.3), birds (acute RQ range: 0.01 – 4.8; chronic RQ range: 0.16 – 2.5), terrestrial invertebrates (adult honey bees chronic RQ range: 44 – 92; larvae acute RQ range: 6.8 – 14; larvae chronic RQ range: 340 – 710), and aquatic non-vascular plants (RQ range: 0.5 – 1.8 , 0.80 – 0.96 (cranberry use)). There were no LOC exceedances for estuarine/marine fish, estuarine/marine invertebrates, and terrestrial plants.

Terrestrial wildlife may also be exposed through ingestion of residues in aquatic organisms which could result from fenpyroximate's potential to bioaccumulate. This exposure pathway was evaluated using the KABAM model (Version 1.0). KABAM-estimated bird dose- and dietary-based RQs did not exceed the Agency's levels of concern (acute RQ range: 0.01 – 0.14; chronic RQ range: 0.08 – 0.18). KABAM-estimated RQs based on chronic dose-based exposures of mammals exceed the Agency's levels of concern (acute dose-based RQ range: <0.01 – 0.01; chronic dose-based RQ range: 0.50 – 1.7; chronic dietary-based RQ range: 0.09 – 0.21).

1.3 Environmental Fate and Exposure Summary

Fenpyroximate is only present as an E-isomer in the product formulation. It is not expected to be volatile under field conditions or from water due to its low vapor pressure (5.6 x 10^{-8} torr at 25°C), high Kow (log K_{OW} of 5.01) and high K_{FOC} (K_{FOC} values of 7,550-58,300 L/kg_{OC}). The compound is not expected to move to ground water via leaching but may be sorbed to suspended sediment in runoff feeding into surface water bodies. As fenpyroximate has a measured BCF value greater than 1,000 (L/kg wet weight) and because fenpyroximate has a log K_{ow} of 5.01, bioconcentration and bioaccumulation in aquatic receptors and consumption of aquatic food items may be a concern for piscivorous birds and mammals.

Fenpyroximate is relatively stable in hydrolysis with a half-life of 226 days at pH 7. It degrades mainly via biodegradation in soil and water bodies (with half-lives that ranges from 28 to 259 days in aerobic soil metabolism studies, 23 to 34 days in aerobic aquatic metabolism studies and 8.95 to 33 days in an anaerobic aquatic metabolism study). This compound rapidly photoisomerizes in shallow, illuminated water (fenpyroximate half-life of 1.8 hours) to reach equilibrium with its *cis*-(Z)-isomer, M-1. However, the importance of this degradation pathway is expected to be limited because fenpyroximate and its isomer are expected to partition to sediment in water bodies, where aqueous photolysis is limited.

Fenpyroximate's *cis*-(Z)-isomer, M-1, its carboxylic acid M-3, cleavage products M-6, M-8, M-11, M-16, and carbon dioxide are the major transformation products (>10% formation) in submitted environmental fate studies. Due to lack of toxicity data for M-1, it is assumed to have equivalent toxicity to the parent. M-1 is included with the parent as a residue of concern due to its same structure as the parent fenpyroximate. Exposure estimates in this assessment reflect total toxic residues of concern (TTR) of parent fenpyroximate and major degradate M-1 for aquatic concerns. The other major transformation products were not considered residues of concern due to information indicating they are less toxic than parent fenpyroximate or the products form via a process that does not substantially influence exposure estimates (e.g., anaerobic aquatic metabolism).

To quantify aquatic exposure, 61 **P**esticide in **W**ater **C**alculator (PWC) scenarios were run, of which the highest EECs based on Florida citrus scenario are: 1.40 µg/L, 0.251 µg/L, and 0.136 µg/L, for 1-in-10-year daily exposure, 21-day average exposure, and 60-day average exposure, respectively. For the cranberry use site, the **P**esticide in **F**looded **A**pplication **M**odel (PFAM) predicts water column EECS of 0.636 µg/L, 0.622 µg/L, and 0.583 µg/L for 1-in-10-year daily exposure, 21-day average exposure, and 60-day average exposure, respectively.

1.4 Ecological Effects Summary

The fenpyroximate effects data set is complete with all required parent and degradates studies.

Fenpyroximate is very highly toxic to freshwater and estuarine/marine fish and invertebrates on an acute exposure basis. Reductions in length (3%), reductions in spawn per female (50%), and increases in time to hatch (14%) for offspring resulted from chronic exposure of fenpyroximate to freshwater fish. Decreased survival (13 - 95%) and reduction in dry weight (12%) resulted from chronic exposure of fenpyroximate to freshwater and estuarine/marine invertebrates. Aquatic plant toxicity testing indicated that vascular plants (*e.g.*, duckweed (*Lemna gibba*)) are not sensitive to fenpyroximate at the concentrations tested (190 µg ai/L), whereas, non-vascular plants (*e.g.*, marine diatoms (*Skeletonema costatum*) and green algae (*Scendesmus suspicatus*)) are sensitive to fenpyroximate at the concentrations tested, based on effects on cell density.

Fenpyroximate is practically non-toxic to young adult honey bees on an acute contact and oral basis, but is highly toxic to honey bee larvae on an acute basis. Additionally, increased mortality resulted from chronic exposure of fenpyroximate to adult and larvae honey bees.

Fenpyroximate is practically non-toxic to highly toxic to birds and moderately toxic to mammals on an acute exposure basis. Reductions in female body weight gain in birds (37%) and decreased parental (4 – 5%) and pup weight (15 – 24%) in mammals resulted from chronic exposure of fenpyroximate. Tier II terrestrial plant testing using both seedling emergence and vegetative vigor assays indicated that neither monocotyledonous nor dicotyledonous plants are sensitive to fenpyroximate at the application rate tested (0.30 lb a.i./A).

Table 1-1. Summary of Risk Quotients for Taxonomic Groups from Current Uses of Fenpyroximate

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC for Non-listed Species	Additional Information/ Lines of Evidence
Freshwater fish	Acute	0.45 – 1.9, 0.73 – 0.87 (cranberry use)	Yes	RQs exceeded the LOCs for all uses, except for uses on mint, ornamentals, and tomatoes. Acute fish toxicity data classified as very highly toxic.
	Chronic	0.91 – 8.5, 1.6 – 36 (cranberry use)	Yes	RQs exceeded the LOCs for all uses. Chronic endpoints include reduction in spawn per female and increase in time to hatch in offspring. There is uncertainty with the radiolabeled quantification method used in the study. This quantification method tends to over-estimate the parent concentrations thus underestimating the toxicity of the parent.
Estuarine/ marine fish	Acute	0.01 – 0.04	No	--
	Chronic	0.03 – 0.75	No	No chronic estuarine/marine fish data has been submitted for fenpyroximate. An acute-to-chronic ratio (ACR) was calculated using the rainbow trout LC_{50} and the fathead minnow NOAEC.

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC for Non-listed Species	Additional Information/ Lines of Evidence
Freshwater invertebrates	Acute	0.09 – 0.39, 0.15 – 0.18 (cranberry use), 0.22 – 0.93 (drift only)	Yes	RQs exceeded the LOC for the use on citrus, almond, pistachio, avocado, tree nuts, and hops. Acute invertebrate toxicity data classified as very highly toxic. The RQs based on drift only are based on formulation acute toxicity data.
	Chronic	0.05 – 0.45, 0.13 – 1.1 (cranberry use)	Yes	RQs exceeded the LOC for the use on cranberries based on a 13% decrease in survival. EEC does not exceed the LOAEC.
Estuarine/ marine invertebrates	Acute	0.1 – 0.42	No	--
	Chronic	0.05 – 0.67	No	--
Freshwater benthic invertebrates	Sub-chronic	<0.01 – 0.13, 0.01 – 2.1 (cranberry use)	Yes	RQs exceeded the LOC for the use on cranberries based on a 13% decrease in survival. EEC also exceeds the LOAEC. The exceedance results from using the most sensitive freshwater water column invertebrate data.
Estuarine/ marine benthic invertebrates	Sub-chronic	0.01 – 0.08, 1.09 – 1.2 (cranberry use)	Yes	RQs exceeded the LOC for the use on cranberries based on a 12% decrease in female dry weight. EEC does not exceed the LOAEC.
Mammals	Acute	<0.01 – 0.16	No	--
	Chronic	0.1 – 1.7	Yes	RQs exceeded the LOCs for small and medium sized mammals consuming short grass dose-based RQs based on parental and pup weight (24% decrease). Only exceeds the chronic LOC for the citrus, tree nuts (almond and pistachios), and avocado uses. EECs do not exceed the LOAEL. KABAM RQs ranged from 0.09 – 1.7.
Birds	Acute	0.01 – 4.8	Yes	For uses of fenpyroximate on citrus, tree nuts, almonds, and pistachios, the LOC was exceeded for small (20 g) and medium (100 g) birds feeding on short grass, tall grass, broadleaf plants, and arthropods; and for large (1000 g) birds feeding on short grass. The dose-based acute LOC for small birds feeding on short grass, tall grass, broad leaf plants and arthropods as well as medium birds feeding on short grass was exceeded for all uses of fenpyroximate.
	Chronic	0.08 – 2.5	Yes	RQs exceeded the LOCs for birds consuming short grass, tall grass, broadleaf plants, and arthropods. Birds feeding on shortgrass exceed the LOC for all uses except cotton, bush and vine crops, fruit trees, and ornamentals. Birds feeding on tall grass, broadleaf plants, and arthropods exceed the LOC for the uses on the citrus fruit group, almonds, pistachio, avocados, and the tree nut crop group.

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC for Non-listed Species	Additional Information/ Lines of Evidence
Terrestrial invertebrates	Acute Adult	Not calculated	No	No mortality in acute contact or oral studies.
	Chronic Adult	44 – 92	Yes	RQs exceeded the LOCs for all uses. 40% increase in mortality was observed at LOAEL.
	Acute Larval	6.8 – 14	Yes	RQs exceeded the LOCs for all uses. Classified as highly toxic.
	Chronic Larval	340 – 710	Yes	RQs exceeded the LOCs for all uses. 14% increased mortality was observed at LOAEL.
Aquatic plants	N/A	0.5 – 2.1	Yes	RQs exceeded the LOC for non-vascular species only for all registered uses except for cranberries, hops, melon, mint, pepper, ornamentals, and tomatoes. Effects were based on cell density.
Terrestrial plants	N/A	Not calculated	No	Seedling emergence and vegetative vigor studies reported an IC_{25}> 0.3 lbs ai/A, with no phytotoxic effects observed.

Level of Concern (LOC) Definitions:
Terrestrial Animals: Acute=0.5; Chronic=1.0; Terrestrial invertebrates=0.4
Aquatic Animals: Acute=0.5; Chronic=1.0
Plants: 1.0
--: No additional information
[1] RQs reflect exposure estimates for parent and degradate M1 and maximum application rates allowed on labels.

2 Introduction

This Draft Risk Assessment (DRA) examines the potential ecological risks associated with labeled uses of fenpyroximate on non-listed non-target organisms. Federally listed threatened/endangered species ("listed") are not evaluated in this document. For additional information on listed species, see **Appendix F**. The DRA uses the best available scientific information on the use, environmental fate and transport, and ecological effects of fenpyroximate. The general risk assessment methodology is described in the *Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs* ("Overview Document") (USEPA, 2004). Additionally, the process is consistent with other guidance produced by the Environmental Fate and Effects Division (EFED) as appropriate. When necessary, risks identified through standard risk assessment methods are further refined using available models and data. This risk assessment incorporates the available exposure and effects data and most current modeling and methodologies.

3 Problem Formulation Update

The purpose of problem formulation is to provide the foundation for the environmental fate and ecological risk assessment being conducted for the labeled uses of fenpyroximate. The problem formulation identifies the objectives for the risk assessment and provides a plan for analyzing the data and characterizing the risk. As part of the Registration Review (RR) process, a detailed Problem Formulation (USEPA, 2014) for this DRA was published to the docket in

December 2014. The following sections summarize the key points of the Problem Formulation and discusses key differences between the analysis outlined there and the analysis conducted in this DRA.

As summarized in the Problem Formulation based on previous risk assessments, potential risks associated with the use of fenpyroximate include chronic risk to mammals and birds, acute and chronic risk to fish (surrogates for aquatic-phase amphibians), acute risk to aquatic invertebrates, and risk to non-vascular aquatic plants. Since the problem formulation was completed, the following data have been reviewed:

- Fate and Exposure Data
    - Aerobic soil metabolism study (MRID 50124101)
    - Anaerobic aquatic metabolism study (MRID 50580601)
    - Environmental chemistry method (ECM) and independent laboratory validation (ILV) in water (MRIDs 50013401 & 50013403)
    - ECM and ILV in soil (MRIDs 50013402 & 50021401)

More specific information on these new data is described in **Sections 5** and **8.1**. The additional data result in updated aquatic modeling input values.

- Ecotoxicity Data
    - Chronic mysid toxicity study (MRID 50401301)
    - Freshwater fish full life-cycle toxicity study (MRID 48735301)
    - Predatory wasp (MRID 48735302)
    - Sediment toxicity study (MRID 48381101)
    - Avian sub-acute dietary toxicity – passerine species (MRID 50534101)
    - Acute and chronic larval oral honeybee toxicity studies (MRIDs 505341025, 50534104, and 50534107)
    - Chronic adult oral honeybee toxicity studies (MRIDs 50534103 & 50534106)
    - Adult acute contact honeybee toxicity study (MRID 50534105)
    - Full-field test for pollinators (MRID 50534108)

These new data are described in more detail in the effect characterization (**Section 6)**. The acute and chronic toxicity data for the honeybee larvae as well as for chronic data for adult honey bees show high sensitivity that was previously unknown due to lack of data.

3.1 Mode of Action for Target Pests

Fenpyroximate is a pyrazole contact insecticide and miticide that inhibits mitochondrial complex I electron transport. The mode of action blocks cell respiration by blocking formation of adenosine triphosphate (ATP), causing the target pest to lose motor control and collapse. Fenpyroximate specifically targets the proton-translocation in Nicotinamide adenine dinucleotide (NADH):ubiquinone oxidoreductase enzyme blocking ubiquinone reduction.

NADH:ubiquinone oxidoreductase, also known as respiratory complex I of mitochondria, transfers electrons from NADH to ubiquinone (coenzyme Q) and links this process with translocation of protons across the inner membrane to the cytoplasmic side creating a proton gradient which drives the synthesis of ATP. Sensitivity of an organism to fenpyroximate is expected to be affected by the specific organism NADH:ubiquinone oxidoreductase enzyme affinity with fenpyroximate, the density of the NADH:ubiquinone oxidoreductase enzyme within mitochondria, and the presence of alternative energy pathways.

In addition to the acute respiratory activity, fenpyroximate inhibits molting of all immature stages (as in insect growth regulators), inhibits oviposition, and decreases feeding action at sublethal levels.

3.2 Label and Use Characterization

3.2.1 Label Summary

Three end-use formulations containing 5% fenpyroximate are currently registered for use in the United States. Fujimite® 5EC (EPA Reg. No. 71711-19), Akari® 5SC Miticide/Insecticide (EPA Reg. No. 71711-4), and NAI-2399-2® 5EC (EPA Reg. No. 71711-40) include many of the same outdoor agricultural, ornamental, and greenhouse uses. Specific use sites, some of which overlap, include exotic fruits, citrus fruits, cotton, cucumbers, corn, fruiting vegetables, grapes, hops, low-growing berries (except cranberries), melons, mint, pome fruits, tuberous and corm vegetables (EPA Reg. No. 71711-40 only), stone fruits (EPA Reg. No. 71711-40 only), snap beans, tree nuts, nonbearing deciduous fruit, tree nuts and vines, ornamentals, greenhouse cucumbers, and greenhouse tomatoes. It is also noted that eight S18 registrations were issued in 2010 for honey bee in-hive use for fenpyroximate for the Varroa mite pest (registered in the states of CO, IN, KY, MN, MS, WI, IL and MO); these registrations all expired in either 2010 or 2011.

Table 3-1. Summary of the Maximum Labeled Use Patterns for Fenpyroximate

Use Site / Crop Group	App Target and Equip	Max Single Rate lbs ai/A	Max # App/yr and MRI	Max Annual Rate lbs ai/A/yr
10-10. Citrus Fruit Group	Foliage; Aerial/ Ground	0.21	2/ 14 days	0.42
Almond; Pistachio	Foliage; Ground	0.21	2/ 14 days	0.42
Avocado	Foliage; Aerial/ Ground	0.21	2/ 14 days	0.21*
14. Tree Nuts	Foliage; Ground	0.21	2/ 14 days	0.21*

Use Site / Crop Group	App Target and Equip	Max Single Rate lbs ai/A	Max # App/yr and MRI	Max Annual Rate lbs ai/A/yr
Hops	Foliage; Ground	0.158	1	0.158
1C. Tuberous and Corm Vegetables Subgroup; 8-10. Fruiting Vegetable Group; Beans, Succulent (Snap); Canistel; Corn, Field; Corn, Pop; Corn, Silage; Cucumber; Mamey (Mammee Apple); Mango; Papaya; Sapodilla; Sapote, Black; Star Apple	Foliage; Aerial/ Ground	0.105	2/ 14 days	0.21
9A. Melon Subgroup; 11-10. Pome Fruit Group; 12-12. Stone Fruit Group; 13-07F. Small Fruit Vine Climbing Subgroup; 13-07G. Low Growing Berry Subgroup; Mint/Peppermint/Spearmint; Pepper	Foliage; Ground	0.105	2/ 14 days	0.21
Cotton	Foliage; Aerial/ Ground	0.105	2/ 14 days	0.105*
Bush and Vine Crops (Edible Peel); Fruit Trees (All or Unspecified); Ornamentals	Foliage; Ground	0.105	2/ 14 days	0.105*
Potato, White/Irish (or Unspecified)	Foliage; Aerial/ Ground	0.10	2/ 7 days	0.20
Tomato	Foliage; Ground	0.10	2/ 14 days	0.20

App=application; equip=equipment; MRI = Minimum retreatment interval
*The max single use rate is the same as the max annual use rate despite the label allowing two applications.

3.2.2 Usage Summary

Based on market usage data from 2007 to 2016, usage of fenpyroximate averaged approximately 30,000 pounds per year (USEPA, 2018). The screening-level use assessment (SLUA) which only considers agricultural use, indicates that an average of 10,000 pounds per year is used on almonds. Other major uses include: oranges (6,000 pounds), grapes (5,000 pounds), corn and cotton (2,000 pound each), apple, grapefruit, and pecans (1,000 pounds each). The rest of the uses involve less than 1,000 pounds per year. Considering fenpyroximate’s importance to individual crops (*i.e.*, percent crop treated), grapefruit has a maximum percent crop treated of 30%, followed by almonds, nectarines, and oranges at 20% each.

4 Residues of Concern

In this risk assessment, the stressors of concern are those chemicals (parent and/or degradates) that may exert adverse effects on non-target organisms within the expected range of EECs.

Collectively, these stressors of concern are known as the Residues of Concern (ROC). The residues of concern usually include the active ingredient, or parent chemical, and may include one or more degradates that are observed in laboratory or field environmental fate studies. Degradates may be included in, or excluded from, the ROC based on submitted toxicity data, percent formation relative to the application rate of the parent compound, modeled exposure, and structure-activity relationships (SARs). Structure-activity analysis may be qualitative, based on retention of functional groups in the degradate, or they may be quantitative, using programs such as ECOSAR, the OECD Toolbox, ASTER, or others.

Fenpyroximate, its *cis* Z-isomer M-1, and the degradate M-3 are the residues of concern for mammals (and other terrestrial organisms, by extension). Due to structural similarity and lack of toxicity data, the residues of concern for mammals are assumed to have equivalent toxicity (USEPA, 2003).

Acute ecotoxicity data indicate that M-3 is four orders of magnitude less toxic to fish and aquatic invertebrates than the parent compound (MRIDs 46974401 and 46974402). Due to the large difference in acute toxicity between fenpyroximate and M-3 to aquatic animals, M-3 is not being considered as a residue of concern. An ECOSAR analysis estimated the M-3 degradate to be 10x less toxic to aquatic animals and aquatic plants on a chronic exposure basis than the estimated parent chronic toxicity values. The major degradates (MTBT, M-15, M-16) only show >10% formation in anaerobic aquatic metabolism laboratory tests which is assumed to be non-representative of biologically relevant exposure to fenpyroximate. However, the major degradates, M-8 and M-11, both form at levels greater than 10% in aerobic aquatic metabolism laboratory tests which provide a clear route of exposure of fenpyroximate to aquatic organisms. However, an ECOSAR analysis estimated M-8 and M-11 to be an order of magnitude less sensitive than the parent compound to fish, aquatic invertebrates, and green algae on an acute and chronic basis. Therefore, the residues of concern for aquatic organisms are fenpyroximate and its *cis* Z-isomer M-1.

5 Environmental Fate Summary

Table 5-1 summarizes the physical-chemical data for fenpyroximate. Fenpyroximate will not significantly volatilize despite having a low solubility in water (0.023-0.034 mg/L at pH 5-9, 25°C; MRID 44781003) and moderate Henry's Law Constant (1.2×10^{-6} atm-m^3/mol) because of its low vapor pressure (5.6×10^{-8} torr at 25°C; MRID 44781003) and high K_{OW} of 100,000 (log K_{OW} of 5.01; MRID 44781003). Minimal volatility was observed in the environmental fate studies because of the low vapor pressure and high sorption to soil. Fenpyroximate is slightly to hardly mobile in soil, with K_{FOC} values of 7,550-58,300 L/kg_{OC} (MRID 45649709). Sorption to soil correlates with the organic carbon fraction in soil (*i.e.*, the coefficient of variation across five soils for K_{FOC} (60%) is less than that for K_F (136%)). The compound is not expected to move to ground water via leaching but may be sorbed to suspended sediment in runoff feeding surface water bodies. Additionally, as fenpyroximate has a measured BCF value greater than 1,000 (L/kg wet weight) and because fenpyroximate has a log K_{ow} of 5.01, bioconcentration and bioaccumulation in aquatic receptors and consumption of aquatic food items may be a concern for piscivorous birds and mammals.

Table 5-1. Summary of Physical-Chemical, Sorption, and Bioconcentration Properties of Fenpyroximate

<table>
<tr><th>Parameter (units)</th><th colspan="3">Value</th><th>Source/
Comment</th></tr>
<tr><td>Molecular Weight (g/mole)</td><td colspan="3">421.50</td><td>$C_{24}H_{27}N_3O_4$</td></tr>
<tr><td>Water Solubility at 25°C mg/L</td><td colspan="3">pH 5: 0.023
pH 7: 0.026
pH 9: 0.034</td><td>MRID 44781003</td></tr>
<tr><td>Vapor Pressure (torr at 25°C)</td><td colspan="3">5.6 x 10^{-8}</td><td>MRID 44781003</td></tr>
<tr><td>Henry's Law constant at 25°C (atm-m^3/mole)</td><td colspan="3">1.2 x10^{-6}</td><td>Estimated from vapor pressure and water solubility at 25°C.</td></tr>
<tr><td>Log octanol-water partition coefficient (K_{ow}) (unitless)</td><td colspan="3">5.01</td><td>MRID 44781003</td></tr>
<tr><td rowspan="6">Freundlich Soil-Water Distribution Coefficients (K_F in L/kg); Freundlich organic carbon normalized distribution coefficients (K_{Foc} in L/kg-organic carbon)</td><td>Soil</td><td>K_F</td><td>K_{FOC}</td><td rowspan="6">MRID 45649709</td></tr>
<tr><td>sand</td><td>83</td><td>7550</td></tr>
<tr><td>loamy sand</td><td>93</td><td>18600</td></tr>
<tr><td>silt loam</td><td>290</td><td>41400</td></tr>
<tr><td>clay loam</td><td>1365</td><td>44000</td></tr>
<tr><td>loamy sand</td><td>175</td><td>58300</td></tr>
<tr><td>Fish bioconcentration factors (steady-state, total residues) (L/kg-wet weight whole fish tissue); depuration half-life (days)</td><td colspan="3"><u>Unadjusted Values</u>
712 (edible), 2674 (inedible), 1794 (whole fish)

<u>Adjusted Values</u>[!]
765-1125 (edible), 2791-4102 (inedible), 1826-2684 (whole fish)

<u>Depuration Half-life</u>
5.3 days</td><td>MRID 48381102</td></tr>
</table>

[!]Reviewer calculated ranges accounting for potential adsorption to Total Organic Carbon.

Table 5-2 summarizes the degradation half-life values from laboratory degradation data for fenpyroximate. Fenpyroximate slowly hydrolyzes at environmental pH values, with half-lives of 180-226 days at pH 5-9 (MRID 44847909). In contrast, fenpyroximate is rapidly photoisomerized to reach equilibrium with its *cis*-(Z)-isomer, M-1, and photolyzed in water, with a half-life of 1.8 hours (MRID 44781016). The photolysis half-life of M-1 was 12 hours. M-11 was the predominant photoproduct of fenpyroximate and M-1. The importance of phototransformation is expected to be limited, however, because fenpyroximate and its isomer are expected to partition to sediment in water bodies, where aqueous photolysis is limited.

Fenpyroximate moderately degraded in aerobic soil with half-lives of 28, 39, and 41 days (MRID 45187901/45649706, 46158501). A newer study (MRID 50124101) shows a wider range with half-lives of 38.6 days, 93.7 days, 253 days, and 259 days. M-3, M-8, and carbon dioxide were major degradates in soil. In aerobic aquatic systems, the compound degraded with half-lives of 23 and 34 days (MRID 47521406). M-3, M-8, and M-11 were major degradates in these systems. Under anaerobic aquatic conditions, fenpyroximate degraded at a similar rate, with a half-life of 33 days (MRID 45649707). A newer study (MRID 50580601) shows shorter half-life values of 8.95 days and 18.3 days. M-3, M-8, M-11, and M-16 were the major degradates in anaerobic conditions (chemical names and structures of degradates are shown in the **Appendix A ROCKs Table**).

Table 5-2. Summary of Environmental Degradation Data for Fenpyroximate and Residues of Concern

Study	System Details	Half-life (days)		Source/Comment
		Fenpyroximate	Residues of Concern (parent + M-1)	
Hydrolysis	pH 5, 7, 9	pH 5: 180 days pH 7: 226 days pH 9: 221 days	273 days	MRID 44847909
Aqueous Photolysis	pH 7, 25°C 40°N sunlight	1.8 hours	10.3 hours	MRID 44781016
Soil Photolysis	Sandy loam, 25°C, pH 7 40°N sunlight	22.4 days	73.6 days	MRID 45649705
Aerobic Soil Metabolism	(Japan) Ehime soil (sand), 25 °C	41 days	32.2 days	MRID 45187901 MRID 45649706
	(Japan) Kanagawa soil (loam), 25 °C	28 days	25.2 days	
	Sandy loam, 25 °C, pH 8.6	39 days	39 days*	MRID 46158501
	(Germany) Loamy Sand, 20 °C, pH 5.7	259 days (SFO)	255 days	MRID 50124101**
	(Germany) Sandy loam, 20 °C, pH 7.3	38.6 days (IORE)	37.9 days	
	(Germany) Clay, 20 °C, pH 7.0	93.7 days (IORE)	90 days	
	IA, Silt loam, 20 °C, pH 6.0	253 days (IORE)	262 days	
Aerobic Aquatic Metabolism	Switzerland, 20°C, river water: sediment, pH 7.59-8.48	23 days	23 days*	MRID 47521406
	Switzerland, 20°C, pond water: sediment, pH 7.86-8.55	34 days	34 days*	
Anaerobic Aquatic Metabolism	Porterville, CA. water: sandy loam, 25 °C, pH 8.9 – 9.9	33 days	33 days*	MRID 45649707
	Golden Lake, ND. water: sandy loam, 20 °C, pH 8.6	8.95 days (SFO)	12.7 days	MRID 50580601**
	Goose River, ND. water: clay loam, 20 °C, pH 8.7	18.3 days (SFO)	19.9 days	

*The M-1 isomer exists in a very small amount or non-existence.
**Only the two newer submitted studies provide the best fit method for half-life calculations.
SFO=single first order; IORE=indeterminate order (IORE).

A summary of terrestrial field dissipation (TFD) data is provided in **Table 5-3**. Fenpyroximate dissipated under terrestrial field conditions with half-lives that ranges from 1 to 24 days (MRID 45649710/-11 and 45649712/45734203), based on the results of three bare ground field experiments conducted in the United States and four conducted in Germany. These field dissipation half-lives range from being shorter than, to similar to, laboratory-derived degradation half-lives in soil. At the U.S. sites, half-lives of fenpyroximate + M-1 + M-3 were 35 days in the silt loam soil in Arkansas, 15 days in the sandy loam soil in California, and 43 days in the sandy loam soil in North Carolina. Fenpyroximate plus M-1 was not detected below the 15-cm soil depth and was not detected at any site after 61 days posttreatment. The soils were also analyzed for the transformation products M-3, M-8, and M-11. M-8 and M-11 were not detected at any of the sites. M-3 was detected in all three U.S. studies. At the German sites, fenpyroximate + M-1 + M-3 dissipated with half-lives of 3 to 37 days. Fenpyroximate was not detected below the 10-cm depth, except at one site at one sampling interval, and was not detected at any site after 56 days posttreatment.

Table 5-3. Summary of Field Dissipation Data for Fenpyroximate.

System Details	Half-life (days)	Source/ Comment
	Fenpyroximate	
German sandy silt loam	1	MRID 45649710/ 45649711
German sandy loam	11	
German loamy sand	12	
German sandy loam	24	
Commerce silt loam, AR	3.6	MRID 45649712/ 45734203
Cajon sandy loam, CA	4.1	
Norfolk sandy loam, NC	15	

6 Ecotoxicity Summary

Ecological effects data are used to estimate the toxicity of fenpyroximate to surrogate species. The ecotoxicity data for fenpyroximate and its associated products have been reviewed previously in multiple ecological risk assessments with the most recent full ecological risk assessment for proposed new uses of fenpyroximate in 2012 (USEPA, 2012a). Two partial assessments followed within one year (USEPA, 2012b; USEPA, 2013) as well as a Problem Formulation for Registration Review (USEPA, 2014). These data are summarized in Section 6.1 and Section 6.2. Various studies with terrestrial invertebrates, birds, and aquatic animals exposed to either the TGAI or formulated fenpyroximate were received since the Problem Formulation was issued in 2014; the results of these studies are described briefly in this section.

A search of the public ECOTOXicology database in May 2017 and the EFED ECOTOX refresh report (August 2017), yielded no new data from suitable studies with more sensitive (lower) toxicity endpoints than those previously used in risk assessments. Additional information on the Endocrine Disruptor Screening Program is available in **Appendix E**.

Table 6-1 and **Table 6-2** summarize the most sensitive measured toxicity endpoints available across taxa. These endpoints are not likely to capture the most sensitive toxicity endpoint for a particular taxa but capture the most sensitive endpoint across tested species for each taxa. All studies in this table are classified as acceptable or supplemental. Non-definitive endpoints are designated with a greater than or less than value. Values that are based on newly submitted data are designated with an N footnote associated with the MRID number in tables.

6.1 Aquatic Toxicity

Fenpyroximate is very highly toxic to freshwater and estuarine/marine fish and invertebrates on an acute exposure basis. In addition, freshwater fish and invertebrates showed a 2x increase in sensitivity to the fenpyroximate typical end-use product (TEP) as compared to the technical grade active ingredient (TGAI). Due to this potential increased sensitivity, a spray drift analysis was performed using the TEP toxicity data and comparing it to spray drift exposure estimates. On a chronic basis, results from the fish full life-cycle study with freshwater fish indicate a significant reduction in spawn per female, and delays in time to hatch observed for the F1 (offspring) generation in the second lowest test concentration (0.031 µg/L; NOAEC = 0.016 µg/L). This test identified parent recovery issues with fenpyroximate, which the study authors attempted to alleviate by utilizing radiolabeled test material. However, this approach often leads to overestimation of parent material and as a result potential underestimation of the parent's toxicity. Despite these deficiencies, the study authors provided evidence through analytical HPLC/RAM analysis that 93.1 – 100% of the Total Radioactive Residue (TRR) was associated with fenpyroximate: however, the recovery of test material was performed at the highest test concentration instead of the NOAEC/LOAEC. In addition, the study authors took steps, through a turnover rate of 7 hours, to keep the test material in solution.

In an early-life stage study, at the LOAEC, a 3% reduction in body length resulted from chronic exposure of fenpyroximate to freshwater fish (NOAEC = 0.11 µg a.i./L), but a percent effect of this magnitude has uncertain biological significance. In addition, this early-life stage study test material was noted to be slightly unstable and insoluble over the duration of the study, which resulted in a supplemental classification.

Similar to the chronic effects observed in the fish studies, reductions in dry weight resulted from chronic exposure of fenpyroximate to freshwater invertebrates and estuarine/marine invertebrates. The 28-day chronic toxicity with mysids (*Americamysis bahia*) resulted in a 12% reduction in female dry weight at 1.5 µg a.i./L (NOAEC = 0.93 µg a.i./L). Considering the fenpyroximate degradate data, the M-3 degradate of fenpyroximate is moderately toxic to freshwater fish and invertebrates on an acute exposure basis.

The 10-day sediment toxicity study with the midge (*Chironomus tentans*) resulted in a 21% reduction in dry weight at 300 µg total radioactive residues (TRR)/L in pore water (NOAEC = 145 µg TRR/L in pore water or 810 µg TRR/kg sediment). The pore water NOAEC is approximately 4x greater than the solubility limit of fenpyroximate (23 – 34 µg a.i./L) introducing uncertainty with the degree to which organisms were exposed to fenpyroximate during the duration of the test. In addition, there are parent recovery issues with fenpyroximate in sediment tests, which leads to similar problems as described above with the fish full life-cycle study. Toxicity values were calculated for sediment and pore water, including concentrations normalized for total organic carbon (TOC) (2.1%).

Aquatic plant toxicity testing indicated that vascular plants (*e.g.,* duckweed *(Lemna gibba)*) are not sensitive to fenpyroximate at the concentrations tested (EC_{50} is 6x greater than the solubility of fenpyroximate), whereas, nonvascular plants (*e.g.,* marine diatoms *(Skeletonema costatum)* and green algae *(Scendesmus suspicatus)*) are sensitive to fenpyroximate at the concentrations tested, based on effects on cell density.

Table 6-1. Aquatic Toxicity Endpoints Selected for Risk Quotient Calculations for Fenpyroximate

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)[1]	MRID Classification	Comments
Freshwater Fish (Surrogates for Vertebrates)					
Acute	TGAI 98.9%	Rainbow trout (*Oncorhynchus mykiss*)	96-h LC_{50} = 0.73	46799201 Acceptable	Very highly toxic
Acute	TEP 5.2%	Rainbow trout (*O. mykiss*)	96-h LC_{50} = 0.44	47098102 Acceptable	Very highly toxic
Acute	M-3 metabolite	Rainbow trout (*O. mykiss*)	96-h LC_{50} = 6200	46974402 Supplemental	Moderately toxic
Chronic	TGAI 98.6%	Fathead minnow (*Pimephales promelas*)	34-days NOAEC = 0.11 LOAEC = 0.23	45649808 Supplemental	3% reduction in length.
Chronic	TGAI 97.2%	Fathead minnow (*P. promelas*)	38-weeks NOAEC = 0.016 LOAEC = 0.031	48735301[N] Supplemental	50 % reduction in spawn per female & 14% reduction in F1 time to hatch. There is uncertainty with the quantification of the parent material. Use of total radioactive residues (TRR) may overestimate parent material.
Estuarine/Marine Fish (Surrogates for Vertebrates)					
Acute	TGAI 98.6%	Sheepshead Minnow (*Cyprinodon variegatus*)	96-h LC_{50} = 36	47098101 Acceptable	Very highly toxic
Chronic	--	--	NOAEC = 0.78 (ACR)	--	Based on ACR (46) of the rainbow trout LC_{50} (0.73 µg/L) and the fathead minnow NOAEC (0.016 µg/L).
Freshwater Invertebrates (Water Column)					
Acute	TGAI 98.35%	Waterflea (*Daphnia magna*)	48-h EC_{50} = 3.6	44781015 Acceptable	Very highly toxic
Acute	TEP 5.2%	Waterflea (*D. magna*)	48-h EC_{50} = 1.6	46800801 Acceptable	Very highly toxic
Acute	M-3 metabolite	Waterflea (*D. magna*)	48-h EC_{50} = 13050	46974401 Acceptable	Moderately toxic

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)[1]	MRID Classification	Comments
Chronic	TGAI 98.35%	Waterflea (*D. magna*)	3-weeks NOAEC = 0.56 LOAEC = 1.0	47098103 Acceptable	13% decrease in survival
Estuarine/Marine Invertebrates (Water Column)					
Acute	TGAI 98.8%	Eastern oyster (*Crassostrea virginica*)	48-h EC_{50} = 3.3	47021401 Acceptable	Very highly toxic
Acute	TGAI 98.8%	Mysid (*Americamysis bahia*)	96-h LC_{50} = 3.7	45649804 Acceptable	Very highly toxic
Chronic	TGAI 98.8%	Mysid (*A. bahia*)	32-days NOAEC = 1.46 LOAEC = 4.58	47521405 Supplemental	95% reduction in F0 Day-15 survival at LOAEC.
Chronic	TGAI 99.4%	Mysid (*A. bahia*)	28-day NOAEC = 0.93 LOAEC = 1.5	50401301[N] Acceptable	12% reduction in female dry weight.
Freshwater Invertebrate (Sediment)					
Subchronic	TGAI 99.8%	Midge (*Chironomus tentans*)	10-day mean-measured TRR Sediment: NOAEC = 810 LOAEC = 1600 µg TRR/kg Sediment (OC-normalized): NOAEC = 39,000 LOAEC = 76,000 µg TRR/kg TOC Pore water: NOAEC = 145 LOAEC = 300 µg TRR/L	48381101 Acceptable	21% reduction in growth (Ash-free dry weight); There is uncertainty with the quantification of the parent material. Use of total radioactive residues (TRR) may overestimate parent material.
Aquatic Plants and Algae					
Vascular	TEP 5.1%	Duckweed (*Lemna gibba*)	7-day EC_{50} >190 NOAEC = 31	45649811 Acceptable	Frond number is most sensitive endpoint.
Non-vascular	TEP 5.1%	Marine Diatom (*Skeletonema costatum*)	96 hr EC50 = 1.9 NOAEC = 0.26	45649815 Acceptable	Cell density is most sensitive endpoint.
Non-vascular	TGAI 99.4%	Green alga (*Scendesmus suspicatus*)	72 hr EC50 = 0.66 NOAEC ≥1.8	45649816 Supplemental	Cell density is most sensitive endpoint.

TGAI=Technical Grade Active Ingredient; TEP= Typical end-use product; a.i.=active ingredient

[N] Studies submitted since the problem formulation was completed are designated with an N associated with the MRID number.

[1] NOAEC and LOAEC are reported in the same units.

>Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011).

< Less than values designate non-definitive endpoints where growth, reproductive, and/or mortality effects are observed at the lowest tested concentration.

6.2 Terrestrial Toxicity

The available data indicate that fenpyroximate is highly toxic to passerine bird species (zebra finch), practically non-toxic to bobwhite quail and mallard ducks, and is moderately toxic to mammals on an acute exposure basis. Mortality and sublethal effects were both observed in the sub-acute dietary toxicity study for mallard ducks. Mortality was less than 50% in all treatment levels (three total); visual sublethal signs of toxicity were observed (decreased body weight, nutation (swaying), unkemptness) in all treatment levels (for a majority of the birds) up to 7 days after dosing.

In addition to the LC_{50} derived from the zebra finch sub-acute dietary toxicity test, an LD_{50} was also derived from the study author's conversion of dietary exposure to acute oral exposure using the same study data. This conversion was calculated from measurements of food consumed per bird in each treatment group, multiplying the food consumption rate by the treatment level of the respective group and then dividing that product by the average of all measured bird body weights for the duration of the study for each treatment group.

Reductions in female body weight gain in birds and decreased parental and pup weight in mammals resulted from chronic exposure to fenpyroximate. Chronic toxicity testing on the mallard ducks resulted in statistically significant effects at 182 mg ai/kg of diet, the second lowest concentration tested. Reduction in female body weight gain was the most sensitive endpoint with 37% reduction at the LOAEC; however, the study was classified as supplemental as the test animals used were 51 weeks of age and laid eggs 3 weeks into the study, which is older than birds typically used for avian reproduction studies. Two additional avian reproduction studies were reviewed. Although no effects were observed in the highest test concentration for either bobwhite quail or mallard ducks in these studies, there were concerns with the health of the control birds. The male and female controls birds in the bobwhite quail reproduction study showed signs of poor health at necropsy (*i.e.*, enlarged spleens, areas of hyperemia in the small and/or large intestine, size of right testis (≤1.6 cm). Additionally, the bobwhite quail and mallard duck reproduction studies had increased uncertainty with the health of the control birds due to small cage sizes that correlated with observed injuries.

Fenpyroximate is practically non-toxic to young adult honey bees on an acute contact and oral exposure basis. However, data indicate that fenpyroximate is highly toxic to larval honey bees on an acute exposure basis and shows chronic toxicity to adult honey bees and larval honey bees. In a 10-day oral toxicity study on adult honey bees, the NOAEL and LOAEL were 0.073 and 0.18 µg a.i./bee/day, based on 40% observed mortality at the LOAEL. In a 22-day oral toxicity study on larval honey bees, the NOAEC and LOAEC were 0.004 and 0.012 µg a.i./bee/day, based on effects observed on larval mortality and day-15 mortality. Additionally, adult and larval chronic oral studies showed increased mortality after exposure to the Fenpyroximate 5SC (5% purity) formulation. In a 10-day oral toxicity study on adult honey bees exposed to the TEP, the NOAEC and LOAEC were 0.615 and 1.36 µg a.i./bee/day, based on 40% increased mortality at the LOAEC. In a 8-day oral toxicity study on larval honey bees exposed to the TEP, the NOAEL and LOAEL were 0.0092 and 0.026 µg a.i./bee/day, based on 36% increased mortality at the LOAEL.

Tier II terrestrial plant testing using both seedling emergence and vegetative vigor assays indicated that monocotyledonous and dicotyledonous plants are not sensitive to fenpyroximate at the application rate tested.

Table 6-2. Terrestrial Toxicity Endpoints Selected for Risk Quotient Calculations and Risk Characterization for Fenpyroximate

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value[1]	MRID or ECOTOX No./ Classification	Comments
Birds (Surrogates for Terrestrial Amphibians and Reptiles)					
Sub-acute Dietary	TGAI 99.7%	Zebra Finches (*Taeniopygia guttata*)	LC_{50} = 403.4 mg ai/kg diet LD_{50} = 20.13 mg a.i./kg-bw	50534101[N]	Highly toxic; The LD_{50} was calculated by converting dietary exposure to acute oral exposure.
Acute Oral	TGAI 99%	Bobwhite Quail (*Colinus virginianus*)	LD_{50} >2000 mg a.i./kg-bw	45649715 Acceptable	Practically non-toxic
Sub-acute dietary	TGAI 99%	Bobwhite Quail (*C. virginianus*)	13-days LC_{50} >5000 mg a.i./kg-diet	44847908 Acceptable	Practically non-toxic
Acute Oral	TGAI 99%	Mallard Duck (*Anas platyrhynchos*)	LD_{50} >2000 mg a.i./kg-bw	45649714 Acceptable	Practically non-toxic
Sub-acute dietary	TGAI 99%	Mallard Duck (*A. platyrhynchos*)	13-days LC_{50} >5000 mg a.i./kg-diet	45649716 Acceptable	Practically non-toxic
Chronic	TGAI 99%	Bobwhite Quail (*C. virginianus*)	38-weeks NOAEC ≥ 255 LOAEC ≥ 255 mg/kg-diet	47521404 Supplemental	No effects
Chronic	TGAI 99%	Mallard Duck (*A. platyrhynchos*)	23-weeks NOAEC = 35 LOAEC = 182 mg/kg-diet	45649718 Supplemental	37% Reduction in female body weight gain.
Chronic	TGAI 99%	Mallard Duck (*A. platyrhynchos*)	21-weeks NOAEC ≥ 255 LOAEC ≥ 255 mg/kg-diet	47521403 Supplemental	No effects
Mammals					
Acute Oral	TGAI 98%	Laboratory rat (*Rattus norvegicus*)	LD_{50} = 245 mg a.i./kg-bw	43560501 Acceptable	Moderately toxic

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value[1]	MRID or ECOTOX No./ Classification	Comments
Chronic (2-generation reproduction)	TGAI 97.3%	Laboratory rat (*R. norvegicus*)	42-week NOAEL = 30 LOAEL = 100 mg a.i./kg-bw/day	43429506 Acceptable	4-5% decreased Parental weight; 24% (F1) and 15% (F2) decrease in pup weight
Terrestrial Invertebrates					
Acute contact (adult)	TEP 5.2%	Honey bee (*Apis mellifera* L.)	LD_{50} >479.8 µg a.i./bee	45649818 Acceptable	Practically non-toxic
Acute contact (adult)	TGAI 98.6%	Honey bee (*A. mellifera* L.)	LD_{50} >15.8 µg a.i./bee	50534105[N] Supplemental	Practically non-toxic
Acute oral (adult)	TGAI 98.6%	Honey bee (*A. mellifera* L.)	LC_{50} >118.5 µg a.i./bee	45649819 Supplemental	Practically non-toxic
Chronic oral (adult)	TGAI 99.4%	Honey bee (*A. mellifera* L.)	NOAEL = 0.073 LOAEL = 0.18 µg a.i./bee/day	50534103[N] Acceptable	40% mortality at the LOAEL
Acute oral (larval)	TGAI 99.4%	Honey bee (*A. mellifera* L.)	LD_{50} = 0.20 µg a.i./larvae	50534102[N] Acceptable	Highly toxic
Chronic oral (larval)	TGAI 98%	Honey bee (*A. mellifera L.*)	NOAEL = 0.004 LOAEL = 0.012 µg a.i./larvae/day	50534104[N] Acceptable	14% decrease in larval survival at LOAEL; 18% decrease in 15-day survival at LOAEL
Full field study (50-days)	TGAI 98% a.i.	Honey bee (*A. mellifera L.*)	NOAEC = > 0.09 lb a.i./acre	50534108[N] Supplemental	Decrease in brood index and increase in termination rate was on the margin of statistical significance for the second brood cycle. The study utilized pseudo replication and showed 32% mortality in the control group during the exposure phase compared to 17% mortality in the exposed colonies. The study also utilized an application rate that is less than the lowest registered application rate.
Terrestrial and Wetland Plants					

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value[1]	MRID or ECOTOX No./ Classification	Comments
Vegetative Vigor	TEP 5.2%	Various species	All plants tested: IC_{25} >0.30 lb a.i./acre; NOAEC = 0.30 lb/acre)	45649809 Acceptable	No effects
Seedling Emergence	TEP 5.2%	Various species	All plants tested: IC_{25} >0.30 lb a.i./acre; NOAEC = 0.30 lb/acre)	45649810 Acceptable	No effects

TGAI=Technical Grade Active Ingredient; TEP= Typical end-use product; a.i.=active ingredient

[N] Studies submitted since the problem formulation was completed are designated with an N associated with the MRID number.

[1] NOAEC and LOAEC are reported in the same units.

> Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011).

< Less than values designate non-definitive endpoints where growth, reproductive, and/or mortality effects are observed at the lowest tested concentration.

6.3 Incident Data

The Incident Data System (IDS) provides information on the available ecological pesticide incidents, including those that have been aggregately reported to the EPA since registration and prior to the latest database search (June of 2019). There are no reported ecological incidents for fenpyroximate in IDS.

7 Analysis Plan

7.1 Overall Process

This assessment uses a weight of evidence approach that relies heavily, but not exclusively, on a risk quotient (RQ) method. RQs are calculated by dividing an estimated environmental concentration (EEC) by a toxicity endpoint (*i.*e., EEC/toxicity endpoint). This is a way to determine if an estimated concentration is expected to be above or below the concentration associated with the effects endpoint. The RQs are compared to regulatory levels of concern (LOCs). The LOCs for non-listed species are meant to be protective of community-level effects. For acute and chronic risks to vertebrates, the LOCs are 0.5 and 1.0, respectively, and for plants, the LOC is 1.0. The acute and chronic risk LOCs for bees are 0.4 and 1.0, respectively. In addition to RQs, other available data (*e.g.*, incident data) can be used to help understand the potential risks associated with the use of the pesticide.

7.2 Modeling

Various models are used to calculate aquatic and terrestrial EECs (see **Table 7-1**). The specific models used in this assessment are discussed further below. Note that for both aquatic and terrestrial modeling the maximum single application rate was modeled for each use. Finally, new policies have been adopted in EFED, such as the selection of the one-day average concentration for the acute EEC in water rather than the peak value.

Table 7-1. List of the Models Used to Assess Risk

Environment	Taxa of Concern	Exposure Media	Exposure Pathway	Model(s) or Pathway
Aquatic	Vertebrates/ Invertebrates (including sediment dwelling)	Surface water and sediment[5]	Runoff and spray drift to water and sediment	PRZM-VVWM with PWC version 1.52[1] PFAM version 2.0[2]
	Aquatic Plants (vascular and nonvascular)			
Terrestrial	Vertebrate	Dietary items	Ingestion of residues in/on dietary items as a result of direct foliar application	T-REX version 1.5.2[3]
		Consumption of aquatic organisms	Residues taken up by aquatic organisms	KABAM version 1.0[4]
	Plants	Spray drift/runoff	Runoff and spray drift to plants	TERRPLANT version 1.2.2
	Bees and other terrestrial invertebrates	Contact Dietary items	Spray contact and ingestion of residues in/on dietary items as a result of direct application	BeeREX version 1.0
All Environments	All	Movement through air to aquatic and terrestrial media	Spray drift	AgDRIFT version 2.1.1 (Spray drift)

[1] The Pesticide in Water Calculator (PWC) is a Graphic User Interface (GUI) that estimates pesticide concentration in water using the Pesticide Root Zone Model (PRZM) and the Variable Volume Water Model (VVWM). PRZM-VVWM.

[2] Pesticides in Flooded Applications Model (PFAM) is used to simulate EECs when pesticides are applied to flooded or intermittently flooded areas.

[3] The Terrestrial Residue Exposure (T-REX) Model is used to estimate pesticide concentration on avian and mammalian food items.

[4] The K_{OW} based Aquatic Bioaccumulation Model (KABAM) is used to estimate exposure to terrestrial animals that may consume aquatic organisms when a chemical has the potential to bioconcentrate or bioaccumulate. The general triggers for running this model is that: the pesticide is a non-ionic, organic chemical; the Log K_{OW} value is between 3 and 8; and the pesticide has the potential to reach aquatic habitats.

[5] Sediment analysis is recommended when the soil-water distribution coefficient (Kd) ≥50-L/kg-soil; the log K_{OW}≥3; or the K_{OC} ≥ 1000 L/kg-organic carbon. Analysis of risk in sediment from exposure in pore water may also occur if

aquatic invertebrates are particularly sensitive, as it is expected that RQs will exceed LOCs even if the sediment is not the primary exposure media.

8 Aquatic Organisms Risk Assessment

8.1 Aquatic Exposure Assessment

8.1.1 Modeling

To predict estimated environmental concentrations (EECs), two of EFED's models PWC (Pesticide Water Calculator, Version 1.52) and PFAM (Pesticides in Flooded Applications Model, Version 2.0) were used. PWC is used to model the typical agricultural practices and PFAM is used to model pesticides applied to flooded or intermittently flooded areas, such as cranberry uses.

PWC was built upon and supersedes the Surface Water Concentration Calculator (SWCC, version 1.106). It is a graphical user interface that runs the Pesticide Root Zone Model (PRZM, version 5, November 15, 2006) and the Variable Volume Water Body Model (VVWM, 3/6/2014).

The PWC chemical input parameters are presented in **Table 8-1** and are based on the product chemistry and environmental fate inputs in the previous drinking water assessment (USEPA, 2012c) and the updated fate information discussed above.

Table 8-1. Aquatic Modeling Input Parameters for Chemical Tab for Fenpyroximate and M-1 Z-isomer

Parameter	Value	Source (MRID)
Physical/Chemical Parameters		
Molecular mass (molecular formula)	Parent[1]: 421.50 g/mol ($C_{24}H_{27}N_3O_4$)	Calculated
Vapor pressure (25 °C)	5.6 x 10^{-8} torr	44781003
Aqueous solubility (25°C)	0.026 mg/L (pH 7)	44781003
Henry's Law Constant (25°C, pH 7)	1.2 x10^{-6} atm-m^3/mol	Calculated
Persistence of Parent and its isomer M-1		
Hydrolysis half-life (25°C)	273 days	44847909
Aqueous photolysis half-life (25°C)	10.3 hours (0.86 solar days)	44781016
Aerobic soil metabolism half-life (25°C)	163.8 days (Upper 90% confidence bound on the mean of 32.2, 25.2, 39, 255*, 37.9*, 90*, and 262* days)	50124101* 46158501
Aerobic aquatic metabolism half-life (20°C)	45.4 days (Upper 90% confidence bound on the mean of 23, 34 d)	47521406

Parameter	Value	Source (MRID)
Anaerobic aquatic metabolism half-life (25°C)	33.1 days (Upper 90% confidence bound on the mean of 33, 12.7, and 19.9 days)	50580601* 45649707
Mobility		
Range of Freundlich organic carbon normalized partition coefficients (K_{FOC})	Parent: 34000 (mean of 7550; 18600; 41400; 44000; 58300 L/kg_{OC})	45649709

[1] The parent fate parameter information is assumed to apply to its Z-isomer M-1 as well.
*Newly submitted fate study

Pesticide in Water Calculator Scenarios are used to specify soil, climatic, and agronomic inputs in PRZM, and are intended to result in high-end water concentrations associated with a particular crop and pesticide within a geographic region. Each PWC scenario is specific to a vulnerable area where the crop is commonly grown. Soil and agronomic data specific to the location are built into the scenario, and a specific climatic weather station providing 30 years of daily weather values is associated with the location. **Table 8-2** identifies the use sites associated with each PRZM scenario as well as the application information including application rate, efficiency and spray drift percentage. To capture higher potential exposures, the timing of applications was assumed to be in the high rainfall months. The emergence date, maturation date and harvest date for each PWC scenario as well as the application dates are included in **Table 8-3**.

Table 8-2. PWC Input Parameters Specific to Use Patterns for Fenpyroximate (Applications Tab and Crop/land Tab)

Use Site	PWC Scenario	App. Rate/App. Efficiency*/ Spray Drift
10-10. Citrus Fruit Group	CAcitrus_WirrigSTD	2 @ 0.21 lb/ac, 95% / 12.5% 2 @ 0.21 lb/ac, 99% / 6.2%
	FLcitrusSTD	
14. Tree Nuts; Almond; Pistachio	CAalmond_WirrigSTD	2 @ 0.21lb/ac, 99% / 6.2%
Avocado	FLavocadoSTD	1 @ 0.21 lb/ac, 95% / 12.5% 1 @ 0.21 lb/ac, 99% / 6.2%
Hops	ORhopsSTD	1 @ 0.158lb/ac, 99% / 6.2%
Cucumbers	FLcucumberSTD	2 @ 0.105 lb/ac, 95% / 12.5% 2 @ 0.105 lb/ac, 99% / 6.2%
Snap beans	MIbeansSTD	
	ORsnbeansSTD	
Corn	IAcornstd	
	ILCornSTD	
	INCornStd	
	KSCornStd	
	MNCornStd	
	MScornSTD	
	NCcornESTD	
	NECornStd	
	OHCornSTD	

Use Site	PWC Scenario	App. Rate/App. Efficiency*/ Spray Drift
	PAcornSTD	
9A. Melon Subgroup	MImelonStd	2 @ 0.105 lb/ac, 99% / 6.2%
	MOmelonStd	
	NJmelonStd	
11-10 Pome Fruit	NCappleSTD	
	ORappleSTD	
	PAappleSTD_V2	
12-12 Stone Fruit	CAfruit_WirrigSTD	
	GAPeachesSTD	
	MICherriesSTD	
Mint/Peppermint	ORmintSTD	
Pepper	FLpeppersSTD	
Cotton	MScottonSTD	1 @ 0.105 lb/ac, 95% / 12.5% 1 @ 0.105 lb/ac, 99% / 6.2%
	NCcottonSTD	
Ornamentals	CAnurserySTD	1 @ 0.105 lb/ac, 99% / 6.2%
	FLnurserySTD	
	MInurserySTD	
	NJnurserySTD	
	ORnurserySTD	
	TNnurseySTD	
Potato	IDNpotato_WirrigSTD	1 @ 0.10 lb/ac, 95% /12.5% 1 @ 0.10 lb/ac, 99% / 6.2%
	MEpotatoSTD	
Tomato	CAtomato_WirrigSTD	1 @ 0.10 lb/ac, 99% / 6.2%
	FLtomatoSTD_V2	
	PAtomatoSTD	

*95% efficiency for aerial applications, 99% efficiency for ground applications

Table 8-3. Timing of PWC modeling Scenarios and Application Dates

Use Site	PWC Scenario	ED*	MD	HD	1st AD	2nd AD
10-10. Citrus Fruit Group	CAcitrus_WirrigSTD	1-1	1-2	12-31	10-1	+14
	FLcitrusSTD	1-1	1-2	12-31	10-1	
14. Tree Nuts; Almond; Pistachio	CAalmond_WirrigSTD	1-16	8-2	9-13	6-1	
Avocado	FLavocadoSTD	3-1	11-15	11-30	7-1	No 2nd Application
Hops	ORhopsSTD	4-1	7-30	9-1	6-1	
Cucumbers	FLcucumberSTD	10-16	12-5	12-10	11-15	
Snap beans	MIbeansSTD	6-1	7-27	9-4	7-1	
	ORsnbeansSTD	6-16	8-18	9-2	7-15	
Corn	IAcornstd	5-25	7-24	10-19	6-1	

Use Site	PWC Scenario	ED*	MD	HD	1st AD	2nd AD
	ILCornSTD	5-1	9-21	10-20	6-1	
	INCornStd	5-15	7-14	10-20	7-1	
	KSCornStd	5-10	7-9	10-20	6-1	
	MNCornStd	5-15	7-14	10-20	7-1	
	MScornSTD	4-10	8-22	9-2	7-1	
	NCcornESTD	4-15	8-28	9-12	7-1	
	NECornStd	5-25	7-24	10-20	7-1	
	OHCornSTD	5-1	9-26	10-25	8-1	
	PAcornSTD	4-16	7-4	10-1	6-15	+14
9A. Melon Subgroup	MImelonStd	4-30	6-25	8-15	5-15	
	MOmelonStd	4-10	7-1	7-31	6-1	
	NJmelonStd	5-1	6-30	7-21	6-1	
11-10 Pome Fruit	NCappleSTD	4-1	5-3	10-25	4-20	
	ORappleSTD	4-1	4-30	10-31	4-20	
	PAappleSTD_V2	4-16	5-10	10-15	5-1	
12-12 Stone Fruit	CAfruit_WirrigSTD	1-16	4-1	8-1	3-15	
	GAPeachesSTD	3-1	5-15	8-31	5-1	
	MICherriesSTD	5-1	7-7	7-21	6-15	
Mint/Peppermint	ORmintSTD	4-15	7-25	8-1	6-15	
Pepper	FLpeppersSTD	9-1	11-15	12-1	10-15	
Cotton	MScottonSTD	5-1	9-7	9-22	8-1	
	NCcottonSTD	6-1	8-1	11-1	7-10	
Ornamentals	CAnurserySTD	3-1	4-1	11-1	3-15	
	FLnurserySTD	1-1	1-2	12-31	5-15	No 2nd Application
	MInurserySTD	1-1	1-2	12-31	5-15	
	NJnurserySTD	1-1	1-2	12-31	5-15	
	ORnurserySTD	1-1	1-2	12-31	5-15	
	TNnurseySTD	3-16	4-15	10-22	4-1	
Potato	IDNpotato_WirrigSTD	6-1	8-15	9-15	7-1	+7
	MEpotatoSTD	6-1	10-1	10-5	8-15	
Tomato	CAtomato_WirrigSTD	3-1	7-1	9-1	6-1	
	FLtomatoSTD_V2	2-1	4-21	5-15	3-15	+14
	PAtomatoSTD	4-16	6-30	10-15	5-10	

*ED – emergence date; MD – maturation date; HD – harvest date; and AD – application date

The estimated environmental concentrations (EECs) for all modeled scenarios are tabulated in **Table 8-4**. Comparing the different mode of applications, the aerial application produces the higher EECs. Among the sixty-one modeling scenarios, only the top three predicted EECs are higher than 1.30 µg/L. The first two are for Florida citrus (representing use of 10-10 Citrus Fruit

Group) and Florida avocado with aerial applications while the third one is for California citrus. The highest water column EECs are 1.40 µg/L, 0.251 µg/L, and 0.136 µg/L for 1-in-10- year daily exposure, 21-day average exposure, and 60-day average exposure, respectively. The Illinois corn aerial application scenario predicted the highest pore water EECs in the sediment. The pore water EECs are 0.0804 µg/L and 0.0737 µg/L, respectively for 1-in-10- year peak and 21-day average exposure. An example of PWC output is presented as **Appendix B.**

Table 8-4. Estimated Environmental Concentrations (EECs) for All PWC Scenarios

PWC Modeling Scenario	Ground or Aerial	1-in-10-year Water Column EECs			1-in-10-year Pore Water EECs		1-in-10-year Sediment EECs	
		1-Day	21-Day	60-Day	Peak	21-Day	Peak	21-Day
Unit		(µg/L)			(µg/L)		(µg/kg dry sediment)	
CAcitrus_WirrigSTD	G	0.686	0.0991	0.0474	0.0254	0.0231	34.544	31.416
	A	1.38	0.20	0.0952	0.0512	0.0462	69.632	62.832
FLcitrusSTD	G	0.98	0.154	0.0935	0.0541	0.0494	73.576	67.184
	A	**1.40**	**0.251**	**0.136**	0.0718	0.0646	97.648	87.856
CAalmond_WirrigSTD	G	0.699	0.105	0.0534	0.030	0.028	40.8	37.67
FLavocadoSTD	G	0.676	0.0541	0.0237	0.0153	0.013	20.808	17.68
	A	1.36	0.107	0.0466	0.0287	0.0245	39.032	33.33
ORhopsSTD	G	0.516	0.0498	0.0266	0.0200	0.0192	27.2	26.112
FLcucumberSTD	G	0.351	0.0591	0.0381	0.0187	0.0182	25.432	24.752
	A	0.698	0.108	0.0594	0.0303	0.0275	41.208	37.4
MIbeansSTD	G	0.402	0.0716	0.0429	0.0291	0.0262	39.576	35.632
	A	0.748	0.121	0.0667	0.0374	0.0357	50.864	48.552
ORsnbeansSTD	G	0.353	0.0690	0.0532	0.0411	0.0394	55.896	53.584
	A	0.702	0.112	0.0576	0.0431	0.0414	58.616	56.304
IAcornstd	G	1.10	0.152	0.0942	0.0665	0.0621	90.44	84.456
	A	1.10	0.181	0.116	0.0747	0.0692	101.592	94.112
ILCornSTD	G	1.15	0.158	0.0982	0.0694	0.0658	94.384	89.488
	A	1.14	0.188	0.119	**0.0804**	**0.0737**	**109.344**	**100.232**
INCornStd	G	0.448	0.0724	0.0441	0.0268	0.0243	36.448	33.048
	A	0.736	0.120	0.0666	0.0308	0.0339	51.68	46.104
KSCornStd	G	0.541	0.115	0.0659	0.0483	0.0442	65.688	60.112
	A	0.761	0.145	0.0879	0.0576	0.0532	78.336	72.352
MNCornStd	G	0.423	0.0745	0.0568	0.0360	0.0162	48.96	45.288
	A	0.745	0.125	0.0799	0.0463	0.0428	62.968	58.208
MScornSTD	G	1.05	0.144	0.0743	0.0582	0.0543	79.152	73.848
	A	1.06	0.176	0.0931	0.0670	0.0580	91.12	78.88
NCcornESTD	G	0.774	0.110	0.0668	0.0471	0.0424	64.056	57.664
	A	0.809	0.146	0.0840	0.0556	0.0492	75.616	66.912
NECornStd	G	0.484	0.104	0.0632	0.0421	0.0364	57.256	49.504

PWC Modeling Scenario	Ground or Aerial	1-in-10-year Water Column EECs			1-in-10-year Pore Water EECs		1-in-10-year Sediment EECs	
		1-Day	21-Day	60-Day	Peak	21-Day	Peak	21-Day
	A	0.823	0.138	0.0803	0.0535	0.0463	72.76	62.968
OHCornSTD	G	0.584	0.109	0.0681	0.0509	0.0462	69.224	62.832
	A	0.747	0.141	0.0899	0.0593	0.0536	80.648	72.896
PAcornSTD	G	0.623	0.104	0.0626	0.0465	0.0415	63.24	56.44
	A	0.919	0.146	0.0848	0.0579	0.0518	78.744	70.448
MImelonStd	G	0.346	0.0553	0.0291	0.0164	0.0145	22.304	22.944
MOmelonStd	G	0.475	0.0691	0.0417	0.0256	0.0226	34.816	30.736
NJmelonStd	G	0.375	0.0588	0.0358	0.0210	0.0182	28.56	24.752
NCappleSTD	G	0.651	0.0923	0.0617	0.0456	0.0427	62.016	58.072
ORappleSTD	G	0.349	0.0564	0.0309	0.0193	0.0183	26.248	24.888
PAappleSTD_V2	G	0.660	0.106	0.0605	0.0467	0.0414	63.512	56.304
CAfruit_WirrigSTD	G	0.345	0.0517	0.0266	0.0146	0.0138	19.856	18.768
GAPeachesSTD	G	0.793	0.0879	0.0526	0.0384	0.0341	52.224	46.376
MICherriesSTD	G	1.02	0.143	0.0905	0.0692	0.0623	94.112	84.728
ORmintSTD	G	0.347	0.0540	0.0275	0.0170	0.0157	23.12	21.352
FLpeppersSTD	G	0.418	0.0735	0.0468	0.0274	0.0249	37.264	33.864
MScottonSTD	G	0.540	0.0827	0.0449	0.0339	0.0294	46.104	39.984
	A	0.807	0.107	0.0549	0.0389	0.0338	52.904	45.968
NCcottonSTD	G	0.580	0.0845	0.0541	0.0387	0.0349	52.632	47.464
	A	0.742	0.109	0.0643	0.0419	0.0377	56.984	51.272
CAnurserySTD	G	0.34	0.0391	0.026	0.0176	0.0163	23.936	22.168
FLnurserySTD	G	0.345	0.0507	0.0299	0.0164	0.0148	22.304	20.128
MInurserySTD	G	0.349	0.0376	0.0232	0.0145	0.0141	19.72	19.176
NJnurserySTD	G	0.353	0.0495	0.0285	0.0192	0.0178	26.112	24.208
ORnurserySTD	G	0.338	0.0289	0.0146	0.00836	0.00794	11.3696	10.7984
TNnurseySTD	G	0.339	0.0397	0.0246	0.0155	0.0143	21.08	19.448
IDNpotato_WirrigSTD	G	0.347	0.057	0.0309	0.0163	0.0155	22.168	21.08
	A	0.681	0.108	0.0542	0.0302	0.0282	41.072	38.352
MEpotatoSTD	G	0.729	0.117	0.0772	0.0628	0.0610	85.408	82.96
	A	0.720	0.142	0.0954	0.0685	0.0666	93.16	90.576
CAtomato_WirrigSTD	G	0.328	0.0484	0.0227	0.013	0.0116	17.68	15.776
FLtomatoSTD_V2	G	0.405	0.0589	0.041	0.0245	0.0225	33.32	30.6
PAtomatoSTD	G	1.18	0.164	0.107	0.0775	0.0736	105.4	100.096

*Maximum EECs are shown in bold.

PFAM was developed specifically for regulatory applications to estimate exposure for pesticides used in flooded agriculture such as rice paddies and cranberry bogs. The model considers the environmental fate properties of pesticides and allows for specification of common management practices that are associated with flooded agriculture, such as scheduled water releases and refills. It estimates both acute and chronic concentrations over different durations, allows for defining different receiving water bodies, and allows for more flexibility in refinement of assessments when needed.

PFAM was used to estimate EECs for fenpyroximate use on cranberries in the flood water released from a bog. The PFAM model simulates application of the pesticide to a wet or dry field and degradation in soil and/or water. If the pesticide is applied to dry soil, water may then be introduced into the field and movement of the pesticide may occur from soil into the water.

After flooding, water may be held in a holding system, recirculated to other areas of the cranberry production facility, or released to adjacent waterbodies (canals, rivers, streams, lakes, or bays) external to the cranberry fields. Potential exposure was evaluated for residues in cranberry bog water (*i.e.*, flood water in the treated cranberry field). The cranberry bog water estimates are post-application residues in flood water introduced into the treated cranberry field.

Release water EECs were calculated based on 30-years of simulated results with two flooding events per year for cranberries (*i.e.*, winter flooding and flooding during harvest). The same chemical inputs used in PWC are also applicable for PFAM. The PFAM applications tab and scenario input parameters are shown in **Table 8-5.**

Table 8-5. PFAM applications tab and scenario

Parameter	Input Value and Unit	Source/Comments
Cranberry	MA_Cranberry-Winter Flood STD.PFA OR_Cranberry-Winter Flood STD.PFA OR_Cranberry-No Flood STD.PFA WI_Cranberry-Winter Flood STD.PFA	Interim standard scenarios
Maximum single application rate	0.105 lb ai/A (0.1176 kg ai/HA), 2x	Use Rate for Cranberry
Application Dates	July 15 and July 29 (14 days apart)	Ground Applications Post bloom (bloom in late June or early July)
Slow Release (1/day)	0	Applied as a EC. Slow release is not expected to occur.
Drift Factor	Not applicable	Not applicable

The PFAM modeling results are presented in **Table 8-6**. The timing of fenpyroximate application on cranberry is before bloom and after bloom. Usually the cranberry blooms in late June or early July. The two applications of fenpyroximate are assumed on July 15 and July 29 at the rate of 0.105 lb/ac (0.1176 kg/HA) each. For estimated environmental concentrations (EECs), the 1-in-10 year daily average concentrations are in the range of 0.53 µg/L to 0.64 µg/L; 21-day average concentrations are in the range of 0.32 µg/L to 0.62 µg/L; and 60-day average concentrations are in the range from 0.026 µg/L to 0.58 µg/L. An example of the PFAM output is included in **Appendix B.**

Table 8-6. Cranberry EECs with PFAM Modeling for Fenpyroximate

Use	PWC Scenario	Application Dates (Month/ Day)	1-in-10 year EEC (µg/L)				
			Water Paddy Values			Pore Water	
			1-day	21-day	60-day	1-day	21-day
Cranberry Two applications @ 0.105 lb/ac (0.1176 kg/HA)	MA_Cranberry-Winter Flood STD.PFA	7/15, 7/29	0.531	0.416	0.391	1.16	1.10
	OR_Cranberry-Winter Flood STD.PFA	7/15, 7/29	0.619	0.369	0.321	1.12	1.01
	OR_Cranberry-No Flood STD.PFA	7/15, 7/29	0.604	0.074	0.0259	1.13	1.10
	WI_Cranberry-Winter Flood STD.PFA	7/15, 7/29	**0.636**	**0.622**	**0.583**	**1.24**	**1.15**

*Maximum EECs are shown in bold.

8.1.2 Monitoring

A search of the Water Quality Portal (USEPA & USGS, 2013) (https://www.waterqualitydata.us/) was completed on May 22, 2019 that included available monitoring information on fenpyroximate. This query returned 1459 sample results (National Water Information System, NWIS) from 470 sites. Among these results, 632 samples are classified as water and the remaining 827 are classified as sediment. Of the 632 water samples, only four of those samples are reported as ground water samples. It is also reported that sampling was completed in 2018 and was measured at <5.2 ng/L (limit of detection for water) for all four samples. Among the remaining surface water samples (628), only three measured above the 5.2 ng/L detection limit. These samples are 97.5 ng/L, 34.3 ng/L, and 14.5 ng/L and were collected from California by the USGS in 2016. For sediment samples, there are 450 classified as bottom materials and 377 as suspended. Only one sediment sample (15.1 µg/kg from Oregon collected by the USGS) was detected above the detection limit. All other sediment samples are <5.2 ng/L (suspended sediment samples) or <1.9 µg/kg (limit of detection for solid sediment samples).

A query was done on California Department of Pesticide Regulation Surface Water Database (http://www.cdpr.ca.gov/docs/emon/surfwtr/surfdata.htm), the results are the same samples as the NWIS samples from USGS.

8.2 Aquatic Organism Risk Characterization

8.2.1 Aquatic Vertebrates

The minimum and maximum aquatic vertebrate RQs generated from PWC and PFAM are displayed in **Table 8-7**. To determine that a use did not have LOC exceedances, all scenarios modeled for that respective use needed to result in RQs that did not exceed the LOC. A full set of minimum and maximum fish RQs for all registered uses are exhibited in **Appendix G**.

Table 8-7. Acute and Chronic Aquatic Vertebrate Risk Quotients for Non-listed Species

Use Site; Scenario	1-in-10 Yr EEC µg/L		Risk Quotient			
			Freshwater		Estuarine/Marine	
	Daily Ave	60-day Ave	Acute[1]	Chronic[2]	Acute[1]	Chronic[2]
			LC_{50} = 0.73 µg a.i./L	NOAEC = 0.016 µg a.i./L	LC_{50} = 36 µg a.i./L	NOAEC = 0.78 µg a.i./L
PWC						
Ornamentals, ORnurserySTD	0.34	0.015	0.46	0.91	0.01	0.02
Tomato, CAtomato_WirrigSTD	0.33	0.023	0.45	**1.4**	0.01	0.03
10-10. Citrus Fruit Group; FLcitrusSTD	1.4	0.14	**1.9**	**8.5**	0.04	0.17
PFAM						
Cranberry, MA Winter Flood STD	0.53	0.39	**0.73**	**24**	0.01	0.50
Cranberry, WI Winter Flood	0.64	0.58	**0.87**	**36**	0.02	0.75

Bolded values exceed the LOC for acute risk to non-listed species of 0.5 or the chronic risk LOC of 1.0. The endpoints listed in the table are the endpoint used to calculate the RQ.
NA: Data not available.
[1] The EECs used to calculate these RQs are based on the 1-in-10-year peak 1-day average value from **Table 8-4** and **Table 8-6.**
[2] The EECs used to calculate these RQs are based on the 1-in-10-year 60-day average value from **Table 8-4** and **Table 8-6**.

On an acute basis, all uses result in LOC exceedances for freshwater fish, except for uses on tomatoes, mint and ornamentals. The range of RQs is from 0.45 from use on tomatoes to 1.9 from use on citrus. The minimum RQ of 0.45 from the tomato use was calculated from a 1-in-10 year 1-day average EEC of 0.3 µg/L. In the context of the study that derived the lowest acute toxicological endpoint (MRID 46799201), this EEC is just under the 0.379 µg/L test concentration that showed no effects to all test organisms (Rainbow trout (*Oncorhynchus mykiss*)) for the duration of the study. Conversely, the highest RQ (1.9) results from an EEC of 1.4 µg/L (1-in-10 year 1-day average) which is nearly 2x greater than the LD_{50} (the concentration that killed 50% of the test population).

On a chronic basis, all uses result in LOC exceedances for freshwater fish. The range of RQs is from 0.91 – 8.5 (for all uses except cranberry) and 1.62 – 36 (cranberry use). Although the

Oregon ornamental scenario ('ORnurserySTD') in **Table 8-7** does not exceed the chronic LOC for freshwater fish, the New Jersey ornamental scenario ('NJnurserySTD') does exceed the LOC. Therefore, the use of fenpyroximate on ornamentals exceeds the LOC for freshwater fish. The 38-week full life-cycle chronic toxicity study (MRID 48735301) resulted in a LOAEC of 0.031 µg/L and at this concentration the test organisms (fathead minnow (*Pimephales promelas*)) exhibited 50% reduction in spawn per female as well as delays in time to hatch for the F_1 generation. All of the modeled uses also exceeded the LOAEC as well as the NOAEC. This study utilizes a TRR approach, which may underestimate the toxicity of parent material meaning that the true toxicity value could be less than the reported TRR NOAEC and LOAEC. It is noted that the study authors took steps to show that most of the TRR was parent material at the highest test concentration (93.1% - 100% fenpyroximate; HPLC/RAM analysis) and ensured the material stayed in solution (7 turnovers of test solution per-day) which does reduce the uncertainty in the overall endpoint of the study. However, since the TRR NOAEC is exceeded in all cases, the RQs, and potential risk, would only increase if the chronic toxicity endpoint of fenpyroximate decreases. This provides more certainty of chronic effects on fish under the exposure scenarios modeled. For estuarine/marine aquatic vertebrates, there were no acute LOC exceedances. It should be noted that the acute freshwater and estuarine/marine fish toxicity data indicates that fenpyroximate is two orders of magnitude more acutely toxic to freshwater fish than estuarine/marine fish. No chronic toxicity data for estuarine/marine aquatic vertebrates has been submitted for fenpyroximate. However, an acute-to-chronic ratio was calculated using the rainbow trout $LC_{50,}$ and the fathead minnow NOAEC were used to estimate an estuarine/marine NOAEC. The chronic endpoint calculated using the ACR resulted in no LOC exceedances for estuarine/marine fish.

Spray Drift Risk

In addition to exposure via runoff, fish in waterbodies adjacent to the treated fields may be exposed to pesticide transported by spray drift. Although the proposed labels include recommendations for reduction of drift, there is still a potential for movement via spray drift to off-field sites resulting in exposure to fish. Spray drift risk is assessed by considering fish in contact with residues transported by spray drift only wherein runoff and erosion are not considered. To evaluate the potential for effects from spray drift, AgDRIFT analyses were completed as a bounding exercise of the maximum and minimum foliar application rates to estimate the terrestrial spray drift distance from the edge of the field to where the acute LOC is still exceeded. In addition, it is important to also consider the spray drift only EECs since the fenpyroximate TEP acute toxicity endpoint is more sensitive than the TGAI derived acute toxicity endpoint. Moreover, the high affinity of fenpyroximate to bind to solid particles limits the chemical's ability to enter water bodies, thus spray drift only EECs derived from the highest application rate tend to be higher than the EECs that incorporate runoff and erosion. The estimated spray drift-only RQs as well as the AgDRIFT distances to acute endpoints are presented in **Table 8-8**.

Minimum and maximum spray drift-only EECs result in acute LOC exceedances with RQs ranging from 0.8 to 3.4. AgDRIFT estimated distances to the acute LOC range from 10 to 400 feet.

Potential spray drift-only risk to freshwater fish exceeding the acute LOC could occur from all uses of fenpyroximate.

Table 8-8. Minimum and Maximum Spray Drift Only RQs and AgDRIFT Derived Distances to Acute LOC

Application Rate (lbs a.i./A); Application Type	Acute (peak) Exposure[1]	Risk Quotient Freshwater LC_{50}[2] = 0.44 µg a.i./L	Drift Distance to Acute LOC (0.22 µg a.i./L) in Feet
0.21; Aerial, Fine to Medium DSD	1.48	**3.4**	400
0.21; Ground, High Boom, Very Fine to Fine DSD	0.73	**1.7**	56
0.1; Aerial, Fine to Medium DSD	0.70	**1.6**	150
0.1; Ground, High Boom, Very Fine to Fine DSD	0.35	**0.8**	10

Bolded values exceed the LOC for acute risk to non-listed species of 0.5. The endpoints listed in the table are the endpoint used to calculate the RQ.
[1]The EECs used to calculate this RQ are based on the absolute peak value estimated by AgDRIFT.
[2] Based on a 96-h acute LC_{50} of 0.44 µg a.i./L; TEP 5.2% (MRID 47098102).
DSD: Droplet size distribution.

Therefore, based on the available data, potential acute and chronic risk to aquatic freshwater vertebrates exceeding the LOC may occur from the use of fenpyroximate on all registered uses.

8.2.2 Aquatic Invertebrates

The minimum and maximum aquatic invertebrate RQs generated from PWC and the maximum RQ generated from PFAM are displayed in **Table 8-8**. Minimum and maximum aquatic sediment-dwelling RQs are displayed in **Table 8-9**. For the determination that a use did not have LOC exceedances, all scenarios modeled for that respective use needed to result in RQs that did not exceed the LOC. A full set of minimum and maximum aquatic invertebrate RQs for all registered uses are exhibited in **Appendix G**.

Table 8-9. Acute and Chronic Aquatic Invertebrate Risk Quotients

Use Sites	1-in-10 Yr EEC µg/L		Risk Quotient			
			Freshwater		Estuarine/Marine	
	Daily Ave	21-day Ave	Acute[1] LC_{50} = 3.6 µg a.i./L	Chronic[2] NOAEC = 0.56 µg a.i./L	Acute[1] LC_{50} = 3.3 µg a.i./L	Chronic[2] NOAEC = 0.93 µg a.i./L
PWC						
Tomato, CAtomato_WirrigSTD	0.33	0.048	0.09	0.09	0.10	0.05
10-10. Citrus Fruit Group; FLcitrusSTD	1.4	0.251	0.39	0.45	0.42	0.27
PFAM						

Cranberry, MA Winter Flood STD	0.53	0.42	*0.15*	0.74	*0.16*	0.45
Cranberry, WI Winter Flood	0.64	0.62	0.18	**1.1**	0.19	0.67

Bolded values exceed the LOC for acute risk to non-listed species of 0.5 or the chronic risk LOC of 1.0. The endpoints listed in the table are the endpoint used to calculate the RQ.
[1] The EECs used to calculate this RQ are based on the 1-in-10-year peak 1-day average value from **Table 8-4** and **Table 8-6**.
[2] The EECs used to calculate this RQ are based on the 1-in-10-year 21-day average value from **Table 8-4** and **Table 8-6**.

None of the RQs for acute toxicity to aquatic invertebrates resulted in acute LOC exceedances. The acute RQs range from 0.09 to 0.39. The maximum 1-in-10 year 21-day average EECs generated from PWC resulted in no chronic LOC exceedances (RQs ranged from 0.09-0.45). The only chronic LOC exceedance was for the use on cranberries in which the RQ was calculated using PFAM with an RQ of 1.11 for freshwater aquatic invertebrates. There were no chronic LOC exceedances for estuarine/marine invertebrates (RQs ranged from 0.05-0.27). The 3-week chronic daphnid study exhibited a 13% decrease in survival at the LOAEC concentration of 1.0 µg/L; the EECs did not exceed the LOAEC for any use.

Spray Drift Risk

Similar to the spray drift assessment performed on fish toxicity data, invertebrates in waterbodies adjacent to the treated fields may be exposed to pesticide transported by spray drift. Although the proposed labels include recommendations for reduction of drift, there is still the potential for movement via spray drift to off-field sites resulting in exposure to invertebrates. Again, AgDRIFT analyses were completed as a bounding exercise of the maximum and minimum foliar application rates to estimate the terrestrial spray drift distance from the edge of the field to where the acute LOC is still exceeded. Invertebrates are also more sensitive to the fenpyroximate TEP than the TGAI. The estimated spray drift-only RQs as well as the AgDRIFT distances to acute endpoints are presented in **Table 8-10**.

Minimum and maximum spray drift-only EECs result in acute LOC exceedances with RQs ranging from 0.22 to 0.93. AgDRIFT estimated distances to the acute LOC range from <1 to 60 feet. Potential spray drift-only risk to freshwater fish exceeding the acute LOC could occur from the use of fenpyroximate on citrus and avocado.

Table 8-10. Estimated Spray Drift-Only RQs and AgDRIFT Distances to Acute Endpoints

Application Rate (lbs a.i./A); Application Type	Acute (peak) Exposure[1]	Risk Quotient	Drift Distance to Acute LOC (0.8 µg a.i./L) in Feet
		Freshwater	
		LC_{50}[2] = 1.6 µg a.i./L	
0.21; Aerial, Fine to Medium DSD	1.48	**0.93**	60

Application Rate (lbs a.i./A); Application Type	Acute (peak) Exposure[1]	Risk Quotient	Drift Distance to Acute LOC (0.8 µg a.i./L) in Feet
		Freshwater	
		LC_{50}[2] = 1.6 µg a.i./L	
0.21; Ground, High Boom, Very Fine to Fine DSD	0.73	0.46	<1
0.1; Aerial, Fine to Medium DSD	0.70	0.44	<1
0.1; Ground, High Boom, Very Fine to Fine DSD	0.35	0.22	<1

Bolded values exceed the LOC for acute risk to non-listed species of 0.5. The endpoints listed in the table are the endpoint used to calculate the RQ.
[1]The EECs used to calculate this RQ are based on the absolute peak value estimated by AgDRIFT.
[2] Based on a 48-h acute EC_{50} of 1.6 µg a.i./L; TEP 5.2% (MRID 46800801).
DSD: Droplet size distribution.

Aquatic Benthic Invertebrates

Three approaches were used in this assessment to derive RQs for benthic invertebrates. The first set of RQs which utilized the labeled pore water concentrations, involves dividing the modeled EEC in sediment pore water by the sediment toxicity-based NOAEC measured in pore water. This approach did not result in LOC exceedances from RQs generated from both PWC and PFAM. For highly hydrophobic chemicals like fenpyroximate (*e.g.,* Log K_{OW} >5), measured concentrations in pore water from sediment toxicity tests can be highly uncertain due to analytical error and factors that affect chemical bioavailability. This uncertainty is evident from the pore water NOAEC and LOAEC exceeding the solubility of fenpyroximate in water. Due to this uncertainty, the second approach of dividing the modeled EEC in bulk sediment by the sediment toxicity-based NOAEC measured in bulk sediment was utilized. The bulk sediment-based RQ values were determined on a sediment organic carbon basis to account for the influence of sediment organic carbon on the bioavailability of the fenpyroximate. The bulk sediment approach resulted in no LOC exceedances for all modeled scenarios. There is a great deal of uncertainty with these endpoints due the study authors utilizing a TRR approach which may overestimate the parent concentration and in turn underestimate the parent's toxicity, thus underestimating risk. A third approach was utilized by dividing the modeled EEC in sediment pore water by the water column toxicity-based NOAEC measured from freshwater and estuarine/marine chronic invertebrate toxicity tests. This approach was utilized as there was only one available toxicity study on benthic invertebrates on the freshwater midge (*C. tentans*) rather than the three that are typically required (two freshwater species and one estuarine/marine species). Minimum and maximum sub-chronic aquatic benthic invertebrate RQs are presented in **Table 8-9**. Based on this third method, there are LOC exceedances for freshwater and estuarine/marine benthic invertebrates for the use on cranberries with RQs ranging from <0.01 – 2.1. The LOAEC is also exceeded for freshwater water column invertebrates that results in a 13% decrease in survival. Minimum and maximum aquatic benthic invertebrate RQs are presented for all uses in **Appendix G**.

Table 8-11. Minimum and Maximum Sub-chronic Aquatic Benthic Invertebrate Risk Quotients

Use Site	1-in-10 Yr EEC Pore Water (PW) or Bulk Sediment (BS)		Risk Quotients Freshwater Sub-Chronic			Risk Quotients Estuarine/Marine Sub-Chronic
	21-day (PW) (µg a.i./L)	21-day (BS)* (µg a.i./kg-oc)	Water Column NOAEC = 0.56 (µg/L)	Pore Water NOAEC = 145 (µg TRR/L)	Bulk Sediment NOAEC = 39000 (µg TRR/kg-oc)	Water Column NOAEC = 0.93 (µg/L)
PWC						
Tomato, CAtomato_WirrigSTD	0.012	394	0.02	<0.01	0.01	0.01
10-10. Citrus Fruit Group; FLcitrusSTD	0.065	2196	0.12	<0.01	0.06	0.07
Corn, ILCornSTD	0.074	2506	0.13	<0.01	0.06	0.08
PFAM						
Cranberry, OR Winter Flood STD	1.01	8594	**1.8**	0.01	0.24	**1.1**
Cranberry, WI Winter Flood	1.15	9786	**2.1**	0.01	0.25	**1.2**

*To normalize for the %OC, the bulk sediment EECs are divided by 0.04 to account for the 4% carbon content of the soil used in the modeling.
TRR = Total Radioactive Residues

Therefore, based on the available data, acute RQ exceedances of the LOC for aquatic invertebrates are expected from the registered use of fenpyroximate on citrus, almond, pistachio, avocado, tree nuts, and hops from spray drift exposures. In addition, potential chronic risk for freshwater invertebrates (included sediment-dwelling invertebrates) may occur from the use of fenpyroximate on cranberries.

8.2.3 Aquatic Plants

The minimum and maximum aquatic plant RQs generated from PWC and PFAM are displayed in **Table 8-10**. To determine that a use did not have LOC exceedances, all scenarios modeled for that respective use required RQs not to exceed the LOC. Minimum and maximum aquatic plant RQs for all use sites are presented in **Appendix G**.

Table 8-12. Minimum and Maximum Aquatic Plant Risk Quotients for Non-listed Species

Use Sites	1-in-10 Year Daily Average EEC µg/L	Risk Quotients	
		Vascular	Non-vascular
		IC_{50} > 190 µg a.i./L	IC_{50} = 0.66 µg a.i./L
PWC			
Tomato, CAtomato_WirrigSTD	0.328	<0.01	0.50
10-10. Citrus Fruit Group; FLcitrusSTD	1.4	<0.01	**2.12**
PFAM			

Cranberry, MA Winter Flood STD	0.53	<0.01	0.80
Cranberry, WI Winter Flood	0.64	<0.01	0.96

The LOC for non-listed plants is 1. The endpoints listed in the table are the endpoints used to calculate the RQ.
NA: Not available.

RQs for vascular plants were not calculated because of a non-definitive endpoint. However, risk is expected to be low since the EECs are three orders of magnitude below the non-definitive endpoint. There were LOC exceedances for non-vascular plants with RQs ranging from 0.5 to 2.12. The supplemental 72-hour green algae (*Scendesmus suspicatus*) study (MRID 45649816) that derived the most sensitive endpoint showed that cell density was the endpoint most affected. Therefore, based on the available data, potential risk to aquatic plants may occur from the use of fenpyroximate to tomatoes (RQs: 0.50 – 1.79), potatoes (RQs: 0.53 – 1.09), cotton (RQs: 0.82 – 1.22), stone fruit (RQs: 0.52 – 1.55), pome fruit (RQs: 0.53 – 1.00), corn (RQs: 0.64 – 1.74), snap beans (RQs: 0.53 – 1.13), cucumbers (RQs: 0.53 – 1.06), avocado (RQs: 1.02 – 2.06), Tree Nuts Crop Group (almonds and pistachios; RQ: 1.04), and Citrus Fruit Group (RQs: 1.04 – 2.12). RQs for all other uses (cranberries, hops, melon, mint, ornamentals and peppers) did not exceed the LOC.

9 Terrestrial Vertebrates Risk Assessment

9.1 Terrestrial Vertebrate Exposure Assessment

Terrestrial wildlife exposure estimates are typically calculated for birds and mammals by emphasizing the dietary exposure pathway. Fenpyroximate is applied through aerial and ground application methods, which includes sprayers and chemigation. Therefore, potential dietary exposure for terrestrial wildlife in this assessment is based on consumption of fenpyroximate residues on food items following foliar spray applications. EECs for birds[1] and mammals from consumption of dietary items on the treated field were calculated using T-REX v.1.5.2. For the foliar uses, EECs are based on application rates, number of applications, and intervals presented in **Table 3-1**. The default foliar dissipation half-life (35 days) was used to calculate EECs. Terrestrial wildlife may also be exposed through ingestion of residues in aquatic organisms. Exposure through this pathway was evaluated using KABAM.

9.1.1 Dietary Items on the Treated Field

Upper-bound Kenaga nomogram values are used to derive EECs for fenpyroximate exposures to terrestrial mammals and birds on the field of application based on a 1-year time period. Consideration is given to different types of feeding strategies for mammals, including herbivores, insectivores and granivores. Dose-based exposures are estimated for three weight classes of birds (20 g, 100 g, and 1,000 g) and three weight classes of mammals (15 g, 35 g, and 1,000 g). EECs on terrestrial food items range from 5.5 to 89 mg/kg-diet based on upper bound

[1] Birds are also used as a proxy for reptiles and terrestrial-phase amphibians.

Kenaga values. Dose base EECs, adjusted for body weight, range from 0.4 to 101 for birds and 0.2 to 84 for mammals. A summary of EECs is found in **Table 9-1**.

Table 9-1. Summary of Minimum and Maximum Dietary (mg a.i./kg-diet) and Dose-based EECs (mg a.i./kg-bw) as Food Residues for Birds, Reptiles, Terrestrial-Phase Amphibians and Mammals from Labeled Uses of Fenpyroximate (T-REX v. 1.5.2, Upper Bound and Mean Kenaga)

Food Type	Dietary-Based EEC (mg/kg-diet)	Dose-Based EEC (mg/kg-body weight)					
		Birds			Mammals		
		Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Citrus Fruit, Almonds, Pistachio (0.21 lb a.i./acre, 2x, 14-day interval)							
Short grass	89	101	58	26	84	58	14
Tall grass	41	46	26	12	39	27	6.2
Broadleaf plants/small insects	50	57	32	14	48	33	7.6
Fruits/pods/(seeds, dietary only)	5.5	6.3	3.6	1.6	5.3	3.7	0.9
Arthropods	35	40	23	10	33	23	5.3
Seeds (granivore)	NA	1.4	0.8	0.4	1.2	0.8	0.2
Cotton, Bush and Vine Crops (Edible Peel), Fruit Trees, Ornamentals (0.105 lb a.i./acre, 1x)							
Short grass	25	29	16	7.3	24	17	3.9
Tall grass	12	13	7.5	3.4	11	7.6	1.8
Broadleaf plants/small insects	14	16	9.2	4.1	14	9.3	2.2
Fruits/pods/(seeds, dietary only)	1.6	1.8	1.0	0.5	1.5	1.0	0.2
Arthropods	9.9	11	6.4	2.9	9.4	6.5	1.5
Seeds (granivore)	NA	0.7	0.4	0.2	0.6	0.4	0.1
Mean Kenaga: Citrus Fruit, Almonds, Pistachio (0.21 lb a.i./acre, 2x, 14-day interval)							
Short grass	31	36	20	9.1	30	21	4.8
Tall grass	13	15	8.6	3.7	13	8.8	2.0
Broadleaf plants/small insects	17	19	11	4.8	16	11	2.5
Fruits/pods/(seeds, dietary only)	2.6	2.9	1.7	0.8	2.5	1.7	0.4
Arthropods	24	27	16	7.0	23	16	3.7
Seeds (granivore)	NA	0.7	0.4	0.2	0.6	0.4	0.1
Mean Kenaga: Cotton, Bush and Vine Crops (Edible Peel), Fruit Trees, Ornamentals (0.105 lb a.i./acre, 1x)							
Short grass	8.9	10	5.8	2.6	8.5	5.9	1.4
Tall grass	3.8	4.3	2.5	1.1	3.6	2.5	0.6
Broadleaf plants/small insects	4.7	5.4	3.1	1.4	4.5	3.1	0.7
Fruits/pods/(seeds, dietary only)	0.7	0.8	0.5	0.2	0.7	0.5	0.1
Arthropods	6.8	7.8	4.4	2.0	6.5	4.5	1.0
Seeds (granivore)	NA	0.2	0.1	0.1	0.2	0.1	0.02

9.2 Terrestrial Vertebrate Risk Characterization

RQ values are generated based on the upper-bound EECs discussed above and toxicity values contained in **Table 6-2**. For acute exposures to birds (surrogate for terrestrial-phase amphibians and reptiles), dose based RQs resulted in LOC exceedances with RQs ranging from 0.01 to 4.8. For uses of fenpyroximate on citrus, almonds, and pistachios, the LOC was exceeded for small (20 g) and medium (100 g) birds feeding on short grass, tall grass, broadleaf plants, and arthropods; and for large (1000 g) birds feeding on short grass. The acute LOC for small birds feeding on short grass, tall grass, broadleaf plants and arthropods as well as medium birds feeding on short grass was exceeded for all uses of fenpyroximate. For dietary-based acute exposures for birds, there were no LOC exceedances with RQs ranging from 0.01 to 0.22 based on upper bound values.

For chronic exposures to birds, there were LOC exceedances for birds feeding on short grass, tall grass, broadleaf plants, and arthropods with dietary-based RQs ranging from 0.16 to 2.5 based on upper bound values, based on a 37% reduction in female body weight gain for the chronic mallard duck study (MRID 45649718). The chronic LOC (1.0) is exceeded for birds feeding on short grass for all uses except for cotton, bush and vine crops, fruit trees, and ornamentals. The chronic LOC (1.0) is exceeded for birds feeding on tall grass, broadleaf plants, and arthropods based on the current application rates for the citrus fruit group, almonds, pistachio, avocados, and the tree nut crop group. The T-REX generated EECs do not exceed the LOAEC (182 mg/kg-diet) for any use. RQs are provided in **Table 9-2**.

RQs based on upper bound Kenaga values, discussed above, give a conservative estimate of risk; however, RQs generated from mean Kenaga values provide a lower bound to the potential risks posed by the use of fenpyroximate caveated by the fact that all RQ calculations using mean Kenaga values means that exposure values may be higher than this around half of the time. For acute exposures to birds (surrogate for terrestrial-phase amphibians and reptiles), dose based RQs resulted in LOC exceedances with RQs ranging from <0.01 to 1.7. For uses of fenpyroximate on citrus, almonds, and pistachios, the LOC was exceeded for small (20 g) and medium (100 g) birds feeding on short grass and arthropods as well as small birds feeding on tall grass and broadleaf plants. The acute LOC for small birds and medium birds feeding on short grass and arthropods was exceeded for all uses of fenpyroximate except cotton, bush and vine crops, fruit trees and ornamentals. The acute LOC for small birds feeding on broad leaf plants was exceed for the use of fenpyroximate on citrus, almonds, pistachios, avocado, and tree nuts. The acute LOC for small birds feeding on tall grass was exceeded for the use of fenpyroximate on citrus, almonds, and pistachios. For dietary-based acute exposures for birds, there were no LOC exceedances with RQs ranging from <0.01 to 0.08. For chronic exposures to birds, there were no LOC exceedances for birds based on mean Kenaga values. RQs are provided in **Table 9-3**.

Additionally, it is observed that the lethal and sublethal effects to birds are not consistent across all test species of birds. Bobwhite quail and mallard duck tend to show less acute toxicity to fenpyroximate than passerine species.

On an acute dose-based exposure for mammals, RQ values range from <0.01 to 0.16, and do not exceed the LOC. For chronic exposures to mammals, dose-based RQs based on parental (4-5% reduction) and pup weight (24% reduction for F1 generation and 15% reduction for F2 generation) endpoints range from 0.01 to 1.3 based on upper bound values and do exceed the LOC but the EECs do not exceed the LOAEL. Based on this analysis, RQs generated for the citrus fruit group, almond, pistachio, avocado, and tree nut uses exceed the LOC for small and medium sized mammals consuming short grass. On a chronic dietary-based exposure for mammals, RQ values range from 0.01 to 0.15, and do not exceed the LOC. RQs are provided in **Table 9-4** and **Table 9-5**.

Table 9-2. Minimum and Maximum Acute and Chronic RQ values for Birds, Reptiles, and Terrestrial-Phase Amphibians from Labeled Uses of Fenpyroximate (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Acute Dose-Based RQ LD_{50} = 20.13 mg a.i./kg-bw			Acute Dietary-Based RQ LC_{50} = 403 mg a.i./kg-diet	Chronic Dietary RQ NOAEC = 35 mg a.i./kg-diet
	Small (20 g)	Medium (100 g)	Large (1000 g)		
10-10. Citrus Fruit Group, Almonds, Pistachio (0.21 lb a.i./acre, 2x, 14-day interval)					
Herbivores/Insectivores					
Short grass	**4.8**	**2.2**	**0.69**	0.22	**2.5**
Tall grass	**2.2**	**0.99**	0.32	0.10	**1.2**
Broadleaf plants	**2.7**	**1.2**	0.39	0.12	**1.4**
Fruits/pods/seeds	0.30	0.14	0.04	0.01	0.16
Arthropods	**1.9**	**0.85**	0.27	0.09	**1.0**
Granivores					
Seeds	0.07	0.03	0.01	N/A	N/A
Cotton, Bush and Vine Crops (Edible Peel), Fruit Trees, Ornamentals (0.105 lb a.i./acre, 1x)					
Herbivores/Insectivores					
Short grass	**1.4**	**0.6**	0.2	0.06	0.72
Tall grass	**0.6**	0.3	0.1	0.03	0.33
Broadleaf plants	**0.8**	0.4	0.1	0.04	0.41
Fruits/pods/seeds	0.1	0.04	0.01	<0.01	0.05
Arthropods	**0.5**	0.2	0.1	0.02	0.28
Granivores					
Seeds	0.02	0.01	<0.01	N/A	N/A

Bolded values exceed the LOC of 0.5 for acute risk to non-listed species or the chronic risk LOC of 1.0. The endpoints listed in the table are the endpoints used to calculate the RQ.
N/A: Not applicable.

Table 9-3. Minimum and Maximum Acute and Chronic RQ values for Birds, Reptiles, and Terrestrial-Phase Amphibians from Labeled Uses of Fenpyroximate (T-REX v. 1.5.2, Mean Kenaga)

Food Type	Acute Dose-Based RQ LD_{50} = 20.13 mg a.i./kg-bw			Acute Dietary-Based RQ LC_{50} = 403 mg a.i./kg-diet	Chronic Dietary RQ NOAEC = 35 mg a.i./kg-diet
	Small (20 g)	Medium (100 g)	Large (1000 g)		
10-10. Citrus Fruit Group, Almonds, Pistachio (0.21 lb a.i./acre, 2x, 14-day interval)					
Herbivores/Insectivores					
Short grass	**1.7**	**0.77**	0.24	0.08	0.90
Tall grass	**0.73**	0.33	0.10	0.03	0.38
Broadleaf plants	**0.91**	0.41	0.13	0.04	0.47
Fruits/pods/seeds	0.14	0.06	0.02	0.01	0.07
Arthropods	**1.3**	**0.59**	0.19	0.06	0.69
Granivores					
Seeds	0.03	0.01	<0.01	N/A	N/A
Cotton, Bush and Vine Crops (Edible Peel), Fruit Trees, Ornamentals (0.105 lb a.i./acre, 1x)					
Herbivores/Insectivores					
Short grass	0.49	0.22	0.07	0.02	0.26
Tall grass	0.21	0.09	0.03	0.01	0.11
Broadleaf plants	0.26	0.12	0.04	0.01	0.14
Fruits/pods/seeds	0.04	0.02	0.01	<0.01	0.02
Arthropods	0.37	0.17	0.05	0.02	0.20
Granivores					
Seeds	0.01	<0.01	<0.01	N/A	N/A

Table 9-4. Minimum and Maximum Acute RQ values for Mammals from Labeled Uses of Fenpyroximate (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Acute Dose-Based RQ LD_{50} = 245 mg a.i./kg-bw		
	Small (15 g)	Medium (35 g)	Large (1000 g)
10-10. Citrus Fruit Group, Almonds, Pistachio (0.21 lb a.i./acre, 2x, 14-day interval)			
Herbivores/Insectivores			
Short grass	0.16	0.13	0.07
Tall grass	0.07	0.06	0.03
Broadleaf plants	0.09	0.08	0.04
Fruits/pods/seeds	0.01	0.01	0.00
Arthropods	0.06	0.05	0.03
Granivores			
Seeds	<0.01	<0.01	<0.01
Cotton, Bush and Vine Crops (Edible Peel), Fruit Trees, Ornamentals (0.105 lb a.i./acre, 1x)			
Herbivores/Insectivores			
Short grass	0.04	0.04	0.02
Tall grass	0.02	0.02	0.01
Broadleaf plants	0.03	0.02	0.01

Food Type	Acute Dose-Based RQ LD$_{50}$ = 245 mg a.i./kg-bw		
	Small (15 g)	**Medium (35 g)**	**Large (1000 g)**
Fruits/pods/seeds	<0.01	<0.01	<0.01
Arthropods	0.02	0.01	0.01
Granivores			
Seeds	<0.01	<0.01	<0.01

Bolded values exceed the LOC of 0.5 for acute risk to non-listed species or the chronic risk LOC of 1.0. The endpoints listed in the table are the endpoints used to calculate the RQ.

Table 9-5. Minimum and Maximum Chronic RQ values for Mammals from Labeled Uses of Fenpyroximate (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Chronic Dose-Based RQ NOAEL = 30 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 600 mg a.i./kg-diet
	Small (15 g)	**Medium (35 g)**	**Large (1000 g)**	
10-10. Citrus Fruit Group, Almonds, Pistachio (0.21 lb a.i./acre, 2x, 14-day interval)				
Herbivores/Insectivores				
Short grass	**1.3**	**1.1**	0.59	0.15
Tall grass	0.59	0.50	0.27	0.07
Broadleaf plants	0.72	0.62	0.33	0.08
Fruits/pods/seeds	0.08	0.07	0.04	0.01
Arthropods	0.50	0.43	0.23	0.06
Granivores				
Seeds	0.02	0.02	0.01	N/A
Cotton, Bush and Vine Crops (Edible Peel), Fruit Trees, Ornamentals (0.105 lb a.i./acre, 1x)				
Herbivores/Insectivores				
Short grass	0.36	0.31	0.17	0.04
Tall grass	0.17	0.14	0.08	0.02
Broadleaf plants	0.20	0.18	0.09	0.02
Fruits/pods/seeds	0.02	0.02	0.01	0.00
Arthropods	0.14	0.12	0.07	0.02
Granivores				
Seeds	0.01	<0.01	<0.01	N/A

Bolded values exceed the LOC of 0.5 for acute risk to non-listed species or the chronic risk LOC of 1.0. The endpoints listed in the table are the endpoints used to calculate the RQ.

Fenpyroximate may bioaccumulate in aquatic organisms, with unadjusted fish bioconcentration factors of up to 712, 2674, and 1794 for edible, inedible, and whole bluegill (*Lepomis macrochirus*) fish tissues, respectively (MRID 48381102). Due to concerns that terrestrial wildlife may also be exposed through ingestion of residues in aquatic organisms, this exposure pathway was evaluated using KABAM. The full KABAM assessment can be found in **Appendix D**.

KABAM-estimated RQs based on dietary-based exposures of birds to fenpyroximate through consumption of contaminated aquatic prey are listed in **Table 9-6**. Dose-based and dietary-based acute and chronic RQs did not exceed the Agency's acute risk LOC for any of the six size classes of birds.

Table 9-6. KABAM RQs for Birds Ingesting Contaminated Aquatic Prey [A]

Wildlife species	Acute		Chronic
	Dose-based	Dietary-based	Dietary-based
Sandpipers	0.14	0.01	0.08
Cranes	0.01	0.01	0.09
Rails	0.08	0.01	0.09
Herons	0.01	0.01	0.10
Small Osprey	0.02	0.01	0.13
White Pelican	0.01	0.02	0.18

[A] **Bolded** values exceed the non-listed species acute risk LOC (0.5) or the chronic risk LOC (1.0).

KABAM-estimated RQs based on dose-based or dietary-based exposures of mammals to fenpyroximate through consumption of contaminated aquatic prey are listed in **Table 9-7**. Dose-based acute RQs did not exceed the Agency's acute risk LOC for any of the six size classes of mammal. However, chronic RQs for four of the six size classes of mammal exceeded the Agency's chronic risk level of concern (1.0) on a dose basis (RQs range from 0.5 - 1.7). These results indicate that only the use of fenpyroximate on cranberries may exceed chronic risk LOCs for some mammals that ingest aquatic organisms.

Table 9-7. KABAM RQs for mammals ingesting contaminated aquatic prey [A]

Wildlife species	Acute	Chronic	
	Dose-based	Dose-based	Dietary-based
Fog/Water Shrew	<0.01	0.50	0.09
Rice Rat/Star-nosed Mole	<0.01	0.63	0.09
Small Mink	0.01	0.96	0.15
Large Mink	0.01	**1.1**	0.15
Small River Otter	0.01	**1.1**	0.15
Large River Otter	0.01	**1.7**	0.21

[A] **Bolded** values exceed the acute non-listed species risk LOC (0.5) or the chronic risk LOC (1.0).

Based on the available data, the risk to mammals on an acute basis from the use of fenpyroximate is expected to be low. However, potential dose-based acute risk to birds may occur from the use of fenpyroximate. A sub-acute dietary study indicated that fenpyroximate is highly toxic to passerine species. The LD_{50} and LC_{50} derived from this study are much more sensitive than the previous studies submitted for avian species. Additionally, based on RQs exceeding the chronic LOC using the NOAEC, there is potential risk to birds on a chronic dietary basis and to mammals on a chronic dose basis from fenpyroximate use on citrus, tree nuts, and avocado; however, the LOC is not exceeded when the LOAEC values are used. Furthermore, chronic mammal LOC exceedances were estimated by KABAM for the use of fenpyroximate on cranberries.

10 Terrestrial Invertebrate Risk Assessment

10.1 Terrestrial Invertebrate Exposure Assessment

A subset of crops to which fenpyroximate is applied is listed in **Table 10-1** (USDA, 2017) along with the USDA pollinator attractive data to identify which crops may have exposure to pollinators on the field. Off-field assessments are conducted for foliar sprays regardless of whether the crop is attractive or not.

Table 10-1. Summary of Information on the Attractiveness of Registered Use Patterns for Fenpyroximate to Bees

Crop Name	Honey Bee Attractive?[1,2]	Bumble Bee Attractive?[1, 2]	Solitary Bee Attractive?[1, 2]	Acreage in the U.S.	Notes
Almonds	Y (nectar[1] & pollen[2])	Yes[1]	Yes[1]	780,000	Bee pollination is required, and the crop uses managed pollinators. Crop is not harvested prior to bloom.
10-10. Citrus Crop Group	Y (nectar & pollen)[2]	Yes[1]	Yes[1]	Oranges: 797,000 Grapefruit: 73,300	Variable among orange cultivars; honey bees brought to grove for orange blossom honey; bee pollination not required but some use managed pollinators.
Avocado	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	59,950	Not harvested prior to bloom.
Hops	Y (pollen)[1]	No	No	35,224	NA
1C. Tuberous and Corm Vegetables Subgroup	N	Yes[1]	Yes[1] (*Andrena*)	Potatoes: 1,052,000	Potatoes and sweet potatoes require pollination for breeding only.
8-10. Fruiting Vegetable Group	N	Yes[1]	Yes[1]	Tomatoes: 93,600 (fresh) and 277,000 (processing)	Tomatoes may be grown in glasshouses where bumblebees are needed for pollination.
Beans, Succulent (Snap)	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	77,200 (snap beans)	Crops not harvested prior to bloom.
Corn	Y (pollen)[1]	Yes[1]	Yes[1]	87,668,000	Wind pollinated but can be visited during pollen shedding.

Cucumber	Y (nectar & pollen)[1]	Yes[1]	Yes[1] (*Melissades Andrena*)	40,060 (fresh) and 82,100 (pickles)	The crop REQUIRES bee pollination and uses managed pollinators. Bees are used for seed production.
9A. Melon Subgroup	Y (nectar & pollen)[1]	Yes[1]	Yes[1] (*Agapostemon, Floridegus, Halictus, Hoplitus, Melissodes*)	Watermelon: 123,330	The crop REQUIRES bee pollination and uses managed pollinators.
11-10. Pome Fruit Group	Y (nectar[1] & pollen[2])	Yes[1]	Yes[2]	Apples: 327,800	Apples REQUIRE bee pollination and the use of managed pollinators.
12-12. Stone Fruit Group	Y (nectar & pollen)[3]	Yes[3]	Yes[1]	Apricot: 12,150 Nectarines: 26,400 Cherry: 86,790 (sweet) and 36,500 (tart) Plums: 82,780	Apricots, nectarines, cherries, and plums REQUIRE bee pollination and the use of managed pollinators.
13-07F. Small Fruit Vine Climbing Subgroup	Y (nectar & pollen)[1]	Yes (attractiveness ranges from not attractive to highly attractive)	Yes (attractiveness ranges from not attractive to opportunistically attractive)	Kiwifruit: 4,200 Grapes: 962,100	Grapes do not require bee pollination or use managed pollinators; not harvested prior to bloom; wind pollinating.
13-07G. Low Growing Berry Subgroup	Y (nectar & pollen)[1]	Yes[1]	Yes[1] (*Andrena, Halictids, Osmia*)	Strawberries: 58,190	For strawberries, some growers use supplemental hives to compliment wind pollination.
Mint/Peppermint/Spearmint	Y (nectar[2] & pollen[1])	Yes[2]	Yes[1]	Peppermint: 68,800	Peppermint oil is produced from vegetative growth, without flowering or seed production.
Pepper	Y (pollen)[1]	Yes[2]	Yes[1]	Chile and Bell: 71,200	May be grown in glasshouses, with bumble bees for pollination.

Cotton	Y (nectar)[1]	Yes[1]	Yes[1]	7,664,400	Does not require bee pollination or use managed pollinators; used by some beekeepers for honey production.

[1] attractiveness rating is a single "+", denoting a use pattern is opportunistically attractive to bees.
[2] attractiveness rating is a double "++" denoting a use pattern is attractive in all cases
[3]attractiveness rating ranges from single "+" to double "++"
ND: No data.
NA: Not available.

10.2 Terrestrial Invertebrate Tier I Exposure Estimates

Contact and dietary exposure are estimated separately using different approaches specific for different application methods. The Bee-REX model (Version 1.0) calculates default (*i.e.*, high end, yet reasonably conservative) EECs for contact and dietary routes of exposure to bees from foliar, soil, and seed treatment applications.

In cases where the Tier I RQs exceed the level of concern (LOC, discussed below), estimates of exposure may be refined using measured pesticide concentrations in pollen and nectar of treated crops, and further calculated for other castes of bees using their food consumption rates as summarized in the White Paper to support the Scientific Advisory Panel (SAP) on the pollinator risk assessment process (USEPA, 2012d).

10.3 Terrestrial Invertebrate Risk Characterization (Tier I)

Tier I bee data are available for fenpyroximate. Non-definitive endpoints were derived from the acute adult contact and acute adult oral studies. The 10-day adult chronic oral study with the TGAI exhibited a NOAEL of 0.073 µg a.i./bee and showed a 40% increase in mortality at the LOAEL of 0.18 µg a.i./bee. The larval acute oral study with the TGAI derived an LD_{50} of 0.20 µg a.i./larvae and is classified as highly toxic. The larval chronic oral study with the TGAI demonstrates a NOAEL of 0.004 µg a.i./larvae and a LOAEL of 0.012 µg a.i./larvae showing a 18% increase in 15-day mortality and a 14% decrease in larval mortality.

10.3.1 Tier I Risk Estimation (Contact Exposure)

On-Field Risk

Since potential exposure to bees was identified for all registered uses both on and off the treated field, the next step in the risk assessment process is to conduct a Tier I risk assessment. Fenpyroximate is registered for more crops identified as having potential exposure to bees, but the above bee attractive crops were selected as representatives for each maximum single application rate. By design, the Tier I assessment begins with (high end) estimates of exposure via contact and oral routes. For contact exposure, only the adult (forager and drones) life stage is considered since this is the relevant life stage for honey bees. Furthermore, toxicity protocols have only been developed for acute exposures. Effects are defined by laboratory exposures to groups of individual bees.

Table 10-2. Default Tier 1 Adult, Acute Contact Risk for Honey Bees Foraging on Almonds

Use Pattern	Bee Attractiveness	Max. Single Application Rate	Dose (μg a.i./bee per 1 lb a.i./A)[1]	Acute RQ[2]
10-10. Citrus Fruit Group, Almonds, Avocado, 14. Tree Nuts	Y (nectar & pollen)	0.21 lb a.i./A	3.2	<0.02

[1] Source: USEPA 2014. Guidance for Assessing Pesticide Risks to Bees

[2] Based on acute contact LD_{50} of >15.8 μg a.i./bee for fenpyroximate (MRID 50534105).

The RQ for adult contact exposure (non-definitive endpoint) did not exceed the LOC. Fenpyroximate is classified as practically non-toxic to adult bees through acute contact exposure.

10.3.2 Tier I Risk Estimation (Oral Exposure)

On-Field Risk

For oral exposure, the Tier I assessment considers the caste of bees with the greatest oral exposure (foraging adults). If risks are identified, then other factors are considered for refining the Tier 1 risk estimates. These factors include other castes of bees and available residue information on pollen and nectar which is deemed applicable to the crops of interest.

Table 10-3. Tier 1 Minimum and Maximum Oral Risk Quotients for Adult Nectar Forager and Larval Worker Honey Bees

Use Pattern	Max. Single Appl. Rate	Bee Caste/Task	Unit Dose (μg a.i./bee per 1 lb a.i./A)[1]	Oral Dose (μg a.i./bee)	Acute Oral RQ[2,3]	Chronic Oral RQ[4]
10-10. Citrus Fruit Group, Almonds, Avocado, 14. Tree Nuts	0.21 lb a.i./A	Adult nectar forager	32	6.7	<0.06	**92**
		Larval worker	13.6	2.9	**14**	**710**
Potato and Tomato	0.10 lb a.i./A	Adult nectar forager	32	3.2	<0.03	**44**
		Larval worker	13.6	1.4	**6.8**	**340**

[1] Source: USEPA 2014. Guidance for Assessing Pesticide Risks to Bees.

[2] Based on a 48-h acute oral LD_{50} of >118.5 µg a.i./bee for adults (MRID 45649819) and 3-d LD_{50} of 0.20 µg a.i./bee for larvae (MRID 50534102).
[3] **Bolded** RQ value exceeds (or potentially exceeds) the acute risk LOC of 0.4 or chronic LOC of 1.0
[4] Based on a 10-d chronic NOAEL of 0.073 µg a.i./bee/d for adults (MRID 50534103) and a 22-d chronic NOAEL of 0.004 µg a.i./bee/d for larvae (MRID 50534104)

RQs for adult acute oral exposure (non-definitive endpoint) did not exceed the LOC. However, there were adult chronic oral LOC exceedances with RQs ranging from 44 to 92 with EECs also exceeding the study's LOAEL where a 40% increase in mortality was observed. Larval acute oral RQs exceeded the LOC with RQs ranging from 6.8 to 14. Similarly, larval chronic oral RQs exceeded the LOC with RQs ranging from 340 to 710 with the EECs also exceeding the LOAEL where a 14% increase in larval mortality occurred.

For characterization purposes, refined acute and chronic oral RQs were calculated for adult bees and larvae using measured residues of fenpyroximate in pollen and nectar collected from bees foraging in *Phacelia* (MRID 50534108). The nectar and pollen residues were collected during the Tier III full-field study performed for fenpyroximate in which fenpyroximate was applied to *Phacelia* at an application rate of 0.09 lb a.i./A (described in **Section 10.4**). Pollen traps at hive entrances were used to collect pollen samples and then *Phacelia* pollen was microscopically separated from non-target plant pollen. Bailers were used to collect foraging honey bees at hive entrances and nectar samples were collected from honey filled stomachs. There were no residues collected from hive matrices. The study authors provided data showing that fenpyroximate dissipated in nectar from 0.02 mg/kg to undetectable levels in 2 days and similarly dissipated in pollen from 9.39 mg/kg to 0.40 mg/kg in 2 days. The residues were used as inputs in Bee-REX (Version 1.0) to estimate exposure values with measured residues. There is a great deal of uncertainty with extrapolating residues from *Phacelia* to the fenpyroximate use patterns, since it is uncertain if *Phacelia* is an appropriate surrogate for the registered use patterns (*i.e*., citrus, almonds, pistachio, avocado, and tree nuts). Also, the application rate used in the field study is more than 2X less than the maximum single application rate allowed for some registered uses. However, in lieu of residue data from fenpyroximate registered use patterns, it is important to explore how the residues measured in the Tier III full-field study compares to the default residues used in Bee-REX (Version 1.0). If residue data collected from registered use patterns are similar to *Phacelia* residue data, then the following risk profile is applicable. The adult acute oral (non-definitive endpoint) RQs, adult chronic oral RQs, and the larval acute oral RQs did not exceed the LOC. The larval chronic oral RQ exceeded the LOC with an RQ of 9.1 and the EECs also exceeding the LOAEL where a 14% increase in mortality occurred.

Table 10-4. Refined Acute and Chronic Oral RQ Values for Adult and Larval Bees Determined Using Measure Residues of Fenpyroximate in Pollen and Nectar

Use Pattern	Max. Single Appl. Rate	Bee Caste/Task	Unit Dose (µg a.i./bee per 1 lb a.i./A)[1]	Oral Dose (µg a.i./bee)[5]	Acute Oral RQ[2,3]	Chronic Oral RQ[4]
10-10. Citrus Fruit Group, Almonds, Avocado, 14. Tree Nuts	0.21 lb a.i./A	Adult nectar forager	32	0.04	<0.01	0.09
		Larval worker	13.6	0.01	0.2	**9.1**

[1] Source: USEPA 2014. Guidance for Assessing Pesticide Risks to Bees.
[2] Based on a 48-h acute oral LD_{50} of >118.5 µg a.i./bee for adults (MRID 45649819) and 3-d LD_{50} of 0.20 µg a.i./bee for larvae (MRID 50534102).
[3] **Bolded** RQ value exceeds (or potentially exceeds) the acute risk LOC of 0.4 or chronic LOC of 1.0
[4] Based on a 10-d chronic NOAEL of 0.073 µg a.i./bee/d for adults (MRID 50534103) and a 22-d chronic NOAEL of 0.012 µg a.i./bee/d for larvae (MRID 50534104)
[5]Derived from measured pollen and nectar residues collected from bees foraging on *Phacelia*. Empirical residue in pollen/bread: 9.39 mg a.i./kg; empirical residue in nectar: 0.02 mg a.i./kg.

Off-Field Risk

In addition to bees foraging on treated fields, bees may also be foraging in fields adjacent to the treated fields where the pesticide may be transported by spray drift and runoff. Although the proposed labels include recommendations for reduction of spray drift, there is still the potential for fenpyroximate movement to off-field sites via spray drift resulting in exposure and risk to bees that are foraging on plants in these off-site locations.

Off-field risk is assessed by considering bees in contact with residues transported by spray drift only (*i.e.*, runoff is not considered). To evaluate the potential for effects from off-site movement, AgDRIFT analyses were completed as a bounding exercise of the maximum and minimum foliar application rates to estimate the terrestrial spray drift distance from the edge of the field where RQ exceedances occurred. The fraction of applied input parameter for each respective RQ and LOC is presented in **Table 10-4**. The estimated AgDRIFT distances for acute and chronic endpoints are presented in **Table 10-5**.

For the maximum foliar application rate (0.21 lbs ai/A; on citrus fruit, almonds, avocados, and tree nuts), the resulting spray drift distance for ground applications ranged from 95 to 236 feet for adult nectar foragers based on chronic oral RQs utilizing low and high boom heights and default droplet sizes. The resulting spray drift distance for aerial applications was >997 feet for adult nectar foragers based on chronic oral RQs utilizing low and high boom heights and default droplet sizes. The resulting spray drift distance for ground applications ranged from 30 to >997 feet for larval workers based on acute and chronic oral RQs and utilizing low and high boom heights and default droplet sizes. The spray drift distances for aerial applications range from 308 to >997 feet for larval and adult oral acute and chronic values.

At the minimum proposed foliar application of fenpyroximate (0.10 lbs a.i./A; on potatoes), broadcast aerial applications resulted in exceedances with a spray drift distance of >997 feet for the larval worker bee chronic oral exposure at the default droplet sizes. For the acute oral larval worker bee, the spray drift distance was 161 feet (from fine to medium droplet size) for aerial applications. For the adult nectar forager, there are chronic exceedances at 459 feet for fine to medium droplet sizes for aerial applications at the minimum proposed foliar rate. For ground applications at the minimum proposed foliar application of fenpyroximate (0.10 lbs a.i./A; on tomatoes and potatoes), the boom height and droplet sizes did not result in any instances in which there was a spray drift distance >997 feet. The remaining spray drift distances for adult nectar foragers ranged from 46 to 125 feet for the chronic oral RQ values; spray drift distance for larvae workers ranged from 16 to 607 feet for the acute and chronic RQ values.

Off-field risk exceedances would occur for the above listed crops and crop groups for one or more applications of fenpyroximate. Based on a Tier I analysis for foliar applications, off-field dietary risks to individual bees exposed to spray drift can extend over 1000 feet from the edge of the treated field. For estimating off-field RQ values, several conservative assumptions are made which may over-estimate exposure and risk:

- Parameterization of AgDRIFT is representative of common application and environmental conditions;
- Estimated spray drift via AgDRIFT deposit on bee-attractive vegetation adjacent to the treated field;
- Vegetation is in bloom at the time of application;
- Bees are actively foraging adjacent to the treated field at the time of application; and
- Bees get all of their pollen and nectar from the contaminated vegetation.

Table 10-5. Fraction of Applied Input Parameter for AgDRIFT Analysis of Effects to Terrestrial Invertebrates

Taxa	Max Single Application (lbs a.i./A)	Type of Endpoint	Highest Risk Quotient	LOC	Fraction of Applied = LOC/RQ
Honey bees (adult)	0.21	Chronic	92	1.0	0.01
Honey bees (larvae)		Acute	14	0.4	0.03
		Chronic	710	1.0	0.0014

Taxa	Max Single Application (lbs a.i./A)	Type of Endpoint	Highest Risk Quotient	LOC	Fraction of Applied = LOC/RQ
Honey bees (adult)	0.10	Chronic	44	1.0	0.02
Honey bees (larvae)		Acute	6.8	0.4	0.06
		Chronic	340	1.0	0.003

Table 10-6. AgDRIFT Analysis based on Tier 1 Oral Risk Quotients for Adult Nectar Forager and Larval Worker Honey Bees

Use Pattern Application Rate	Bee Caste/Task	Boom Height	Droplet Size Distribution	Distance (Feet) for Acute Endpoint	Distance (Feet) for Chronic Endpoint
10-10. Citrus Fruit Group, Almonds, Avocado, 14. Tree Nuts 0.21 lbs a.i./A Ground	Adult nectar forager	low boom	very fine to fine	NA	95
		high boom		NA	236
	Larval worker	low boom		30	725
		high boom		85	>997 (out of range)
10-10. Citrus Fruit Group, Avocado 0.21 lbs a.i./A Aerial	Adult nectar forager	fine to medium		NA	>997 (out of range)
	Larval worker			308	>997 (out of range)
Tomato and Potato 0.10 lbs a.i./A Ground	Adult nectar forager	low boom	very fine to fine	NA	46
		high boom		NA	125
	Larval worker	low boom		16	351
		high boom		43	607
Potato 0.10 lbs a.i./A Aerial	Adult nectar forager	fine to medium		NA	459
	Larval worker			161	>997 (out of range)

10.4 Terrestrial Invertebrate Risk Characterization (Tier III)

A supplemental (qualitative) Tier III full-field study was completed for fenpyroximate. The study authors found that the measured toxicological endpoints showed no statistically significant effects to adult or larval honey bees. However, t-tests performed on brood index and termination rate measured during the second brood cycle were just outside the margin of statistical significance (p-value = 0.051). These results are similar to the considerable toxicity suggested by the Tier I toxicity data for larvae. The Tier III study could be indicating that fenpyroximate is negatively impacting brood development given the relative reduction in brood index and increased brood termination. However, the study author attributed the brood declines to the colonies preparing to overwinter. On the contrary, given the timeframe in which the study was conducted (late July to early August) this seems too early to be preparation for overwintering.

There are major uncertainties associated with this Tier III full-field study. The study design does not utilize valid replicates because it employs pseudo replication with multiple colonies placed adjacent to a single field. The study was conducted with only one application to *Phacelia* at 0.09 lbs a.i./A, which is less than the lowest registered application rate for fenpyroximate (0.1 lbs a.i./A), is 2x less than the highest single max application rate (0.21 lbs/A), and 4x less than the max annual rate (0.42 lbs/A/yr). Spraying was also performed at night, which may reduce contact exposure relative to the labeled use since application during bloom is not restricted on the label. In addition, there are concerns with increased pre-exposure mortality in the treatment group relative to the control which suggests that the treatment group colonies may have been performing poorly prior to the study initiation. The poor performance of the hives at study initiation is supported by the wide range of hive strength at the test initiation (9828 – 19,188 bees/colony). There was also increased mortality among the control group relative to the treatment group during the exposure phase. Specifically, the study showed 32% mortality in the control group during the exposure phase compared to 17% mortality in the exposed colonies. Furthermore, the colonies appeared to be introduced to the fields close to full bloom, and the application was not made until at least 9 days after bloom was possibly waning. The study authors reported that the bloom was waning within the control group which corresponded with a decrease in foraging activity. Foraging activity could also be limited due to the 2.86 ha test field since this field size is relatively small to support the foraging needs of 6 medium sized colonies. Because of these confounding factors it is difficult to tell whether the mortality, decreased foraging activity, and negative brood effects were from fenpyroximate, limited forage availability, bad weather conditions, or stress from the 11 colony assessments that were performed.

10.5 Terrestrial Invertebrate Risk Characterization – Additional Lines of Evidence

The Tier III study suggests negative brood effects associated with fenpyroximate use which support Tier I acute and chronic larvae toxicity studies. These effects seem to be consistent with the fenpyroximate mode of action which disrupts ATP synthesis. Additionally, the fenpyroximate mode of action has been characterized as affecting the molting stage of insects which also supports evidence of bee larvae mortality and negative brood effects.

The citrus and almond use patterns are highly attractive to honey bees and opportunistically attractive to bumble bees and solitary bees. Additionally, these crops show the highest amount of fenpyroximate use according to the SLUA report supplied by BEAD supporting a route of probable exposure of fenpyroximate to foraging bees (USEPA, 2018). Furthermore, these use patterns generated the highest RQs for chronic adult exposure as well as acute and chronic larvae exposure since they have the highest registered single maximum application rate.

10.6 Other Terrestrial Invertebrates

EFED has received a non-guideline parasitoid wasp extended residue study for fenpyroximate (MRID 48735302). The extended residue study exposed the parasitoid wasp, *Aphidius Rhopalosiphi,* to residues from a treated broad bean crop. Fenpyroximate was applied to the test crop at 5 different application rates, and *A. rhopalosiphi* was exposed to fenpyroximate residues 0, 7 and 14 days after treatment (DAT). At 0 DAT, the LC_{50} of fenpyroximate was 0.024 lbs/A. However, 7 and 14 DAT resulted in a non-definitive LC_{50} of >0.1 lbs/A which was the highest test rate.

11 Terrestrial Plant Risk Assessment

Seedling emergence and vegetative vigor studies reported an IC25 > 0.3 lbs ai/A with no phytotoxic effects observed. This application rate is greater than the maximum single application rate but less than the maximum annual application rate. Since the endpoints were non-definitive, Terrplant model was not used to estimate risk to terrestrial plants in areas adjacent to the treated field (sheet runoff), wetland areas (channelized runoff), and areas susceptible to spray drift. Based on the data, the potential for risk to terrestrial plants from fenpyroximate exposure is anticipated to be low.

12 Conclusions

Given the uses of fenpyroximate and the chemical's environmental fate properties, there is a likelihood of exposure of fenpyroximate and its degradate M-1 to non-target terrestrial and/or aquatic organisms. When used in accordance with the label, such exposure may result in adverse effects on the survival, growth, and reproduction of non-target terrestrial and aquatic organisms. There is a potential for direct adverse effects to freshwater fish, freshwater invertebrates (water column and benthic), birds, mammals (chronic only), terrestrial invertebrates, and aquatic plants from exposure to fenpyroximate as a result of registered uses. The risk to freshwater fish, freshwater invertebrates, mammals, and aquatic and terrestrial plants are all consistent with previous risk assessments (USEPA, 2012a, USEPA, 2014). However, fenpyroximate's newly submitted toxicity data for birds and honeybees adds a new facet to fenpyroximate's overall risk picture. A more in-depth summary of the risk conclusions is available in the Executive Summary (see **Section 1**).

Table 12-1. Potential Environmental Fate Concerns Identified for Fenpyroximate

Bioconcentration/ Bioaccumulation[1]	Groundwater Contamination	Sediment	Persistence[2]	Residues of Concern	Volatilization
Yes, log K_{ow}>3	No[2]	Yes	Moderately Persistent	Parent and M-1 (Degradate)	No

[1] Based on K_{ow} Based Aquatic Bioaccumulation Model (KABAM) for chemicals with a log K_{ow} >3.
[2] Persistence classification consistent with Goring *et al* (1975) applied to aerobic soil metabolism studies.

13 Literature Cited

Arnot, J. A., & Gobas, F. A. P. C. 2004. A food web bioaccumulation model for organic chemicals in aquatic ecosystems. *Environmental Toxicology and Chemistry, 23*(10), 2343-2355.

Goring, C. A. I., Laskowski, D. A., Hamaker, J. H., & Meikle, R. W. 1975. Principles of pesticide degradation in soil. In R. Haque & V. H. Freed (Eds.), *Environmental dynamics of pesticides.* . NY: Plenum Press.

USDA. 2017. *Attractiveness of Agricultural Crops to Pollinating Bees for the Collection of Nectar and/or Pollen*. U.S. Department of Agriculture. Available at http://www.ree.usda.gov/ree/news/Attractiveness_of_Agriculture_crops_to_pollinating_bees_Report-FINAL.pdf.

USEPA. 2002. Technical Basis for the Derivation of Equilibrium Partitioning Sediment Guidelines (ESGs) for the Protection of Benthic Organisms: Nonionic Organics [Draft]. EPA 822-R-02-041.October.

USEPA. 2003. Stokes, J., G. Reddy, and J. Breithaupt. Fenpyroximate: Conclusion and Briefing Memorandum for 07/09/03 Meeting of the Health Effects Division (HED) Metabolism Assessment Review Committee (MARC). DP barcode 292639. U.S. Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Health Effects Division. Internal memorandum. Aug. 12, 2003.

USEPA. 2004 *Government Printing Office. Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs*. January 23, 2004. Environmental Fate and Effects Division. Office of Pesticide Programs. U.S. Environmental Protection Agency. Available at https://www.epa.gov/sites/production/files/2014-11/documents/ecorisk-overview.pdf.

USEPA. 2010a *Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in the Problem Formulation for Registration Review, Registration Review Risk Assessments, Listed Species Litigation Assessments, New Chemical Risk Assessments, and Other Relevant Risk Assessments*. January 25, 2010. Environmental Fate and Effects Division. Office of Chemical Safety and Pollution Prevention. U.S. Environmental Protection Agency. Available at http://www.epa.gov/pesticides/science/efed/policy_guidance/team_authors/endangered_species_reregistration_workgroup/esa_reporting_fate.htm.

USEPA. 2011. *Guidance for Using Non-Definitive Endpoints in Evaluating Risks to Listed and Non-listed Animal Species*. Memorandum From D. J. Brady to E. F. a. E. Division. May 10, 2011. Environmental Fate and Effects Division. Office of Chemical Safety and Pollution Prevention. U.S. Environmental Protection Agency. Available at http://www.epa.gov/pesticides/science/efed/policy_guidance/team_authors/endangered_species_reregistration_workgroup/esa_non_definitive_endpoints.htm.

USEPA. 2012a. Ecological Risk Assessment for Proposed New Uses of Fenpyroximate on Snap Beans and Tropical Fruits including Avocado, a Proposed Outdoor Use on Cucumbers, and Current Uses on Citrus, Almonds, Pistachios, Ornamentals, and Cranberries. DP barcode 2086934. U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, Environmental Fate and Effects Division. Memorandum to the Registration Division. Mar. 21, 2012.

USEPA. 2012b. Fenpyroximate: Ecological Risk Assessment for a Proposed New Use on Corn and Proposed Label Amendments for Uses on Mint, Melons, Fruiting Vegetables, and Citrus in Texas, Including Updates to the Previous Ecological Risk. DP barcode 394367. U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, Environmental Fate and Effects Division. Memorandum to the Registration Division. Apr. 18, 2012.

USEPA. 2012c. Fenpyroximate: Drinking Water Exposure Assessment for Proposed New Uses on Snap Beans and Tropical Fruits including Avocado and a Proposed Outdoor Use on Cucumbers. DP barcode 391431. U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, Environmental Fate and Effects Division. Memorandum to the Health Effects Division and Registration Division. Jan. 23, 2012.

USEPA. 2012d. *White Paper in Support of the Proposed Risk Assessment Process for Bees*. September 11-14, 2012. Environmental Fate and Effects Division. Office of Pesticide Programs. U.S. Environmental Protection Agency. Available at https://www.regulations.gov/document?D=EPA-HQ-OPP-2012-0543-0004.

USEPA. 2013. Fenpyroximate: Ecological Risk Assessment for Proposed New Uses on Stone Fruits (Crop Group 12-12), Tuberous and Corm Vegetables (Crop Subgroup 1C), and Small Viue Climbing Fruits Except Kiwifruit (Crop Subgroup 13-07F). DP barcode 406242. U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, Environmental Fate and Effects Division. Memorandum to the Registration Division. Feb. 19, 2013.

USEPA. 2014. EFED Registration Review Problem Formulation for Fenpyroximate. DP barcode 421244. U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, Environmental Fate and Effects Division. Memorandum to the Pesticide Re-evaluation Division. Nov. 6, 2014.

USEPA. 2018. Screening Level Estimates of Agricultural Uses of Fenpyroximate (129131). U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention, Biological and Economic Analysis Division. Sep. 27, 2018.

USEPA, Health Canada PMRA, & California Department of Pesticide Regulation. 2014 *Guidance for Assessing Pesticide Risks to Bees*. June 23, 2014. U.S. Environmental Protection Agency. Health Canada Pest Management Regulatory Agency. California Department of Pesticide Regulation. Available at http://www2.epa.gov/pollinator-protection/pollinator-risk-assessment-guidance.

USEPA, & USGS. 2013 *Water Quality Portal*. United States Environmental Protection Agency. United States Geological Survey. Available at http://www.waterqualitydata.us/portal.jsp#.

14 Referenced MRIDs

14.1 Submitted Product Chemistry and Environmental Fate Studies

MRID	Citation Reference
44781003	Todhunter, J.; Hill, J. (1999) Fenpyroximate–Technical Active Ingredient (TGAI) and Fenpyroximate 5% SC (End Use Product): Product Chemistry, Series 63: Lab Project Number: NNI-FENPY-99-003. Unpublished study prepared by SRS International Corporation. 19 p.
44781016	Swanson, M. (1993) Direct Photolysis of Pyrazole-^{14}C-Fenpyroximate in a Buffered Aqueous Solution Under Artificial Sunlight: Final Report: Lab Project Number: SC910077: SC910089: E-4015. Unpublished study prepared by Battelle Memorial Institute. 126 p.
44847909	Saxena, A.; McCann, D. (1992) Hydrolysis of Pyrazole-^{14}C-Fenpyroximate in Buffered Aqueous Solutions: Final Report: Lab Project Number: SC900192. Unpublished study prepared by Battelle Memorial Institute. 97 p.
45187901	Funayama, S.; Atsuko, H.; Izawa, Y. (1990) Degradation of [Pyrazole-14C] and [Benzyl-14C]Fenpyroximate in Soils Under Laboratory Conditions: Lab Project Number: E-4005. Unpublished study prepared by Nihon Nohyaku Co., Ltd. 52 p.
45649705	Concha, M. (2001) Photodegradation of ^{14}C-Fenpyroximate in/on Soil by Artificial Light: Lab Project Number: E-4030: 870W-1: 870W. Unpublished study prepared by PTRL West, Inc. 188 p.
45649706	Maks, M. (2002) Degradation of [Pyrazole-14C] and [Benzyl-14C]Fenpyroximate in Soils Under Laboratory Conditions: Lab Project Number: E-4005. Unpublished study prepared by Nichino America, Inc. 8 p.
45649707	McKemie, T.; Shepler, K. (2001) Anaerobic Aquatic Metabolism of [^{14}C] Fenpyroximate: Lab Project Number: 889W-1: 889W: E-4031. Unpublished study prepared by PTRL West, Inc. 232 p.
45649708	Concha, M. (2002) Soil Adsorption/Desorption of [^{14}C] M-3 by the Batch Equilibrium Method: Lab Project Number: 1045W. Unpublished study prepared by PTRL West, Inc. 132 p.
45649709	Concha, M. (2002) Soil Adsorption/Desorption of [^{14}C] Fenpyroximate by the Batch Equilibrium Method: Lab Project Number: 987W: E-4033. Unpublished study prepared by PTRL West, Inc. 151 p.
45649710	Burstell, H.; Sochor, H. (1994) Fenpyroximate Water Miscible Suspension 50g/l: Investigation of the Degradation Behaviour in Soil Under Field Conditions: Lab Project Number: E-4028: ER91DEU824: A53773. Unpublished study prepared by Hoechst Schering AgrEvo GmbH. 55 p.
45649711	Specht, W. (1993) Determination of the Residues of Fenpyroximate (HOE 094552), M-1 (HOE 112573) and M-3 (HOE 112721) in Soil: Lab Project Number: HOE-9107: 93615/91: A53773. Unpublished study prepared by Chemische Laboratorien GMBH. 146 p.

MRID	Citation Reference
45649712	Baker, F.; Mickelson, K.; Hiler, R. (2001) Field Soil Dissipation of Fenpyroximate in Bare Ground in North Carolina, Arkansas, and California: Lab Project Number: 803W-1: 803W: E-4032. Unpublished study prepared by Research for Hire. 253 p.
45734203	Hiler, R. (2002) Quantification of Metabolites M-3, M-8, and M-11 in Soil from Field Soil Dissipation of Fenpyroximate in Bare Ground in North Carolina, Arkansas and California: Lab Project Number: E-4038: 1026W: 1026W-1. Unpublished study prepared by Research for Hire. 855 p.
46158501	Shepler, K. (2003) Aerobic Soil Metabolism of [^{14}C] Fenpyroximate. Project Number: 1038W. Unpublished study prepared by PTRL West, Inc. 160 p.
47521406	Volkl, D. (2001) [^{14}C] Fenpyroximate (NNI-850) [Pyrazole-labelled] Degradation and Metabolism in Aquatic Systems. Project Number: E/4027/SUPP/1, 7L365. Unpublished study prepared by RCC Ltd. 134 p.
48381102	Thomas, S.; Kendall, T.; Krueger, H. (2010) Fenpyroximate: A Bioconcentration Test with the Bluegill (*Lepomis macrochirus*): Final Report. Project Number: 397A/140. Unpublished study prepared by Wildlife International, Ltd. 93 p.
50580601	Cooper, J. and P. Challis. (2018) [^{14}C]-Fenpyroximate: Anaerobic Aquatic Metabolism in Two Water/Sediment Systems at 20 ± 2°C.
50124101	Roohi, A. (2016) [^{14}C]-Fenpyroximate: Route and Rate of Degradation in Four Soils under Aerobic Conditions at 20°C.

14.2 Submitted Ecological Toxicity Studies

MRID	Citation Reference
45649714	Tolle, D. (1991) Avian Single-Dose LD (50) Test of Fenpyroximate in Mallard Ducks: Final Report: Lab Project Number: SC910033. Unpublished study prepared by Battelle. 46 p.
45649715	Tolle, D. (1991) Avian Single-Dose LD (50) Test of Fenpyroximate in Bobwhite Quail: Final Report: Lab Project Number: SC910018: W-4031. Unpublished study prepared by Battelle. 44 p.
44847908	Tolle, D. (1991) 8-Day Avian Dietary LC50 Test of Fenpyroximate in Bobwhite Quail: Final Report: Lab Project Number: SC910016: W-4015. Unpublished study prepared by Battelle. 76 p.
45649716	Tolle, D. (1991) 8-Day Avian Dietary LD (50) Test of Fenpyroximate in Mallard Ducks: Final Report: Lab Project Number: SC910017: W-4016. Unpublished study prepared by Battelle. 77 p.
45649717	Stadens-Peek, W.; Frieling, W. (1997) 6-Weeks Dietary Study in Mallard Duck with Fenpyroximate (Pilot Dietary Study for Reproduction Study): Lab Project Number: 191778: 67455: W-4046. Unpublished study prepared by NOTOX B.V. 39 p.
45649718	van Dreumel, I.; Frieling, W. (1997) Reproduction Study in Mallard Duck with Fenpyroximate (By Dietary Admixture): Lab Project Number: 191047: 67455: W-4047. Unpublished study prepared by NOTOX B.V. 154 p.

MRID	Citation Reference
45649719	Frieling, W. (2001) Reproduction Study in Bobwhite Quail with Fenpyroximate Technical (By Dietary Admixture): Lab Project Number: 265027: 64577: W-6062. Unpublished study prepared by NOTOX B.V. 210 p. {OPPTS 850.2300}
45649720	Todhunter, J. (2002) Analysis and Evaluation of Data from a Fenpyroximate Reproduction Study in Bobwhite Quail Conducted at NOTOX B.V: Lab Project Number: W-4062: 265027. Unpublished study prepared by SRS International Corp. 21 p.
47521403	Temple, D.; Martin, K.; Beavers, J.; et al. (2008) Fenpyroximate: A Reproduction Study with the Mallard: Final Report. Project Number: 397/106. Unpublished study prepared by Wildlife International, Ltd. 156 p.
47521404	Temple, D.; Martin, K.; Beavers, J.; et al. (2008) Fenpyroximate: A Reproduction Study with the Northern Bobwhite: Final Report. Project Number: 397/105. Unpublished study prepared by Wildlife International Ltd. 159 p.
44781014	Knacker, T.; Brodesser, H.; Schallnab, H. et al. (1992) A Study of the Acute Toxicity to Fish (*Oncorhynchus mykiss*) of Fenpyroximate Under Flow-Though Conditions: Final Report (Revised): Lab Project Number: BF-EA-101-91-01-FIA-1. Unpublished study prepared by Battelle Europe. 62 p.
45477201	Maks, M. (2001) Addendum 1 to A Study of the Acute Toxicity to Fish (*Oncorhynchus mykiss*) of Fenpyroximate Under Flow-Through Conditions: Lab Project Number: BE-EA-107-91-01-FIA-1. Unpublished study prepared by Battelle Europe, and Nihon Nohyaku Company, Ltd. 15 p.
45649721	Dionne, E. (2001) Fenpyroximate Technical–Acute Toxicity to Bluegill Sunfish (*Lepomis macrochirus*) Under Flow-Through Conditions: Lab Project Number: 13657.6134: W-4055. Unpublished study prepared by Springborn Laboratories, Inc. 55 p. {OPPTS 850.1075}
45649801	Dionne, E. (2001) Fenpyroximate 5% EC–Acute Toxicity to Bluegill Sunfish (*Lepomis macrochirus*) Under Flow-Through Conditions: Lab Project Number: 13657.6141: W-4060: 093098/FIFRA/OPPTS/1. Unpublished study prepared by Springborn Laboratories, Inc. 55 p. {OPPTS 850.1075}
45649802	Knacker, T.; Brodesser, J.; Schallnass, H.; et al. (1992) A Study of the Acute Toxicity to Fish (*Cyprinus carpio*) of Fenpyroximate Under Flow-Through Conditions: Final Report: Lab Project Number: BE-EA-107-91-01-F5A-: W-4004. Unpublished study prepared by Battelle Europe. 66 p.
45649803	Dionne, E. (2001) Fenpyroximate 5% EC–Acute Toxicity to Rainbow Trout (*Oncorhynchus mykiss*) Under Flow-Through Conditions: Lab Project Number: 13657.6140: W-4059. Unpublished study prepared by Springborn Laboratories, Inc. 55 p. {OPPTS 850.1075}
46188801	Habig, C. (2004) Addendum 2 to A Study of the Acute Toxicity to Fish (*Oncorhynchus mykiss*) of Fenpyroximate Under Flow-Through Conditions (MRID # 44781014). Project Number: BE/EA/107/91/01/FIA/1. Unpublished study prepared by Battelle Europe and Nihon Nohyaku Co. Ltd. 6 p.
47021402	Maks, M. (2007) Supplement 1 to Fenpyroximate 5 Percent EC-Acute Toxicity to Rainbow Trout (*Oncorhynchus mykiss*) Under Flow-Through Conditions . Project Number: 13657/6140, W/4059. Unpublished study prepared by Springborn Smithers Laboratories. 7 p.

MRID	Citation Reference
46799201	Palmer, S.; Kendall, T.; Krueger, H. (2006) Fenpyroximate TGAI: A 96-Hour Static-Renewal Acute Toxicity Test With the Rainbow Trout: Final Report. Project Number: 397A/105. Unpublished study prepared by Wildlife International, Ltd. 40 p.
46974402	Pawlowski, S.; Wydra, V. (2005) Acute Toxicity of M-3, A Fenpyroximate Matabolie, to Rainbow Trout (*Oncorhynchus mykiss*) in a 96-Hour Static Test: Final Report. Project Number: 23771230. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 58 p.
47021402	Maks, M. (2007) Supplement 1 to Fenpyroximate 5 Percent EC-Acute Toxicity to Rainbow Trout (*Oncorhynchus mykiss*) Under Flow-Through Conditions . Project Number: 13657/6140, W/4059. Unpublished study prepared by Springborn Smithers Laboratories. 7 p.
47098102	Palmer, S.; Kendall, T.; Krueger, H. (2007) Fenpyroximate 5% EC: A 96-Hour Flow – Through Acute Toxicity Test with the Rainbow Trout (*Oncorhynchus mykiss*): Final Report. Project Number: 397A/109. Unpublished study prepared by Wildlife International, Ltd. 43 p.
44781015	Knacker, T.; Zietz, E.; Schallnab, H. et al. (1992) A Study of the Acute Toxicity to the Freshwater Aquatic Invertebrate (*Daphnia magna*) of Fenpyroximate: Final Report (Revised): Lab Project Number: BE-EA-107-90-01-DAK-1. Unpublished study prepared by Battelle Europe. 55 p.
46800801	Palmer, S.; Kendall, T.; Krueger, H. (2006) Fenpyroximate 5%EC: A 48-Hour Static-Renewal Acute Toxicity Test with the Cladoceran (*Daphnia magna*): Final Report. Project Number: 397A/103A. Unpublished study prepared by Wildlife International, Ltd. 43 p.
46974401	Motoba, K. (2005) Acute Immobilization Test of M-3, A Fenpyroximate Metabolite on *Daphnia magna*: Final Report. Project Number: GC/12, 05/0035. Unpublished study prepared by Nihon Nohyaku Co., Ltd. 41 p.
45649805	Dionne, E. (2001) Fenpyroximate Technical–Acute Toxicity to Sheepshead Minnow (*Cyprinodon variegatus*) Under Flow-Through Conditions: Lab Project Number: 13657.6135: W-4057: 020499/FIFRA/OPPTS/F. Unpublished study prepared by Springborn Laboratories, Inc. 52 p. {OPPTS 850.1075}
46188802	Dionne, E. (2001) Fenpyroximate Technical – Acute Toxicity to Sheepshead Minnow (*Cyprinodon variegatus*) Under Flow-Through Conditions. Project Number: 13657/6135, W/4057, 020499/FIFRA/OPPTS/FT/SHM. Unpublished study prepared by Springborn Laboratories Inc. 52 p.
47098101	Palmer, S.; Kendall, T.; Krueger, H. (2007) Fenpyroximate TGAI: A 96-Hour Flow – Through Acute Toxicity Test with the Sheepshead Minnow (*Cyprinodon variegatus*): (Fujimite 5EC Miticide/Insecticide): Final Report. Project Number: 397A/110. Unpublished study prepared by Wildlife International, Ltd. 41 p.
45649804	Dionne, E. (2001) Fenpyroximate Technical–Acute Toxicity to Mysids (*Americamysis bahia*) Under Flow-Through Conditions: Lab Project Number: 13657.6137: W-4058. Unpublished study prepared by Springborn Laboratories, Inc. 56 p. {OPPTS 850.1035}
45649806	Dionne, E. (2001) Fenpyroximate Technical–Acute Toxicity to Eastern Oyster (*Crassostrea virginica*) Under Flow-Through Conditions: Lab Project Number: 13657.6136: W-4056. Unpublished study prepared by Springborn Laboratories, Inc. 58 p. {OPPTS 850.1025}

MRID	Citation Reference
47021401	Palmer, S.; Kendall, T.; Krueger, H. (2006) Fenpyroximate TGAI: A 96-Hour Shell Deposition Test with the Eastern Oyster (*Crassostrea virginica*): Final Report. Project Number: 397A/111. Unpublished study prepared by Wildlife International, Ltd. 40 p.
45649808	Sousa, J. (2001) Fenpyroximate Technical–The Toxicity to Fathead Minnow (*Pimephales promelas*) During an Early Life-Stage Exposure: Lab Project Number: 13657.6142: W-4061. Unpublished study prepared by Springborn Laboratories, Inc. 71 p.
46188803	Sousa, J. (2004) Supplement 1 to Fenpyroximate Technical-The Toxicity to Fathead Minnow (*Pimephales promelas*) During an Early Life-Stage Exposure (MRID No. 45649808). Project Number: 13657/6142, W/4061, 346230. Unpublished study prepared by Springborn Laboratories Inc. and Nihon Nohyaku Co. Ltd. 25 p.
45649807	Knacker, T.; Brodresser, J.; Reifenberg, P.; et al. (1992) A Study of the Chronic Toxicity to *Daphnia* of Fenpyroximate: Final Report: Lab Project Number: BE-EA-107-90-01-DCH-: W-4034. Unpublished study prepared by Battella Europe. 97 p.
46188804	Habig, C. (2004) Supplement 1 to A Study of the Chronic Toxicity to *Daphnia* of Fenpyroximate (MRID No. 45649807). Project Number: BE/EA/107/90/01/DCH/1: W/4034. Unpublished study prepared by Battelle Europe. 9 p.
47098103	Palmer, S.; Kendall, T.; Krueger, H. (2007) Fenpyroximate TGAI: A Flow – Through Life – Cycle Toxicity Test with the Cladoceran (*Daphnia magna*): Final Report. Project Number: 397A/106A. Unpublished study prepared by Wildlife International, Ltd. 61 p.
47521405	Palmer, S.; Kendall, T.; Krueger, H. (2007) Fenpyroximate TGAI: A Flow-Through Life-Cycle Toxicity Test with the Saltwater Mysid (*Americamysis bahia*): Final Report. Project Number: 397A/108. Unpublished study prepared by Wildlife International Ltd. 75 p
46847202	Heusel, R. (1997) Fenpyroximate (Carbon 14)-Labelled Chronic Toxicity to the Sediment Dwelling Chironomid Larvae (*Chiromus riparius*). Project Number: CE96/077, W/4044. Unpublished study prepared by Hoechst Schering Agrevo Gmbh. 60 p.
45649809	Teixeira, D. (2001) Fenpyroximate 5% EC–Determination of Effects on Seedling Emergence of Ten Plant Species: Lab Project Number: 13657.6157. Unpublished study prepared by Springborn Laboratories, Inc. 188 p. {OPPTS 850.4100, 850.4225}
45649810	Teixeira, D. (2001) Fenpyroximate 5% EC–Determination of Effects on Vegetative Vigor of Ten Plant Species: Lab Project Number: 13657.6158: 022301/OPPTS/VV. Unpublished study prepared by Springborn Laboratories, Inc. 143 p. {OPPTS 850.4150, 850.4250}
45649811	Hoberg, J. (2001) Fenpyroximate 5% EC–Toxicity to Duckweed, *Lemna gibba*: Lab Project Number: 13657.6154: N-4060. Unpublished study prepared by Springborn Laboratories, Inc. 54 p. {OPPTS 850.4400}
45649812	Hoberg, J. (2001) Fenpyroximate 5.0% EC–Acute Toxicity to Freshwater Diatom (*Navicula* pelliculosa): Lab Project Number: 13657.6151: N-4056. Unpublished study prepared by Springborn Laboratories, Inc. 51 p. {OPPTS 850.5400}

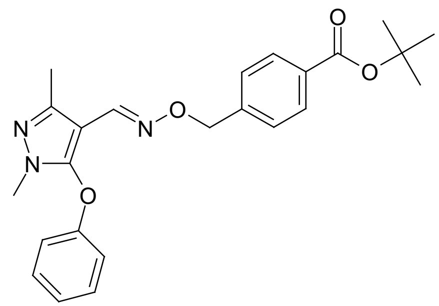
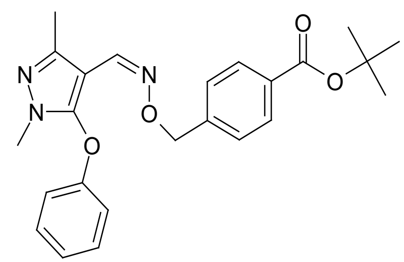
MRID	Citation Reference
45649813	Hoberg, J. (2001) Fenpyroximate 5.0% EC–Acute Toxicity to Freshwater Blue-Green Alga, *Anabaena flos-aquae*: Lab Project Number: 13657.6153: N-4057. Unpublished study prepared by Springborn Laboratories, Inc. 50 p. {OPPTS 850.5400}
45649814	Hoberg, J. (2001) Fenpyroximate 5.0% EC–Acute Toxicity to Freshwater Green Alga, *Pseudokirchneriella subcapitata*: Lab Project Number: 13657.6150: N-4058. Unpublished study prepared by Springborn Laboratories, Inc. 52 p. {OPPTS 850.5400}
45649815	Hoberg, J. (2001) Fenpyroximate 5.0% EC–Acute Toxicity to Marine Diatom, *Skeletonema costatum*: Lab Project Number: 13657.6152: N-4059. Unpublished study prepared by Springborn Laboratories, Inc. 51 p. {OPPTS 850.5400}
45649816	Heusel, R. (1992) Fenpyroximate-Substance, Technical: Effect to *Scendesmus suspicatus* (Green Alga) in Growth Inhibition Test: Lab Project Number: CE90/119: N-4016: A48254. Unpublished study prepared by Hoechst AG. 31 p.
45649817	Fischer, R. (1990) HOE 094552-Water Miscible Suspension Concentrate; 5%: Effect to *Scendesmus suspicatus* (Green Alga) in Growth Inhibition Test: Lab Project Number: CE90/085: N-4017: A44948. Unpublished study prepared by Hoechst AG. 24 p.
47021403	Maks, M. (2007) Supplement 1 to Fenpyroximate 5 Percent EC-Acute Toxicity to the Marine Diatom (*Skeletonema costatum*). Project Number: 13657/6152, N/4059. Unpublished study prepared by Springborn Smithers Laboratories. 9 p.
47021404	Maks, M. (2007) Supplement 1 to Fenpyroximate 5 Percent EC-Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata*. Project Number: 13657/6150, N/4058. Unpublished study prepared by Springborn Smithers Laboratories. 7 p.
45649818	Krebs, B. (2000) Contact Toxicity (LD50) to Honey Bees (*Apis mellifera* L.) Fenpyroximate Water Miscible Suspension Concentrate: Lab Project Number: C008608: KS-023-06-2000: N-4040. Unpublished study prepared by Aventis CropScience GmbH. 16 p.
45649819	Waltersdorfer, A. (2000) Oral Toxicity (LD50) to Honey Bees (*Apis mellifera* L.) Fenpyroximate Substance Technical: Lab Project Number: CW99/137: N-4039. Unpublished study prepared by Hoechst Schering AgrEvo GmbH. 16 p.
47737801	Walsh, D. (2009) Pollinator Pesticide Safety Trials 2007: Flonicamid. Project Number: IB/2009/PH/002/01. Unpublished study prepared by Washington State University. 19 p.
45649821	Kimura, M. (1991) Acute Toxicity Study of Fenpyroximate in Phytoseild Mites: Lab Project Number: N-4003. Unpublished study prepared by Nihon Nohyaku Company. 9 p.
45649822	Kimura, M. (1991) Acute Toxicity Study of Fenpyroximate in Green Lacewing: Lab Project Number: N-4004. Unpublished study prepared by Nihon Nohyaku Company. 11 p.
45649823	Kimura, M. (1991) Acute Toxicity Study of Fenpyroximate in Ladybug: Lab Project Number: N-4005. Unpublished study prepared by Nihon Nohyaku Company. 11 p.
45649824	Kimura, M. (1992) Acute Toxicity Study of Fenpyroximate in Predacious Thrips, Scolothrips, Sp: Lab Project Number: N-4022. Unpublished study prepared by Nihon Nohyaku Company. 8 p.

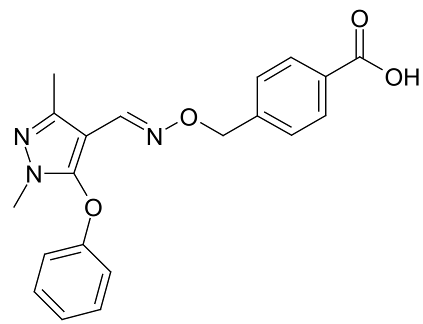
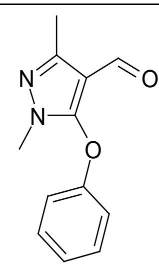
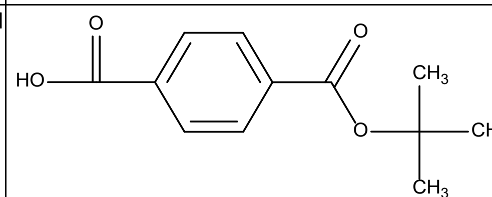
MRID	**Citation Reference**
45649825	Chisholm, K. (1992) Fenpyroximate and Fenpyroximate 5% SC: Acute Toxicity Studies to Beneficial Arthropods: Lab Project Number: FEN-EC-03: N-4008: CW00/019. Unpublished study prepared by Nihon Nohyaku Company. 230 p.
48381102	Thomas, S.; Kendall, T.; Krueger, H. (2010) Fenpyroximate: A Bioconcentration Test with the Bluegill (*Lepomis macrochirus*): Final Report. Project Number: 397A/140. Unpublished study prepared by Wildlife International, Ltd. 93 p.
45649820	Fischer, R. (1991) HOE 094552–Substance, Technical: Effect to *Eisenia fetida* (Earthworm) in a 14 Day Artificial Soil Test: Lab Project Number: CE90/118: N-4014: A 45245. Unpublished study prepared by Hoechst AG. 32 p.
48381101	Thomas, S.; Krueger, H.; Kendall, T.; Nixon, W. (2010) Fenpyroximate: A 10-Day Survival and Growth Toxicity Test with the Midge *Chironomus tentans* Using Spiked Sediment: Final Report. Project Number: 397A-141. Unpublished study prepared by Wildlife International, Ltd. 73 p.
48735301	York, D. (2010) [14C]Fenpyroximate – Full Life-Cycle Toxicity Test with Fathead Minnow (*Pimephales promelas*) Following FIFRA Guideline 72-5 and OCSPP (form. OPPTS) Draft Guideline 850.1500. Laboratory Project ID: Springborn Smithers Study No. 13657.6162. Unpublished study prepared by Springborn Smithers Laboratories. 151 p.
50401301	Urann, K. (2017) Fenpyroximate – Life-Cycle Toxicity Test with Mysids (*Americamysis bahia*). Unpublished study performed by Smithers Viscient Laboratories, Wareham, Massachusetts. Laboratory Study No. 13657.6193. Study sponsored by Nihon Nohyaku Company, Ltd., Chuo-ku, Tokyo, Japan. Study initiated December 7, 2016 and completed September 27, 2017.
50534101	Taylor, K. (2017) Fenpyroximate: Zebra Finch (*Taeniopygia guttata*) Dietary Acute Toxicity Test. Unpublished study performed by Smithers Viscient, Carolina Research Center, Snow Camp, North Carolina, USA. Laboratory Project No. 13657.4101. Study sponsored by Nihon Nohyaku Co., Ltd., Chuo-ku, Tokyo, Japan. Study initiated March 29, 2017 and completed October 6, 2017.
50534102	Rathjen, K. (2017) Fenpyroximate- Honey Bee (*Apis mellifera*) Larval Toxicity Test, Single Exposure. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Report ID 13657.6196. Study sponsored by Nihon Nohyaku Co., Ltd., Chuo-ku, Tokyo, Japan. Study completed August 8, 2017.
50534103	Rathjen, K. (2017) Fenpyroximate – 10-Day Oral Toxicity Test with the Adult Honey Bee (*Apis mellifera*). Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Report ID 13657.6198. Study sponsored by Nihon Nohyaku Co., Ltd., Chuo-ku, Tokyo, Japan. Study completed October 31, 2017.
50534104	Rathjen, K. (2017) Fenpyroximate –Honey Nee (*Apis mellifera* L.) Larval Toxicity Test, Repeat Exposure. Unpublished study performed by Smithers Viscient. Laboratory Report ID 13657.6197. Study sponsored by Nihon Nohyaku Co., Ltd. Study completed December 27, 2017.
50534105	Waltersdorfer, A. (2000) Contact Toxicity (LD50) to Honey Bees (*Apis mellifera* L.) Fenpyroximate Substance Technical. Laboratory Report ID: CW99/135. Unpublished study prepared by Hoechst Schering AgrEvo GmbH.

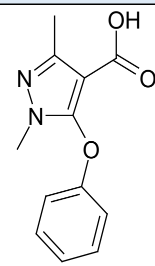
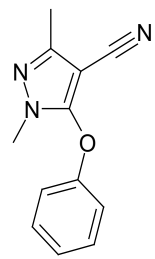
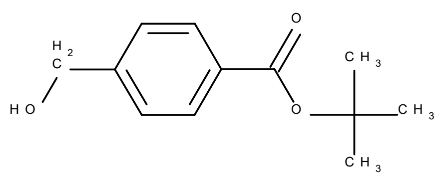
MRID	Citation Reference
50534108	Vallon, A. (2016) Determination of Side-Effects of Fenpyroximate 5SC on Honeybees (*Apis mellifera* L.) in the Field after One Application on *Phacelia tanacetifolia* in Germany 2015. Unpublished study performed by Eurofins Agroscience Services EcoChem GmbH/ Eurofins Agroscience Services Ecotox GmbH. Laboratory Report ID: S15-02968. Study sponsored by Nihon Nohyaku Co., Ltd. Study completed August 31, 2016.
48735302	Gray, J. (2011) Evaluation of the Effects of Fenpyroximate on the Parasitoid Wasp *Aphidius Rhopalosiphi* in an Extended Laboratory Aged Residue Study on Broad Bean. Study performed by Huntingdon Life Sciences. Study sponsored by Nihon Nohyaku Co., Ltd. Laboratory Report ID: LMS0016. Study completed February 16, 2011.
50534106	Ruhland, S. (2015) Chronic Toxicity of Fenpyroximate 5SC to the Honey Bee *Apis mellifera* L. under Laboratory Conditions. Study performed by BioChem agrar GmbH. Study sponsored by Nihon Nohyaku. Laboratory Report ID: 15 10 48 014 B. Study completed December 9, 2015.
50534107	Kllebaum, K. (2016) Chronic Toxicity of Fenpyroximate 5SC to Honeybee Larvae *Apis mellifera* L. Under Laboratory Conditions (in vitro). Study performed by BioCChem agrar. Study sponsored by Nihon Nohyaku Co. Ltd. Laboratory Report ID: 15 10 48 015 B. Study completed June 9, 2016.

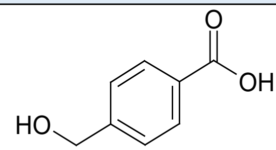
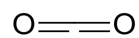
Appendix A. ROCKs table

Table A1. Chemical Names and Structures of Fenpyroximate and its Transformation Products

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	Ref. [A] (MRID)	Maximum %AR (day)	Final %AR (study length)
			PARENT			
Fenpyroximate (E-isomer)	**IUPAC:** *tert*-butyl I-α-(1,3-dimethyl-5-phenoxypyrazol-4-ylmethyleneaminooxy)-p-toluate **CAS:** 1,1-dimethylethyl 4-[[[(E)-[(1,3-dimethyl-5-phenoxy-1H-pyrazol-4-yl)methylene]amino]oxy]methyl]benzoate **CAS No.:** 134098-61-6 **Formula:** $C_{24}H_{27}N_3O_4$ **MW:** 421.50 g/mol					
			TRANSFORMATION PRODUCTS			
M-1 (Z-isomer)	*tert*-butyl (Z)-4-[(1,3-dimethyl-5-phenoxypyrazol-4-yl)methylene-aminooxymethyl]-benzoate **Formula:** $C_{24}H_{27}N_3O_4$ **MW:** 421.50 g/mol		Hydrolysis	44847909	4.5% (30 d)	4.5% (30 d)
			Aq photolysis	44781016	**60%** (4 hrs)	1.5% (73 hrs)
			Soil photolysis	45649705	**37%** (30 d)	37% (30 d)
			Aerobic soil	45187901/ 45649706	3.0% (7 d)	0.3% (112 d)
				50124101	3.4% (7 d)	2.3% (120 d)
					3.4% (1 d)	0.0% (219 d)
					3.1% (0 d)	0.03% (219 d)
					3.2% (0 d)	1.8% (219 d)
			Anaerobic aquatic	45649707	1.7% (30 d)	n.d. (366 d)
M-3	(E)-4-[(1,3-dimethyl-5-phenoxypyrazol-4-yl)methylene-aminooxy-methyl]-benzoic acid		Hydrolysis	44847909	8.5% (30 d)	8.5% (30 d)
			Aq photolysis	44781016	2.5% (4 hrs)	n.d. (73 hrs)
			Soil photolysis	45649705	1.5% (30 d)	1.5% (30 d)
			Aerobic soil	46158501	**16%** (90 d)	4.0% (365 d)

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	Ref. [A] (MRID)	Maximum %AR (day)	Final %AR (study length)
	Formula: $C_{20}H_{19}N_3O_4$ **MW:** 365.39 g/mol		Aerobic soil	45187901/ 45649706	**11%** (14 d)	0.1% (112 d)
			Aerobic soil	50124101	**12.8%** (120 d)	**12.8%** (120 d)
					30.5% (14 d)	5.1% (219 d)
					19.5% (70 d)	**9.9%** (219 d)
					21.2% (120 d)	**17.3%** (219 d)
			Anaerobic aquatic	45649707	**50%** (59 d)	18% (366 d)
			Aerobic aquatic	45734202/ 47521406	**26%** (14 d)	3.3% (105 d)
			Terrestrial field	45649710/ 45649711	**13%** (14, 29 d)	n.d. (370 d)
			Terrestrial field	45649712/ 45734203	**32%** (7 d)	n.d. (120 d)
M-6	1,3-dimethyl-5-phenoxypyrazole-4-carbaldehyde **Formula:** $C_{12}H_{12}N_2O_2$ **MW:** 216.24 g/mol		Aq photolysis	44781016	8.5% (12 hrs)	0.5% (73 hrs)
			Soil photolysis	45649705	1.4% (30 d)	1.4% (30 d)
			Aerobic soil	46158501	3.6% (273 d)	1.1% (365 d)
			Aerobic soil	45187901/ 45649706	0.4% (14 d)	0.1% (112 d)
			Anaerobic aquatic	45649707	6.7% (366 d)	6.7% (366 d)
MTBT	**IUPAC:** 4-(tert-Butoxycarbonyl)benzoic acid **CAS No.:** 20576-82-3 **Formula:** $C_{12}H_{14}O_4$ **MW:** 222.24 g/mol **SMILES:** OC(C1=CC=C(C(OC(C)(C)C)=O)C=C1)=O		Anaerobic aquatic metabolism	50580601	**78.57%** (30 d)	**52.31%** (100 d)
					55.15% (30 d)	**45.24%** (100 d)
M-8	1,3-dimethyl-5-phenoxypyrazole-4-carboxylic acid **Formula:** $C_{12}H_{12}N_2O_3$ **MW:** 232.24 g/mol		Soil photolysis	45649705	4.1% (30 d)	4.1% (30 d)
			Aerobic soil	46158501	**12%** (90 d)	2.1% (365 d)
				45187901/ 45649706	3.5% (84 d)	2.7% (112 d)
				50124101	4.6% (120 d)	4.6% (120 d)

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	Ref. [A] (MRID)	Maximum %AR (day)	Final %AR (study length)
					**16.0%** (70 d)	2.0% (219 d)
					10.1% (120 d)	4.6% (219 d)
					17.8% (120 d)	**17.1%** (219 d)
			Anaerobic aquatic	45649707	**36%** (366 d)	36% (366 d)
			Aerobic aquatic	45734202/ 47521406	**31%** (61 d)	15% (105 d)
M-11	1,3-dimethyl-5-phenoxypyrazole-4-carbonitrile **Formula:** $C_{12}H_{11}N_3O$ **MW:** 213.24 g/mol		Aq photolysis	44781016	**22%** (24 hrs)	15% (73 hrs)
			Aerobic soil	46158501	5.9% (90 d)	1.6% (365 d)
			Aerobic soil	45187901/ 45649706	8.8% (28 d)	6.8% (112 d)
				50124101	3.9% (120 d)	3.9% (120 d)
					8.5% (70 d)	3.3% (219 d)
					5.7% (70 d)	5.0% (219 d)
					10.8% (170 d)	**9.6%** (219 d)
			Anaerobic aquatic	45649707	**21%** (366 d)	21% (366 d)
				50580601	**55.86%** (65 d)	**54.10%** (100 d)
					43.30% (100 d)	**43.30%** (100 d)
			Aerobic aquatic	45734202/ 47521406	**33%** (105 d)	33% (105 d)
M15	**IUPAC:** tert-Butyl 4-hydroxymethylbenzoate **Formula:** $C_{12}H_{16}O_3$ **MW:** 208.2 g/mol **SMILES:** CC(C)(C)OC(=O)c1ccc(cc1)CO		Anaerobic aquatic metabolism	50580601	**17.27%** (10 d)	ND (100 d)
					5.31% (10 d)	0.18% (100 d)
M-16	4-hydroxymethylbenzoic acid **Formula:** $C_8H_8O_3$		Aerobic soil	46158501	3.6% (273 d)	1.1% (365 d)
			Aerobic soil	45187901/ 45649706	0.1% (7 d)	n.d. (112 d)

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	Ref. [A] (MRID)	Maximum %AR (day)	Final %AR (study length)
	MW: 152.15 g/mol		Anaerobic aquatic	45649707	**58%** (182 d)	45% (366 d)
UNK-1	Unidentified photodegradate UNK-1	Not identified	Soil photolysis	45649705	**17%** (30 d)	17% (30 d)
PS-6	Unidentified biodegradate	Not identified	Aerobic aquatic	45734202/ 47521406	**17%** (30 d)	3.5% (105 d)
Carbon dioxide	Carbon dioxide **Formula:** CO_2 **MW:** 44.1 g/mol		Soil photolysis	45649705	1.6% (30 d)	1.6% (30 d)
			Aerobic soil	46158501	**59%** (365 d)	59% (365 d)
			Aerobic soil	45187901/ 45649706	**70%** (112 d)	70% (112 d)
			Anaerobic aquatic	45649707	9.6% (366 d)	9.6% (366 d)
			Aerobic aquatic	45734202/ 47521406	2.0% (105 d)	2.0% (105 d)

Bolded values are laboratory study values >10%AR.

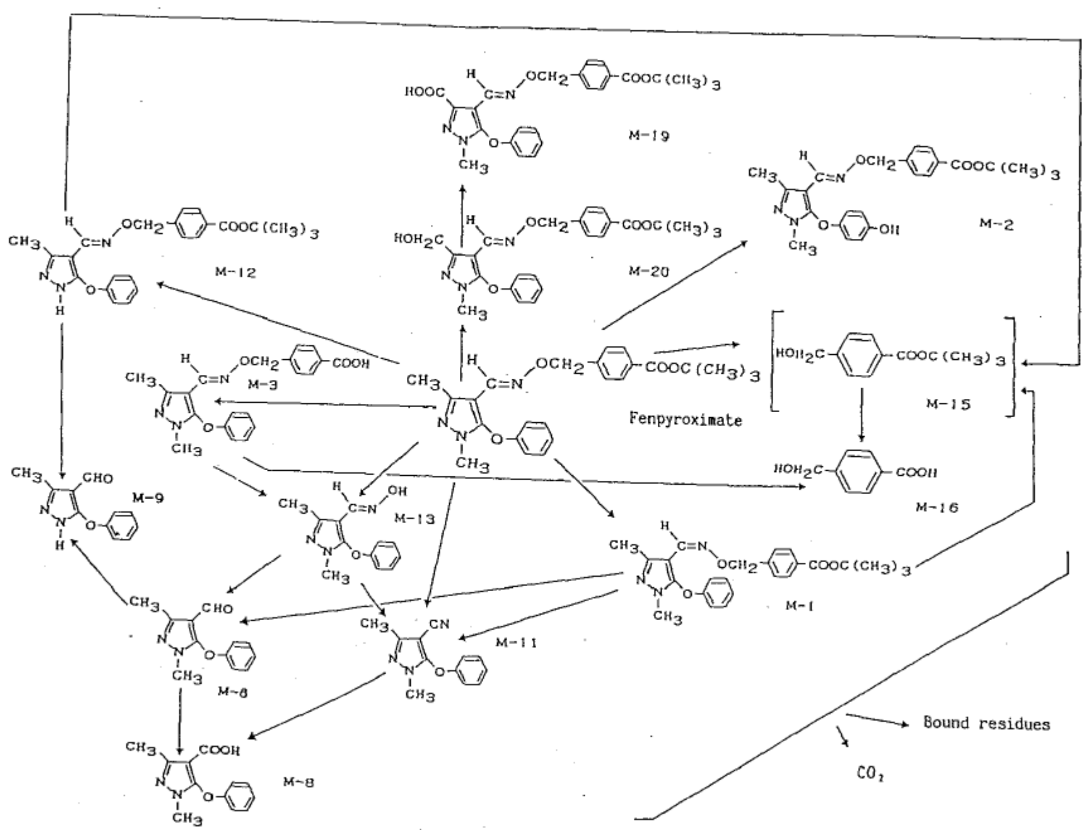


Figure A.1. Environmental Transformation Route of Fenpyroximate (MRID 45187901, p 52)

Appendix B. Example Aquatic Modeling Output and Input Files

PWC output file – with FL Citrus Aerial Application Scenario

Estimated Environmental Concentrations for Fenpyroximate are presented in Table 1 for the USEPA standard pond with the FLcitrusSTD field scenario. A graphical presentation of the year-to-year peaks is presented in Figure 1. These values were generated with the Pesticide Water Calculator (PWC), Version 1.52. Critical input values for the model are summarized in Tables 2 and 3.

This model estimates that about 2.2% of Fenpyroximate applied to the field eventually reaches the water body. The main mechanism of transport from the field to the water body is by spray drift (55.8% of the total transport), followed by erosion (34%) and runoff (10.3%).

In the water body, pesticide dissipates with an effective water column half-life of 29.1 days. (This value does not include dissipation by transport to the benthic region; it includes only processes that result in removal of pesticide from the complete system.) The main source of dissipation in the water column is metabolism (effective average half-life = 48.8 days) followed by photolysis (94.8 days) and hydrolysis (295.5 days).

In the benthic region, pesticide dissipates (35.6 days). The main source of dissipation in the benthic region is metabolism (effective average half-life = 35.6 days) followed by hydrolysis (1002766 days). The vast majority of the pesticide in the benthic region (99.97%) is sorbed to sediment rather than in the pore water.

Table 1. Estimated Environmental Concentrations (ppb) for Fenpyroximate.

Peak (1-in-10 yr)	1.40
4-day Avg (1-in-10 yr)	0.530
21-day Avg (1-in-10 yr)	0.251
60-day Avg (1-in-10 yr)	0.136
365-day Avg (1-in-10 yr)	0.378E-01
Entire Simulation Mean	0.299E-01

Table 2. Summary of Model Inputs for Fenpyroximate.

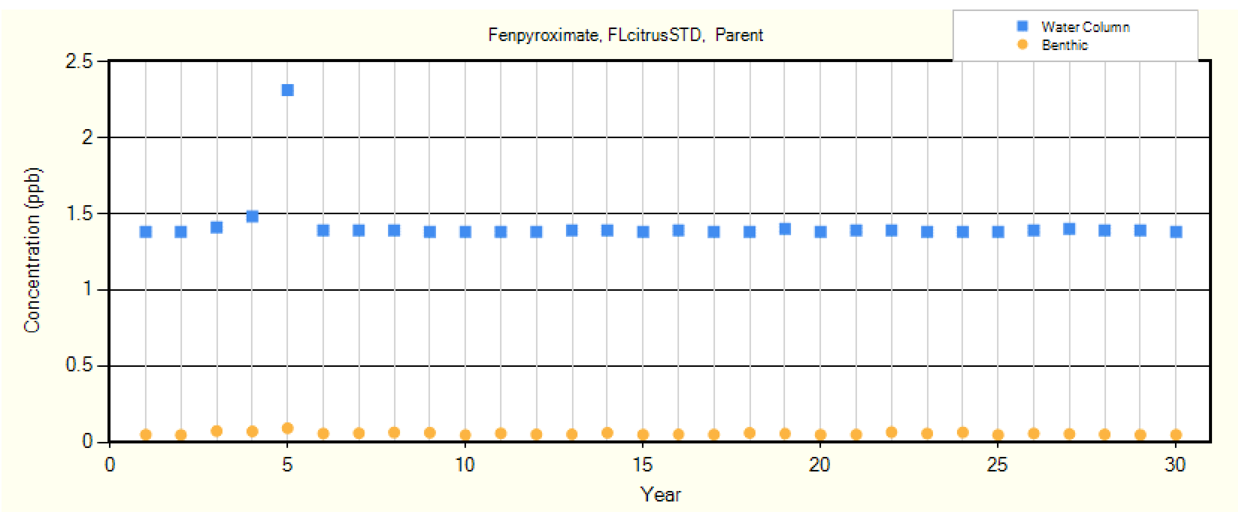
Scenario	FLcitrusSTD
Cropped Area Fraction	1
Koc (ml/g)	34000
Water Half-Life (days) @ 25 °C	45.4
Benthic Half-Life (days) @ 25 °C	33.1

Photolysis Half-Life (days) @ 25 °Lat	0.86
Hydrolysis Half-Life (days)	273
Soil Half-Life (days) @ 25 °C	163.8
Foliar Half-Life (days)	0
Molecular Weight	421.5
Vapor Pressure (torr)	5.6e-8
Solubility (mg/l)	0.026
Henry's Constant	0.0

Table 3. Application Schedule for Fenpyroximate.

Date (Mon/Day)	Type	Amount (kg/ha)	Eff.	Drift
10/1	Above Crop (Foliar)	0.2352	0.95	0.125
10/15	Above Crop (Foliar)	0.2352	0.95	0.125

Figure 1. Yearly Peak Concentrations



<u>PFAM output file – with WI_Cranberry-Winter Flood Scenario</u>

Pesticide in Flooded Applications (PFAM)
Version 2

7/10/2019 8:07:30 AM
******* Summary of Paddy Concentration Rankings ********

****
************** Analysis for Parent ************
Max released concentration (ppb) = 0.188E+04
Index for max concentration = 4237

1-in-10 Year Return Concentrations:
********* WATER COLUMN CONCENTRATION (ug/L) ************
Water Column Peak = 0.709
Water Column 1-day Avg = 0.636
Water Column 4-day Avg = 0.635
Water Column 21-day Avg = 0.622
Water Column 60-day Avg = 0.583
Water Column 90-day Avg = 0.563
Water Column 365-day Avg = 0.175

****** BENTHIC PORE WATER (ug/L) Concentration *********
Benthic Pore Water Peak = 1.24
Benthic Pore Water 4-day Avg = 1.21
Benthic Pore Water 21-day Avg = 1.15
Benthic Pore Water 60-day Avg = 1.01
Benthic Pore Water 90-day Avg = 0.943
Benthic Pore Water 365-day Avg = 0.643

***** BENTHIC TOTAL CONCENTRATION (Mass/Dry Mass) ******
Benthic Total Conc. Peak = 422.
Benthic Total Conc. 4-day Avg = 413.
Benthic Total Conc. 21-day Avg = 391.
Benthic Total Conc. 60-day Avg = 345.
Benthic Total Conc. 90-day Avg = 321.
Benthic Total Conc. 365-day Avg = 219.
****

Appendix C. Example Output for Terrestrial Modeling

Upper Bound Kenaga Residues For RQ Calculation

Chemical Name:	Fenpyroximate_129131	
Use	crop	
Formulation	0	
Application Rate	0.21	lbs a.i./acre
Half-life	35	days
Application Interval	14	days
Maximum # Apps./Year	2	
Length of Simulation	1	year
Variable application rates?	no	

Endpoints			
Avian	Zebra Finches (Body weight = 15.9 g)	LD50 (mg/kg-bw)	20.13
	Zebra Finches (Body weight = 15.9 g)	LC50 (mg/kg-diet)	403.40
	Mallard duck	NOAEL(mg/kg-bw)	NA
	Mallard duck	NOAEC (mg/kg-diet)	35.00
Mammals		LD50 (mg/kg-bw)	245.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	88.60
Tall Grass	40.61
Broadleaf plants	49.84
Fruits/pods/seeds	5.54
Arthropods	34.70

Avian Results

Avian Class	Body Weight (g)	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% Body wgt consumed	FI (kg-diet/day)
Small	20	5	23	114	2.28E-02
Mid	100	13	65	65	6.49E-02
Large	1000	58	291	29	2.91E-01
Granivores	20	5	5	25	5.06E-03
	100	13	14	14	1.44E-02
	1000	58	65	6	6.46E-02

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	20.83
100	26.52
1000	37.47

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams)		
	Small 20	Mid 100	Large 1000
Short Grass	100.90	57.54	25.76
Tall Grass	46.25	26.37	11.81
Broadleaf plants	56.76	32.37	14.49
Fruits/pods	6.31	3.60	1.61
Arthropods	39.52	22.54	10.09
Seeds	1.40	0.80	0.36

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	4.84	2.17	0.69
Tall Grass	2.22	0.99	0.32
Broadleaf plants	2.72	1.22	0.39
Fruits/pods	0.30	0.14	0.04
Arthropods	1.90	0.85	0.27

Seeds	0.07	0.03	0.01

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs	
	Acute	Chronic
Short Grass	0.22	2.53
Tall Grass	0.10	1.16
Broadleaf plants	0.12	1.42
Fruits/pods/seeds	0.01	0.16
Arthropods	0.09	0.99

Mammalian Results

Mammalian Class	Body Weight	Ingestion (Fdry) (g bwt/day)	Ingestion (Fwet) (g/day)	% Body wgt consumed	FI (kg-diet/day)
Herbivores/ insectivores	15	3	14	95	1.43E-02
	35	5	23	66	2.31E-02
	1000	31	153	15	1.53E-01
Granivores	15	3	3	21	3.18E-03
	35	5	5	15	5.13E-03
	1000	31	34	3	3.40E-02

Mammalian Class	Body Weight	Adjusted LD50	Adjusted NOAEL
Herbivores/ insectivores	15	538.47	65.93
	35	435.68	53.35
	1000	188.44	23.07
Granivores	15	538.47	65.93
	35	435.68	53.35
	1000	188.44	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams)		
	15	35	1000
Short Grass	84.47	58.38	13.54
Tall Grass	38.72	26.76	6.20
Broadleaf plants	47.51	32.84	7.61
Fruits/pods	5.28	3.65	0.85
Arthropods	33.08	22.87	5.30
Seeds	1.17	0.81	0.19

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	Small mammal 15 grams		Medium mammal 35 grams		Large mammal 1000 grams	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	**0.16**	**1.28**	**0.13**	**1.09**	**0.07**	**0.59**
Tall Grass	**0.07**	**0.59**	**0.06**	**0.50**	**0.03**	**0.27**
Broadleaf plants	**0.09**	**0.72**	**0.08**	**0.62**	**0.04**	**0.33**
Fruits/pods	**0.01**	**0.08**	**0.01**	**0.07**	**0.00**	**0.04**
Arthropods	**0.06**	**0.50**	**0.05**	**0.43**	**0.03**	**0.23**
Seeds	**0.00**	**0.02**	**0.00**	**0.02**	**0.00**	**0.01**

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	**#DIV/0!**	**0.15**
Tall Grass	**#DIV/0!**	**0.07**
Broadleaf plants	**#DIV/0!**	**0.08**
Fruits/pods/seeds	**#DIV/0!**	**0.01**
Arthropods	**#DIV/0!**	**0.06**

Appendix D. Terrestrial Vertebrate Analysis for KABAM

Residues in Aquatic Food Items For Terrestrial Vertebrates:

The KABAM model (K_{OW} (based) Aquatic BioAccumulation Model) version 1.0 was used to evaluate the potential exposure and risk of direct effects to birds and mammals via bioaccumulation and biomagnification in aquatic food webs. KABAM is used to estimate potential bioaccumulation of hydrophobic organic pesticides in freshwater aquatic ecosystems and risks to mammals and birds consuming aquatic organisms which have bioaccumulated these pesticides. The bioaccumulation portion of KABAM is based upon work by Arnot and Gobas (2004) who parameterized a bioaccumulation model based on PCBs and some pesticides (e.g., lindane, DDT) in freshwater aquatic ecosystems (Arnot and Gobas, 2004). KABAM relies on a chemical's octanol-water partition coefficient (K_{OW}) to estimate uptake and elimination constants through respiration and diet of organisms in different trophic levels. Pesticide tissue residues are calculated for organisms at different levels of an aquatic food web. The model then uses pesticide tissue concentrations in aquatic animals to estimate dose- and dietary-based exposures and associated risks to mammals and birds (surrogate for amphibians and reptiles) consuming aquatic organisms. Seven different trophic levels including phytoplankton, zooplankton, benthic invertebrates, filter feeders, small-sized (juvenile) forage fish, medium-sized forage fish, and larger piscivorous fish, are used to represent an aquatic food web.

Fenpyroximate may bioaccumulate in aquatic organisms, with fish bioconcentration factors of up to 1100, 4100, and 2700 for edible, inedible, and whole bluegill (*Lepomis macrochirus*) fish tissues, respectively (MRID 48381102). Depuration half-lives for the edible, inedible, and whole fish tissues were 5.2-5.3 days. One concentration of fenpyroximate was studied and metabolism and degradation were not monitored in this study (*i.e.*, the presence of transformation products was not investigated).

Input scenarios and parameters were chosen to represent the range of exposures from high to low and are presented in **Table 14-1.** In order to estimate BCF values for aquatic organisms accumulating fenpyroximate, KABAM was run using a log K_{OW} of 5.01 (MRID 44781003) to represent the partitioning of fenpyroximate to aquatic organisms. BCF values for organisms in modeled trophic levels are depicted in **Table 14-2**.

Table 14-1. Bioaccumulation Model Input Values for Fenpyroximate

Parameter	Input Value	Source
Pesticide Name	Fenpyroximate	--
Log K_{OW}	5.01	MRID 44781003
K_{OC}	34000	Mean K_{OC} value from MRID 45649709.
Pore water EEC (µg/L)	0.622	Maximum 1-in-10 year 21-day average value from the WI cranberry winter flood scenario surface water modeling. The estimated time to reach steady state was 30 days.
Water column EEC (µg/L)	1.15	Maximum 1-in-10 year 21-day average value from the WI cranberry winter flood scenario surface water modeling. The estimated time to reach steady state was 30 days.

Table 14-2. Estimated BCF Values for Fenpyroximate in Aquatic Organisms

Trophic Level	Total BCF (L/kg-ww)
Phytoplankton	4913
Zooplankton	3501
Benthic Invertebrates	3823
Filter Feeders	2513
Small Fish	4918
Medium Fish	4918
Large Fish	4918

The KABAM-estimated BCF for fenpyroximate was 4900, which is only 2 – 3x higher than the study-derived values of 1800 for whole fish. The proximity of the KABAM-estimated BCF values to the study derived BCF values gives confidence for using the default KABAM input parameters.

Example KABAM output to document inputs etc:

Table 1. Chemical characteristics of Fenpyroximate.		
Characteristic	**Value**	**Comments/Guidance**
Pesticide Name	**Fenpyroximate**	**Required input**
Log K_{OW}	**5.01**	**Required input** Enter value from acceptable or supplemental study submitted by registrant or available in scientific literature.
K_{OW}	**102329**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
K_{OC} (L/kg OC)	**34000**	**Required input** Input value used in PRZM/EXAMS to derive EECs. Follow input parameter guidance for deriving this parameter value (USEPA 2002).
Time to steady state (T_S; days)	**30**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
Pore water EEC (µg/L)	**1.15**	**Required input** Enter value generated by PRZM/EXAMS benthic file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the pore water of the sediment. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. Select the EEC generated by PRZM/EXAMS which has an averaging period closest to the time to steady state calculated above. In cases where the time to steady state exceeds 365 days, the user should select the EEC representing the average of yearly averages. The peak EEC should not be used.
Water Column EEC (µg/L)	**0.622**	**Required input** Enter value generated by PRZM/EXAMS water column file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the water column. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. The averaging period used for the water column EEC should be the same as the one selected for the pore water EEC (discussed above).

Table 2. Input parameters for rate constants. "calculated" indicates that model will calculate rate constant.					
Trophic level	**k_1 (L/kg*d)**	**k_2 (d^{-1})**	**k_D (kg-food/kg-org/d)**	**k_E (d^{-1})**	**k_M* (d^{-1})**
phytoplankton	calculated	calculated	0*	0*	0
zooplankton	calculated	calculated	calculated	calculated	0
benthic invertebrates	calculated	calculated	calculated	calculated	0
filter feeders	calculated	calculated	calculated	calculated	0
small fish	calculated	calculated	calculated	calculated	0
medium fish	calculated	calculated	calculated	calculated	0
large fish	calculated	calculated	calculated	calculated	0

* Default value is 0.

k_1 and k_2 represent the uptake and elimination constants respectively, through respiration.

k_D and k_E represent the uptake and elimination constants, respectively, through diet.

k_M represents the metabolism rate constant.

Table 3. Mammalian and avian toxicity data for Fenpyroximate. These are required inputs.				
Animal	**Measure of effect (units)**	**Value**	**Species**	**If selected species is "other," enter body weight (in kg) here.**
Avian	LD_{50} (mg/kg-bw)	20.13	other	0.0159
	LC_{50} (mg/kg-diet)	403.4	other	0.0159
	NOAEC (mg/kg-diet)	35	mallard duck	
	Mineau Scaling Factor	1.15	Default value for all species is 1.15 (for chemical specific values, see Mineau et al. 1996).	
Mammalian	LD_{50} (mg/kg-bw)	245	laboratory rat	
	LC_{50} (mg/kg-diet)	N/A	laboratory rat	
	Chronic Endpoint	30	laboratory rat	
	units of chronic endpoint*	ppm		

*ppm = mg/kg-diet

Table 11. Estimated concentrations of Fenpyroximate in ecosystem components.				
Ecosystem Component	Total concentration (µg/kg-ww)	Lipid normalized concentration (µg/kg-lipid)	Contribution due to diet (µg/kg-ww)	Contribution due to respiration (µg/kg-ww)
Water (total)*	1	N/A	N/A	N/A
Water (freely dissolved)*	1	N/A	N/A	N/A
Sediment (pore water)*	1	N/A	N/A	N/A
Sediment (in solid)**	1,564	N/A	N/A	N/A
Phytoplankton	2,894	144699	N/A	2,893.98
Zooplankton	2,236	74527	70.67	2,165.15
Benthic Invertebrates	2,671	89028	233.52	2,437.31
Filter Feeders	1,754	87675	150.44	1,603.06
Small Fish	3,872	96807	812.19	3,060.08
Medium Fish	4,615	115378	1,658.50	2,956.61
Large Fish	6,234	155854	3,532.34	2,701.83
* Units: µg/L; **Units: µg/kg-dw				

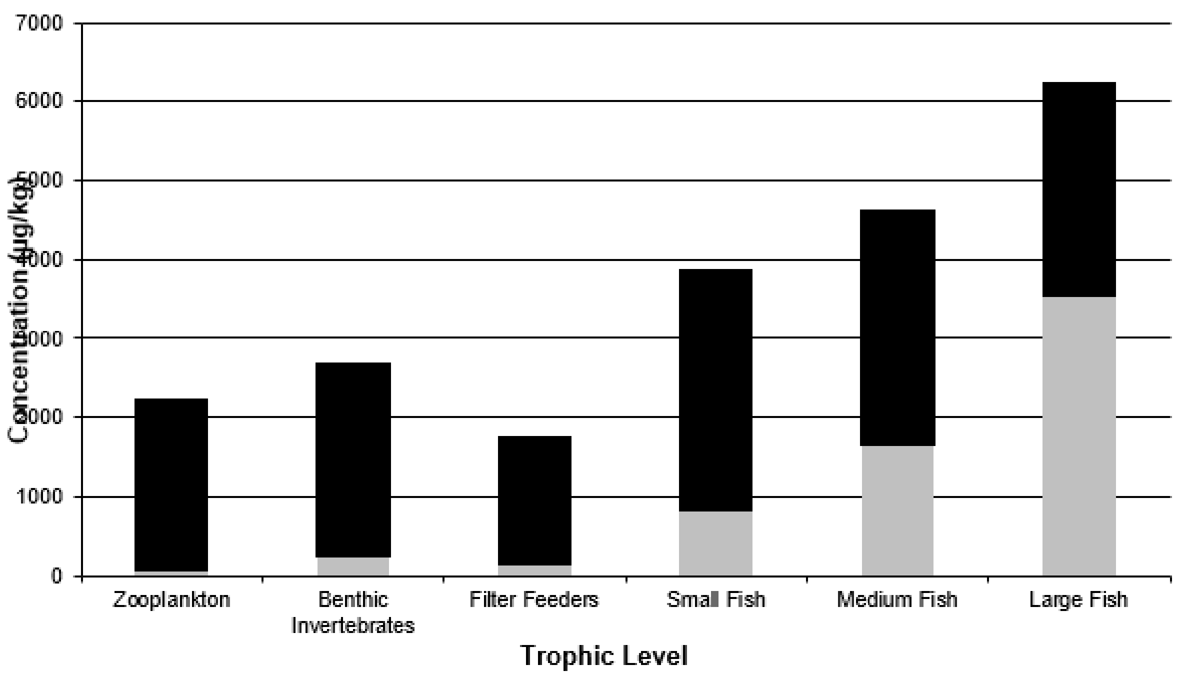


Figure 1. Total pesticide concentration per trophic level

Table 12. Total BCFand BAF values of Fenpyroximate in aquatic trophic levels.		
Trophic Level	Total BCF (µg/kg-ww)/(µg/L)	Total BAF (µg/kg-ww)/(µg/L)
Phytoplankton	4913	4653
Zooplankton	3501	3595
Benthic Invertebrates	3985	4294
Filter Feeders	2620	2819
Small Fish	5126	6226
Medium Fish	5126	7420
Large Fish	4918	10023

Table 13. Lipid-normalized BCF, BAF, BMF and BSAF values of Fenpyroximate in aquatic trophic levels.				
Trophic Level	BCF (µg/kg-lipid)/(µg/L)	BAF (µg/kg-lipid)/(µg/L)	BMF (µg/kg-lipid)/(µg/kg-lipid)	BSAF (µg/kg-lipid)/(µg/kg-OC)
Phytoplankton	245635	232635	N/A	4
Zooplankton	116684	119819	0.52	2
Benthic Invertebrates	132834	143132	1.23	2
Filter Feeders	130985	140957	1.21	2
Small Fish	128159	155638	1.18	2
Medium Fish	128159	185495	1.24	3
Large Fish	122941	250570	1.35	4

Table 14. Calculation of EECs for mammals and birds consuming fish contaminated by Fenpyroximate.						
Wildlife Species	Biological Parameters				EECs (pesticide intake)	
	Body Weight (kg)	Dry Food Ingestion Rate (kg-dry food/kg-bw/day)	Wet Food Ingestion Rate (kg-wet food/kg-bw/day)	Drinking Water Intake (L/d)	Dose Based (mg/kg-bw/d)	Dietary Based (ppm)
Mammalian						
fog/water shrew	0.02	0.140	0.585	0.003	1.563	2.67
rice rat/star-nosed mole	0.1	0.107	0.484	0.011	1.338	2.76
small mink	0.5	0.079	0.293	0.048	1.354	4.62
large mink	1.8	0.062	0.229	0.168	1.058	4.62
small river otter	5.0	0.052	0.191	0.421	0.882	4.62
large river otter	15.0	0.042	0.157	1.133	0.980	6.23
Avian						
sandpipers	0.0	0.228	1.034	0.004	2.8707	2.78
cranes	6.7	0.030	0.136	0.211	0.4117	3.03
rails	0.1	0.147	0.577	0.010	1.8889	3.27
herons	2.9	0.040	0.157	0.120	0.5734	3.64
small osprey	1.3	0.054	0.199	0.069	0.9203	4.62
white pelican	7.5	0.029	0.107	0.228	0.6652	6.23

Table 15. Calculation of toxicity values for mammals and birds consuming fish contaminated by Fenpyroximate.

Wildlife Species	Toxicity Values			
	Acute		Chronic	
	Dose Based (mg/kg-bw)	Dietary Based (mg/kg-diet)	Dose Based (mg/kg-bw)	Dietary Based (mg/kg-diet)
Mammalian				
fog/water shrew	514.48	N/A	3.15	30
rice rat/star-nosed mole	349.00	N/A	2.14	30
small mink	230.08	N/A	1.41	30
large mink	162.69	N/A	1.00	30
small river otter	126.02	N/A	0.77	30
large river otter	95.75	N/A	0.59	30
Avian				
sandpipers	20.83	403.40	N/A	35
cranes	49.84	403.40	N/A	35
rails	25.14	403.40	N/A	35
herons	43.95	403.40	N/A	35
small osprey	38.74	403.40	N/A	35
white pelican	50.69	403.40	N/A	35

Table 16. Calculation of RQ values for mammals and birds consuming fish contaminated by Fenpyroximate.				
Wildlife Species	**Acute**		**Chronic**	
	Dose Based	**Dietary Based**	**Dose Based**	**Dietary Based**
Mammalian				
fog/water shrew	0.003	N/A	0.496	0.089
rice rat/star-nosed mole	0.004	N/A	0.626	0.092
small mink	0.006	N/A	0.961	0.154
large mink	0.007	N/A	**1.062**	0.154
small river otter	0.007	N/A	**1.143**	0.154
large river otter	0.010	N/A	**1.671**	0.208
Avian				
sandpipers	**0.138**	0.007	N/A	0.079
cranes	0.008	0.008	N/A	0.087
rails	0.075	0.008	N/A	0.093
herons	0.013	0.009	N/A	0.104
small osprey	0.024	0.011	N/A	0.132
white pelican	0.013	0.015	N/A	0.178

Appendix E. Endocrine Disruptor Screening Program (EDSP)

As required by FIFRA and the Federal Food, Drug, and Cosmetic Act (FFDCA), EPA reviews numerous studies to assess potential adverse outcomes from exposure to chemicals. Collectively, these studies include acute, subchronic and chronic toxicity, including assessments of carcinogenicity, neurotoxicity, developmental, reproductive, and general or systemic toxicity. These studies include endpoints which may be susceptible to endocrine influence, including effects on endocrine target organ histopathology, organ weights, estrus cyclicity, sexual maturation, fertility, pregnancy rates, reproductive loss, and sex ratios in offspring. For ecological hazard assessments, EPA evaluates acute tests and chronic studies that assess growth, developmental and reproductive effects in different taxonomic groups. As part of the Draft Ecological Risk Assessment for Registration Review, EPA reviewed these data and selected the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. However, as required by FFDCA section 408(p), fenpyroximate is subject to the endocrine screening part of the Endocrine Disruptor Screening Program (EDSP).

EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a "naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect.

Under FFDCA section 408(p), the Agency must screen all pesticide chemicals. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. A second list of chemicals identified for EDSP screening was published on June 14, 2013[1] and includes some pesticides scheduled for registration review and chemicals found in water. Neither of these lists should be construed as a list of known or likely endocrine disruptors. Fenpyroximate is not on List 1. For

[1] See http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0477-0074 for the final second list of chemicals.

further information on the status of the EDSP, the policies and procedures, the lists of chemicals, future lists, the test guidelines and Tier 1 screening battery, please visit our website[2].

[2] Available: http://www.epa.gov/endo/

Appendix F. Listed Species

In November 2013, the EPA, along with the Services and the United States Department of Agriculture (USDA), released a summary of their joint Interim Approaches for assessing risks to endangered and threatened (listed) species from pesticides. The Interim Approaches were developed jointly by the agencies in response to the National Academy of Sciences' (NAS) recommendations and reflect a common approach to risk assessment shared by the agencies as a way of addressing scientific differences between the EPA and the Services. The NAS report[1] outlines recommendations on specific scientific and technical issues related to the development of pesticide risk assessments that EPA and the Services must conduct in connection with their obligations under the ESA and FIFRA.

EPA received considerable public input on the Interim Approaches through stakeholder workshops and from the Pesticide Program Dialogue Committee (PPDC) and State-FIFRA Issues Research and Evaluation Group (SFIREG) meetings. As part of a phased, iterative process for developing the Interim Approaches, the agencies will also consider public comments on the Interim Approaches in connection with the development of upcoming Registration Review decisions. The details of the joint Interim Approaches are contained in the white paper *Interim Approaches for National-Level Pesticide Endangered Species Act (ESA) Assessments Based on the Recommendations of the National Academy of Sciences April 2013 Report*[2], dated November 1, 2013.

Given that the agencies are continuing to develop and work toward implementation of the Interim Approaches to assess the potential risks of pesticides to listed species and their designated critical habitat, this ecological risk assessment for fenpyroximate does not contain a complete ESA analysis that includes effects determinations for specific listed species or designated critical habitat. Although EPA has not yet completed effects determinations for specific species or habitats, this assessment assumed, for all taxa of non-target wildlife and plants, that listed species and designated critical habitats may be present in the vicinity of the application of fenpyroximate. This assessment will allow EPA to focus its future evaluations on the types of species where the potential for effects exists once the scientific methods being developed by the agencies have been fully vetted. Once the agencies have fully developed and implemented the scientific methodology for evaluating risks for listed species and their designated critical habitats, these methods will be applied to subsequent analyses for fenpyroximate as part of completing this registration review.

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[1] *Assessing Risks to Endangered and Threatened Species from Pesticides.* Available at http://www.nap.edu/catalog.php?record_id=18344

[2] Available at http://www2.epa.gov/endangered-species/assessing-pesticides-under-endangered-species-act#report

Appendix G. Minimum and Maximum Aquatic Risk Quotients for All Uses and All Taxa

Table 14-3. Minimum and Maximum Acute and Chronic Aquatic Vertebrate Risk Quotients for Non-listed Species for All Uses

Use Site; Scenario	1-in-10 Yr EEC µg/L		Risk Quotient			
			Freshwater		Estuarine/Marine	
	Daily Ave	60-day Ave	Acute[1]	Chronic[2]	Acute[1]	Chronic[2]
			LC_{50} = 0.73 µg a.i./L	NOAEC = 0.016 µg a.i./L	LC_{50} = 36 µg a.i./L	NOAEC = 0.78 µg a.i./L
PWC						
Tomato, CAtomato_WirrigSTD	0.328	0.0227	0.45	**1.4**	0.01	0.03
Tomato, PAtomatoSTD	1.18	0.107	**1.62**	**6.69**	0.03	0.14
Potato, IDNpotato_WirrigSTD	0.347	0.0309	0.48	**1.93**	0.01	0.04
Potato, MEpotatoSTD	0.73	0.0954	**1.00**	**5.96**	0.02	0.12
Ornamentals, ORnurserySTD	0.338	0.0146	0.46	0.91	0.01	0.02
Ornamentals, NJnurserySTD	0.353	0.0285	0.48	**1.78**	0.01	0.04
Cotton, MScottonSTD	0.54	0.0449	**0.74**	**2.81**	0.02	0.06
Cotton, MScottonSTD	0.807	0.0549	**1.11**	**3.43**	0.02	0.07
Pepper, FLpeppersSTD	0.418	0.0468	**0.57**	**2.93**	0.01	0.06
Mint, ORmintSTD	0.347	0.0275	0.48	**1.72**	0.01	0.04
Stone Fruit, CAfruit_WirrigSTD	0.345	0.0266	0.47	**1.66**	0.01	0.03
Stone Fruit, MICherriesSTD	1.02	0.0905	**1.40**	**5.66**	0.03	0.12
Pome Fruit, ORappleSTD	0.349	0.0309	0.48	**1.93**	0.01	0.04
Pome Fruit, PAappleSTD_V2	0.66	0.0605	**0.90**	**3.78**	0.02	0.08
Melon, MImelonStd	0.346	0.0291	0.47	**1.82**	0.01	0.04
Melon, MOmelonStd	0.475	0.0417	**0.65**	**2.61**	0.01	0.05
Corn, MNCornStd	0.423	0.0568	**0.58**	**3.55**	0.01	0.07
Corn, ILCornSTD	1.15	0.0982	**1.58**	**6.14**	0.03	0.13

Use Site; Scenario	1-in-10 Yr EEC µg/L		Risk Quotient			
			Freshwater		Estuarine/Marine	
	Daily Ave	60-day Ave	Acute[1]	Chronic[2]	Acute[1]	Chronic[2]
			LC_{50} = 0.73 µg a.i./L	NOAEC = 0.016 µg a.i./L	LC_{50} = 36 µg a.i./L	NOAEC = 0.78 µg a.i./L
Snap Beans, MIbeansSTD	0.353	0.0532	0.48	**3.33**	0.01	0.07
Snap Beans, MIbeansSTD	0.748	0.0667	**1.02**	**4.17**	0.02	0.09
Cucumbers, FLcucumberSTD	0.351	0.0381	0.48	**2.38**	0.01	0.05
Cucumbers, FLcucumberSTD	0.698	0.0594	**0.96**	**3.71**	0.02	0.08
Hops, ORhopsSTD	0.516	0.0266	**0.71**	**1.66**	0.01	0.03
Avocado, FLavocadoSTD	0.676	0.0237	**0.93**	**1.48**	0.02	0.03
Avocado, FLavocadoSTD	1.36	0.0466	**1.86**	**2.91**	0.04	0.06
Tree Nuts, Almonds, Pistachio CAalmond_WirringSTD	0.699	0.0534	**0.96**	**3.34**	0.02	0.07
10-10. Citrus Fruit Group; CAcitrus_Wirrig STD	0.686	0.0474	**0.94**	**2.96**	0.02	0.06
10-10. Citrus Fruit Group; FLcitrusSTD	1.4	0.136	**1.9**	**8.5**	0.04	0.17
PFAM						
Cranberry, MA Winter Flood STD	0.604	0.0259	**0.83**	**1.62**	0.01	0.50
Cranberry, WI Winter Flood	0.636	0.583	**0.87**	**36**	0.02	0.75

Table 14-4. Minimum and Maximum Acute and Chronic Aquatic Invertebrate Risk Quotients for all Uses

Use Site; Scenario	1-in-10 Yr EEC µg/L		Risk Quotient			
			Freshwater		Estuarine/Marine	
	Daily Ave	21-day Ave	Acute[1]	Chronic[2]	Acute[1]	Chronic[2]
			LC_{50} = 3.6 µg a.i./L	NOAEC = 0.56 µg a.i./L	LC_{50} = 3.3 µg a.i./L	NOAEC = 0.93 µg a.i./L
PWC						
Tomato, CAtomato_WirrigSTD	0.328	0.0484	0.09	0.09	0.10	0.05
Tomato, PAtomatoSTD	1.18	0.164	0.33	0.29	0.36	0.18
Potato, IDNpotato_WirrigSTD	0.347	0.057	0.10	0.10	0.11	0.06
Potato, MEpotatoSTD	0.72	0.142	0.20	0.25	0.22	0.15
Ornamentals, ORnurserySTD	0.338	0.0289	0.09	0.05	0.10	0.03
Ornamentals, NJnurserySTD	0.353	0.0495	0.10	0.09	0.11	0.05
Cotton, MScottonSTD	0.54	0.0827	0.15	0.15	0.16	0.09
Cotton, MScottonSTD	0.807	0.107	0.22	0.19	0.24	0.12
Pepper, FLpeppersSTD	0.418	0.0735	0.12	0.13	0.13	0.08
Mint, ORmintSTD	0.347	0.054	0.10	0.10	0.11	0.06
Stone Fruit, CAfruit_WirrigSTD	0.345	0.0517	0.10	0.09	0.10	0.06
Stone Fruit, MICherriesSTD	1.02	0.143	0.28	0.26	0.31	0.15
Pome Fruit, ORappleSTD	0.349	0.0564	0.10	0.10	0.11	0.06
Pome Fruit, PAappleSTD_V2	0.66	0.106	0.18	0.19	0.20	0.11
Melon, MImelonStd	0.346	0.0553	0.10	0.10	0.10	0.06
Melon, MOmelonStd	0.475	0.0691	0.13	0.12	0.14	0.07
Corn, MNCornStd	0.423	0.0745	0.12	0.13	0.13	0.08
Corn, ILCornSTD	1.15	0.158	0.32	0.28	0.35	0.17
Snap Beans, MIbeansSTD	0.353	0.069	0.10	0.12	0.11	0.07

Use Site; Scenario	1-in-10 Yr EEC µg/L		Risk Quotient			
			Freshwater		Estuarine/Marine	
	Daily Ave	21-day Ave	Acute[1]	Chronic[2]	Acute[1]	Chronic[2]
			LC_{50} = 3.6 µg a.i./L	NOAEC = 0.56 µg a.i./L	LC_{50} = 3.3 µg a.i./L	NOAEC = 0.93 µg a.i./L
Snap Beans, MIbeansSTD	0.748	0.121	0.21	0.22	0.23	0.13
Cucumbers, FLcucumberSTD	0.351	0.0591	0.10	0.11	0.11	0.06
Cucumbers, FLcucumberSTD	0.698	0.108	0.19	0.19	0.21	0.12
Hops, ORhopsSTD	0.516	0.0498	0.14	0.09	0.16	0.05
Avocado, FLavocadoSTD	0.676	0.0541	0.19	0.10	0.20	0.06
Avocado, FLavocadoSTD	1.36	0.107	0.38	0.19	0.41	0.12
Tree Nuts, Almonds, Pistachio CAalmond_WirringSTD	0.699	0.105	0.19	0.19	0.21	0.11
10-10. Citrus Fruit Group; CAcitrus_WirrigSTD	0.686	0.0991	0.19	0.18	0.21	0.11
10-10. Citrus Fruit Group; FLcitrusSTD	1.4	0.136	1.4	0.251	0.39	0.45
PFAM						
Cranberry, MA Winter Flood STD	0.531	0.416	0.15	0.74	0.16	0.45
Cranberry, WI Winter Flood	0.636	0.622	0.18	**1.11**	0.19	0.67

Table 14-5. Minimum and Maximum Sub-chronic Aquatic Benthic Invertebrate Risk Quotients for All Uses

Use Site	1-in-10 Yr EEC Pore Water (PW) or Bulk Sediment (BS)		Risk Quotients Freshwater Sub-Chronic			Risk Quotients Estuarine/Marine Sub-Chronic
	21-day (PW) (µg a.i./L)	21-day (BS)* (µg a.i./kg-oc)	Water Column NOAEC = 0.56 (µg/L)	Pore Water NOAEC = 145 (µg TRR/L)	Bulk Sediment NOAEC = 39000 (µg TRR/kg-oc)	Water Column NOAEC = 0.93 (µg/L)
PWC						
Tomato, CAtomato_Wirrig STD	0.0116	394	0.02	0.00	0.01	0.01
Tomato, PAtomatoSTD	0.0736	2502	0.13	0.00	0.06	0.08
Potato, IDNpotato_Wirrig STD	0.0155	527	0.03	0.00	0.01	0.02
Potato, MEpotatoSTD	0.0666	2264	0.12	0.00	0.06	0.07
Ornamentals, ORnurserySTD	0.00794	270	0.01	0.00	0.01	0.01
Ornamentals, NJnurserySTD	0.0178	605	0.03	0.00	0.02	0.02
Cotton, MScottonSTD	0.0294	1000	0.05	0.00	0.03	0.03
Cotton, NCcottonSTD	0.0377	1282	0.07	0.00	0.03	0.04
Pepper, FLpeppersSTD	0.0249	847	0.04	0.00	0.02	0.03
Mint, ORmintSTD	0.0157	534	0.03	0.00	0.01	0.02
Stone Fruit, CAfruit_WirrigSTD	0.0138	469	0.02	0.00	0.01	0.01
Stone Fruit, MICherriesSTD	0.0623	2118	0.11	0.00	0.05	0.07
Pome Fruit, ORappleSTD	0.0183	622	0.03	0.00	0.02	0.02
Pome Fruit, PAappleSTD_V2	0.0414	1408	0.07	0.00	0.04	0.04
Melon, MImelonStd	0.0145	493	0.03	0.00	0.01	0.02
Melon, MOmelonStd	0.0226	768	0.04	0.00	0.02	0.02

Corn, MNCornStd	0.0162	551	0.03	0.00	0.01	0.02
Corn, ILCornSTD	0.0737	2506	0.13	0.00	0.06	0.08
Snap Beans, MIbeansSTD	0.0394	1340	0.07	0.00	0.03	0.04
Snap Beans, MIbeansSTD	0.0357	1214	0.06	0.00	0.03	0.04
Cucumbers, FLcucumberSTD	0.0182	619	0.03	0.00	0.02	0.02
Cucumbers, FLcucumberSTD	0.0275	935	0.05	0.00	0.02	0.03
Hops, ORhopsSTD	0.0192	653	0.03	0.00	0.02	0.02
Avocado, FLavocadoSTD	0.013	442	0.02	0.00	0.01	0.01
Avocado, FLavocadoSTD	0.0245	833	0.04	0.00	0.02	0.03
Tree Nuts, Almonds, Pistachio CAalmond_WirringSTD	0.028	952	0.05	0.00	0.02	0.03
10-10. Citrus Fruit Group; CAcitrus_WirrigSTD	0.0231	785	0.04	0.00	0.02	0.02
10-10. Citrus Fruit Group; FLcitrusSTD	0.0646	2196	0.12	0.00	0.06	0.07
PFAM						
Cranberry, OR Winter Flood STD	1.01	8594	**1.80**	0.01	0.22	**1.09**
Cranberry, WI Winter Flood	1.15	9786	**2.05**	0.01	0.25	**1.24**

Table 14-6. Minimum and Maximum Aquatic Plant Risk Quotients for Non-listed Species for All Uses

Use Sites	1-in-10 Year Daily Average EEC µg/L	Risk Quotients	
		Vascular	Non-vascular
		IC_{50} > 190 µg a.i./L	IC_{50} = 0.66 µg a.i./L
PWC			
Tomato, CAtomato_WirrigSTD	0.328	<0.01	0.50
Tomato, PAtomatoSTD	1.18	<0.01	**1.79**
Potato, IDNpotato_WirrigSTD	0.347	<0.01	0.53
Potato, MEpotatoSTD	0.72	<0.01	**1.09**
Ornamentals, ORnurserySTD	0.338	<0.01	0.51
Ornamentals, NJnurserySTD	0.353	<0.01	0.53
Cotton, MScottonSTD	0.54	<0.01	0.82
Cotton, MScottonSTD	0.807	<0.01	**1.22**
Pepper, FLpeppersSTD	0.418	<0.01	0.63
Mint, ORmintSTD	0.347	<0.01	0.53
Stone Fruit, CAfruit_WirrigSTD	0.345	<0.01	0.52
Stone Fruit, MICherriesSTD	1.02	<0.01	**1.55**
Pome Fruit, ORappleSTD	0.349	<0.01	0.53
Pome Fruit, PAappleSTD_V2	0.66	<0.01	**1.00**
Melon, MImelonStd	0.346	<0.01	0.52
Melon, MOmelonStd	0.475	<0.01	0.72
Corn, MNCornStd	0.423	<0.01	0.64
Corn, ILCornSTD	1.15	<0.01	**1.74**
Snap Beans, MIbeansSTD	0.353	<0.01	0.53
Snap Beans, MIbeansSTD	0.748	<0.01	**1.13**
Cucumbers, FLcucumberSTD	0.351	<0.01	0.53
Cucumbers, FLcucumberSTD	0.698	<0.01	**1.06**
Hops, ORhopsSTD	0.516	<0.01	0.78
Avocado, FLavocadoSTD	0.676	<0.01	**1.02**
Avocado, FLavocadoSTD	1.36	<0.01	**2.06**
Tree Nuts, Almonds, Pistachio CAalmond_WirringSTD	0.699	<0.01	**1.06**

10-10. Citrus Fruit Group; CAcitrus_WirrigSTD	0.686	<0.01	**1.04**
10-10. Citrus Fruit Group; FLcitrusSTD	1.4	<0.01	**2.12**
PFAM			
Cranberry, MA Winter Flood STD	0.531	<0.01	0.80
Cranberry, WI Winter Flood	0.636	<0.01	0.96