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WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

July 21, 2020

PC Code: 012311
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MEMORANDUM

SUBJECT: **Tiafenacil:** Ecological Risk Assessment for Use of the New Herbicide Tiafenacil on Corn, Cotton, Soybeans, Wheat, Grapes, Fallow, and Non-Cropped Areas.

FROM: Daniel Aboagye, Ph.D., Biologist
Joshua Antoline, Ph.D., Chemist
Environmental Risk Branch IV
Environmental Fate and Effects Division (7507P)

DANIEL ABOAGYE Digitally signed by DANIEL ABOAGYE Date: 2020.07.27 16:09:40 -04'00'
Antoline, Joshua Digitally signed by Antoline, Joshua Date: 2020.07.27 14:30:42 -04'00'

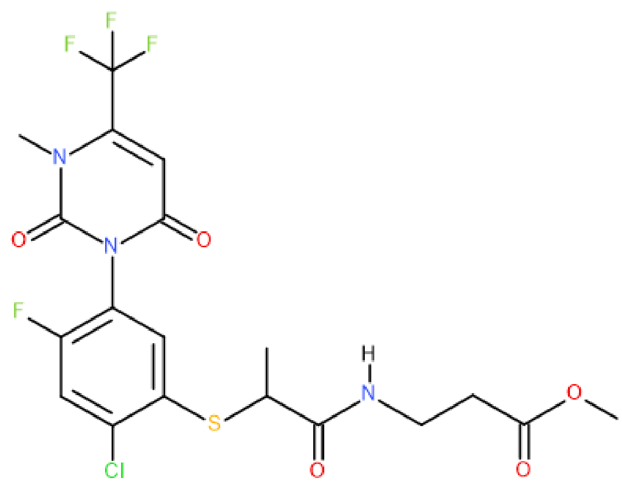
THRU: Katrina White, Ph.D., Senior Fate Scientist
Thomas Steeger, Ph.D., Senior Science Advisor
Jean Holmes, DVM, Branch Chief
Environmental Risk Branch IV
Environmental Fate and Effects Division (7507P)

KATRINA WHITE Digitally signed by KATRINA WHITE Date: 2020.07.28 08:20:05 -04'00'
THOMAS STEEGER Digitally signed by THOMAS STEEGER Date: 2020.07.28 06:01:47 -04'00'
Jean Holmes 2020.07.28 08:46:41 -04'00'

TO: Grant Rowland, Risk Manager Reviewer
Emily Schmid, Product Manager Team 25
Dan Kenny, Branch Chief
Herbicide Branch
Registration Division (7508P)

The Environmental Fate and Effects Division (EFED) has completed the environmental fate and ecological risk assessment in support of the Section 3 Registration of the herbicide tiafenacil (PC code 012311, CAS number 1220411-29-9) for use on corn, cotton, grapes, soybeans, wheat, fallow fields, and non-crop areas.

Ecological Risk Assessment for the Section 3 Registration of Tiafenacil



Tiafenacil; CAS No 1220411-29-9
USEPA PC Code: 012311

Prepared by:
Daniel Aboagye, Ph.D., Biologist
Joshua Antoline, Ph.D., Chemist

Reviewed by:
Katrina White, Ph.D., Senior Fate Scientist
Thomas Steeger, Ph.D., Senior Science Advisor

Approved by:
Jean Holmes, DVM, Branch Chief
Environmental Risk Branch IV
Environmental Fate and Effects Division
Office of Pesticide Programs
United States Environmental Protection Agency

July 21, 2020

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1 Executive Summary

1.1 Overview

This Ecological Risk Assessment examines the potential ecological risks associated with the proposed uses of tiafenacil (methyl 3-[(2RS)-2-{2-chloro-4-fluoro-5-[1,2,3,6-tetrahydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)pyrimidin-1(6H)-yl]phenylthio}propionamido]propionate) relative to non-target species. Tiafenacil is a contact uracil class Light Dependent Peroxidizing Herbicide (LDPH) proposed for use as a non-selective pre-plant/pre-emergence burndown herbicide on a range of agricultural crops, a post-emergence herbicide for fallow fields and non-cropped areas, and as a preharvest desiccant for cotton. The maximum proposed single application rate is 0.067 lb active ingredient (a.i.) per acre (A) and the proposed maximum annual application rate is 0.223 lb a.i./A/year. Different use patterns can be combined (*e.g.* wheat+fallow, cotton burndown+cotton desiccation) up to the maximum annual application rate.

Tiafenacil degrades rapidly in soil and water to a wide range of major and minor degradates. Available data indicate these degradates are more persistent and mobile than the parent compound. Based on submitted toxicity data for the parent and qualitative structure-activity relationship (QSAR) information from the structurally similar herbicide saflufenacil (PC Code 118202; CAS No. 372137-35-4), the Residues of Concern (ROC) in this assessment are tiafenacil parent and the degradates M-01, M-12, and M-13. The aquatic estimated environmental concentrations (EECs) for parent and total ROC were compared to the toxicity endpoints for parent tiafenacil and to the molar equivalency NOAEC . Given that aquatic organisms are likely to be exposed simultaneously to LDPH and ultraviolet (*uV)* light in natural settings, there is a concern that standard laboratory tests may underestimate the toxicity of LDPH in shallow, clear waters. The molar equivalency NOAEC is therefore used to account for the potential for increased toxicity under enhanced lighting conditions. The EECs for terrestrial organisms are not influenced by the total residue approach.

Taxa evaluated in this assessment include birds (which serve as surrogates for terrestrial-phase amphibians and reptiles), mammals, bees (where honey bees, *Apis mellifera*, serve as surrogates for both *Apis* and non-*Apis* bees), fish (where freshwater fish serve as surrogates for aquatic-phase amphibians), aquatic invertebrates, and aquatic and terrestrial plants. A Total Residue (TR) approach was used for the exposure assessment and aquatic Estimated Environmental Concentrations (EECs). For more information on the ROC see **Section 4**.

1.2 Risk Conclusions Summary

Table 1-1 summarizes potential risks associated with the proposed labeled uses of tiafenacil. When compared to the measured toxicity endpoints for tiafenacil, risk quotients (RQ) do not exceed the acute risk to non-listed species Level of Concern (LOC) of 0.5 or the chronic risk LOC of 1.0 for birds (surrogates for reptiles and terrestrial-phase amphibians), bees, aquatic invertebrates, and do not exceed the LOC for risk to aquatic plants for any of the proposed tiafenacil uses evaluated based on either parent compound alone or the TR. Therefore, the likelihood of adverse effects to these taxa from exposure as a result of the proposed uses of parent tiafenacil is expected to be low. Decreased plant growth and survival of non-target terrestrial plants may occur from exposure for the proposed uses of tiafenacil as the terrestrial plant LOC of 1.0 is exceeded. There are no acute LOC exceedances for aquatic vertebrates; however, there are possible chronic LOC exceedances for aquatic vertebrates in the presence of light.

For aquatic vertebrates, RQs using the measured toxicity endpoints for tiafenacil in the absence of enhanced light chronic LOCs are not exceeded. However, to account for uncertainty surrounding potential increased sensitivity of fish to LDPH chemicals under enhanced lighting conditions (*i.e.*, clear, shallow waterbodies in direct sunlight), risk to freshwater and estuarine/marine fish was also evaluated using a molar equivalency-adjusted chronic NOAEC. Both the parent and degradates contain the uracil structure associated with increased toxicity in the presence of light and both tiafenacil alone and TR residues were evaluated assuming a potential for enhanced toxicity in the presence of light. Based on this analysis, RQ values exceed the chronic risk LOC for both freshwater and estuarine/marine fish when evaluated using TR for the proposed uses on corn, cotton, non-cropped areas, soybeans, and fallow fields. The extent to which the tiafenacil and M-01, M-12, and M-13 exhibit increased toxicity under enhanced light conditions is uncertain due to a lack of toxicity studies conducted under enhanced lighting conditions; therefore, this estimated risk of concern based on TR may or may not be conservative. There are no LOC exceedances considering exposure to parent alone.

For mammals, the likelihood of direct adverse effects from acute exposure to tiafenacil residues in their diet from the proposed uses is low. Mammalian chronic dietary-based RQs (0.01-0.28) fall below the chronic risk LOC of 1.0, following application of tiafenacil at the maximum application rate for all proposed use patterns. However, some of the dosed based RQs (0.02 to 2.29) exceed chronic risk LOC of 1 for all proposed uses of tiafenacil. These RQs were based on a NOAEC where no effects were observed in the study at the highest tested concentrations and whether effects would occur at the predicted concentrations based on the use pattern is uncertain. The toxicity test did not test high enough to evaluate the potential for effects to occur at estimated environmental concentrations (EECs). If RQs were based on mean exposure values (where exposure is expected to exceed this level about half the time) instead of upper-bound exposure values, the chronic dose-based RQs would range from <0.01 to 0.81 and will fall below the chronic risk LOC of 1 for all the proposed uses of tiafenacil.

For bees, since the adult oral and contact toxicity values are higher than the highest dose tested (*i.e.*, non-definitive LD_{50} >0.1 mg ai/bee), risk to bees from acute oral and contact exposure to tiafenacil is expected to be low for all the proposed uses. However, adverse effects were identified in other beneficial insects at application rates lower than the proposed label rates.

Based on adverse effects on terrestrial plant survival and growth (plant height and dry weight), the proposed maximum single application rates result in RQs values which exceed the LOC of 1.0 for risk to both monocotyledonous and dicotyledonous plants in semi-aquatic areas exposed to tiafenacil through runoff and/or spray drift. The distance from the edge of the field where terrestrial plants may be exposed to spray drift at levels that could result in LOC exceedances is estimated to be 500 feet, based on fine to medium/coarse droplet size.

1.3 Environmental Fate and Exposure Summary

Tiafenacil is highly water soluble (FAO, 2000)[1] and is not considered likely to volatilize (USEPA, 2010a). Based on a log octanol-water partition coefficient (K_{ow}) of 1.95, the compound is not expected to bioconcentrate significantly in aquatic organisms. Tiafenacil degrades rapidly on soil, with aerobic soil model input half-lives of <1 day (d). Degradation was comparably rapid on sterilized soil samples and was faster than the hydrolysis half-life of tiafenacil (estimated $t_{1/2}$ = 41 d at pH 7, 25 ℃), but the exact mechanism (*i.e.*, biotic versus abiotic) of the increased degradation rate is uncertain. Tiafenacil also degraded in days to weeks in aerobic and anaerobic aquatic metabolism studies, with DT_{50} values ranging from 3.7 to 8.2 d and 2.5-4.9 d, respectively. Field dissipation studies showed a similar trend, with DT_{50} values of the parent of <1 d and none of the parent compound detected below the 15 cm in any of the soil samples. Based on the degradation rates on soil, mobility, and field studies, the parent is not likely to leach into groundwater.

Tiafenacil breaks down into multiple degradation products, with 24 major (>10% applied radioactivity (AR)) and 4 minor (<10% AR) degradates identified. While it was not possible to obtain reliable mobility data for the parent due to its instability, an estimated sorption coefficient was calculated. The parent compound is considered slightly mobile on soil (FAO mobility classification); however, mobility data for 16 of the major degradates indicate they are highly to moderately mobile in soil (FAO classification system). The degradates are generally more persistent than the parent in both soil and aquatic environments. There were unextracted residues in >10% AR in all soil studies, but these residues were shown to be bound to the soil and are not considered a potential source of exposure. Based on submitted toxicity data and structure-activity relationships of similar herbicides, the Residues of Concern (ROC) include the parent compound and degradates M-01, M-12, and M-13. The ROC are substantially more persistent than the parent compound, but still degrade quickly in laboratory studies, with DT_{50} values ranging from days to weeks. Overall, there are no major uncertainties in the fate dataset or proposed labels for tiafenacil.

Surface water EECs were estimated using the Pesticide in Water Calculator (PWC version 1.52) and were <0.1 µg/L and <5.0 µg/L for tiafenacil and tiafenacil ROC, respectively. The primary routes of exposure are runoff into surface water and spray drift onto adjacent waterbodies and non-target organisms. These EECs may overestimate the exposure potential due to spray drift,

[1] Based on the Food and Agricultural Organization (FAO) solubility classification (FAO, 2000).

as the label specifies medium to coarse droplet size but the spray drift values were calculated for fine to medium/coarse sized droplets, the largest droplet size option for ground applications in the AgDRIFT™ model.

1.4 Ecological Effects Summary

The available data indicate that tiafenacil technical grade active ingredient (TGAI) had no detectable effect on freshwater Rainbow Trout (*Oncorhynchus mykiss*) and Sheepshead Minnow (*Cyprinodon variegatus*) up to the highest concentration tested in acute toxicity studies. Tiafenacil is classified as no more than slightly toxic to freshwater fish on an acute exposure basis and since freshwater fish serve as surrogates for aquatic-phase amphibians, tiafenacil is classified as no more than slightly toxic to aquatic-phase amphibians as well. With respect to freshwater invertebrates, tiafenacil TGAI had no detectable effect on the freshwater invertebrate waterflea (*Daphnia magna*) up to the highest concentration tested and is classified as no more than slightly toxic to freshwater invertebrates on an acute exposure basis, However, tiafenacil is classified as highly toxic to the estuarine/marine invertebrate mysid shrimp (*Americamysis bahia*) on an acute exposure basis.

Chronic exposure of freshwater Fathead Minnow (*Pimephales promelas*) to tiafenacil TGAI led to a no observed adverse effect concentration (NOAEC) of 0.016 mg ai/L based on a 4.9 and 15% reduction in total length and dry weight, respectively, at the LOAEC of 0.04 mg ai/L. A 34-day exposure of the estuarine/marine Sheepshead Minnow (*C. variegatus*) to tiafenacil TGAI resulted in a NOAEC value of 0.12 mg ai/L, based on a 60% reduction in post-hatch survival at the LOAEC of 0.42 mg ai/L.

Chronic exposure of the freshwater invertebrate *D. magna* to tiafenacil TGAI led to a NOAEC of 0.61 mg ai/L based on a 9% reduction in the number of offspring per female at a LOAEC of 1.2 mg ai/L. Chronic exposure of mysid shrimp to tiafenacil TGAI resulted in a NOAEC of 0.086 mg ai/L and a LOAEC of 0.175 mg ai/L, at which there was a 79% reduction in the number of offsprings per female and roughly an 11% increase in time to first brood.

Exposure of the nonvascular freshwater green algae *Raphidocelis subcapitata* to the tiafenacil typical end-use product (TEP; DCC-3825 30 SC; 30.7% ai) resulted in NOAEC and IC_{50} values of 0.00257 and 0.00455 mg/L, respectively, with a 95% reduction in yield and 94.5% reduction in biomass at the LOAEC of 0.00506 mg ai/L. Exposure of the vascular aquatic plant duckweed (*Lemna gibba*) to the tiafenacil TEP DCC-3825 70% WG resulted in NOAEC and IC_{50} values of 0.000769 and 0.00557 mg a.i./L, respectively; there was a 29% reduction in the frond number yield at a LOAEC of 0.00212 mg/L.

The available data indicate that tiafenacil TGAI is practically non-toxic to birds on acute oral and sub-acute dietary exposure basis. Since birds serve as surrogates for terrestrial-phase amphibians and reptiles, tiafenacil TGAI is classified as practically non-toxic to these taxa as well.

Chronic exposure of birds to tiafenacil TGAI in an avian reproduction study led to a NOAEC and LOAEC values of 1,438 and 5,099 mg ai/kg diet, respectively. Effects at the LOAEC included a 21% decrease in the number of viable embryos per eggs set, a 22% decrease in the number of live embryos per eggs set, 27% reduction in the number of hatchlings per eggs set, a 28% reduction in the number of surviving hatchlings, and a 5.4% reduction in 14-day survivor weight.

Tiafenacil is classified as practically non-toxic to rats (*Rattus norvegicus*) on an acute oral exposure basis. A two-generation reproduction toxicity study with laboratory rat resulted in no toxicity on survival and growth with a NOAEC and LOAEC of 150 and >150 mg/kg-diet, respectively.

Tiafenacil TGAI is no more than moderately toxic to honey bee larvae on an acute (single dose) exposure basis and is practically non-toxic to young adult honey bees on both an acute contact and oral exposure basis. Exposure of honey bee larvae to tiafenacil TGAI in a chronic (repeat dose) toxicity test resulted in no detectable effect on either larval/pupal mortality or adult emergence with NOAEC, LOAEC and EC_{50} values of 149, >149 and >149 mg ai/kg diet, respectively (corresponding to doses of 5.63, >5.63 and >5.63 µg ai/larva/day, respectively). A 10-day chronic (repeat dose) toxicity study with adult honey bees using TGAI resulted in a NOAEL of 0.022 mg ai/bee/day, based on a 10% increase in mortality at the LOAEL of 0.047 mg ai/bee/day with an LD_{50} of >0.084 mg ai/bee/day.

Exposure to terrestrial plants with the tiafenacil TEP DCC-3825 70 WG (70% ai), led to 12-21% reductions in plant biomass (dry weight and height) with monocotyledon (monocot) species NOAEC and IC_{25} values of 0.000075 and 0.0000815 lb ai/A, respectively; and dicotyledonous (dicot) species NOAEC and IC_{25} values of <0.000075 and 0.000197 lb ai/A, respectively. A seedling emergence test with DCC-3825 70 WG) resulted in a monocot NOAEC and IC_{25} values of 0.016 and 0.0206 lb ai/A, respectively, based on a 60% reduction in dry weight and a dicot NOAEC and IC_{25} values of 0.00301 (EC_{05} value) and 0.00722 lb ai/A, respectively, based on a 25% reduction in survival.

1.5 Identification of Data Gaps

The environmental fate data base is complete; however, with respect to ecological effects, the following studies are not available:

- Benthic invertebrate toxicity studies (OCSPP 850.1735 and 850.1740) have not been submitted but are required for chemicals with an organic carbon-normalized sorption coefficient (K_{oc}) ≥1,000 or log K_{ow} ≥3. Although tiafenacil has a K_{oc} of 1,965 L/kg_{oc} and a log K_{ow} of 1.95, the aerobic soil metabolism half-life of <1-day, low toxicity for water-column organisms, and low proposed application rates indicate that potential risk to benthic invertebrate is expected to be low. Additional data are not expected to change the risk conclusions for this risk assessment.

Table 1-1 Summary of Risk Quotients (RQs) for Taxonomic Groups from the Proposed Uses of Tiafenacil.

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC for Non-listed Species	Additional Information/Lines of Evidence
Freshwater Fish[2]	Acute	Parent: <0.01; TR: <0.01	No	–
	Chronic	Parent: <0.01 TR: 0.01-0.25	No	-
Estuarine/ Marine Fish	Acute	Parent: <0.01 TR: <0.01	No	-
	Chronic	Parent: <0.01 TR: <0.01-0.03	No	-
Freshwater and Estuarine/ Marine Fish using molar equivalency-adjusted chronic NOAEC	Chronic	Parent: 0.03-0.04	No	-
		TR: 0.20-3.88	Yes	There is potential increased sensitivity of fish to LDPH chemicals under enhanced lighting conditions (*i.e.*, clear, shallow waterbodies in direct sunlight). RQs exceed the chronic LOC only when exposure is based on TR using the molar equivalency-adjusted chronic NOAEC to account for this chemicals LDPH properties. The use of the molar equivalency-adjusted chronic NOAEC provides an additional safety factor to the fish chronic assessment. However, the molar threshold approach uses a toxicity endpoint based on 3 surrogate LDPH chemicals, therefore, it may underestimate or overestimate the actual toxicity of tiafenacil to fish under natural sunlight in the environment
Freshwater Invertebrates (water-column exposure)	Acute	<0.01	No	–
	Chronic	<0.01	No	There are no toxicity data available for aquatic invertebrates exposed in sediment. However, the aerobic soil metabolism half-life of <1-day, low toxicity for water-column organisms, and low proposed application rates indicate that potential risk to benthic invertebrate is expected to be low.
Estuarine/ Marine Invertebrates (water-column exposure)	Acute	<0.01	No	
	Chronic	0.01-0.05	No	
Mammals	Acute	N/A	No	Endpoint of toxicity test was non-definitive; test concentrations were high enough to cover potential exposure. Therefore, likelihood of direct adverse effects on mammals from acute exposure to tiafenacil residues in their diet from the proposed uses is low.

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC for Non-listed Species	Additional Information/Lines of Evidence
	Chronic	<0.01-2.29 See additional information	Yes See additional information	Chronic-dose based RQs for mammals feeding on all food types except fruit/pods and seeds exceed the chronic risk LOC of 1.0 for all proposed use patterns at their maximum application rates. These chronic effects are based on a NOAEC and LOAEC of 150 and >150 mg/kg-diet, respectively. The potential for risk is uncertain because the organisms in the toxicity test were not exposed at the predicted concentrations.
Birds[3]	Dose-based Acute	<0.01-0.03	No	-
	Dietary-based Acute	<0.01-0.01	No	-
	Dietary-based Chronic	0.03-0.75	No	-
Terrestrial invertebrates[4]	Acute Adult	<0.01-0.02	No	-
	Chronic Adult	<0.01-0.10	No	-
	Acute Larval	<0.01-0.20	No	
	Chronic Larval	<0.01-0.16	No	
Aquatic plants	N/A	Vascular: 0.11-0.80	No	–
		Non-vascular: 0.13-0.98	No	
Terrestrial plants	N/A	0.20-4.75	Yes	RQ values for monocots and dicot in semi-aquatic areas exposed to tiafenacil through runoff and/or spray drift exceed the LOC of 1 for risk to non-listed plants for all of the evaluated uses of tiafenacil.

N/A: Not applicable; TR=total residues

Level of Concern (LOC) Definitions:

- Terrestrial Animals: Acute=0.5; Chronic=1.0;
- Terrestrial invertebrates: Acute=0.4; Chronic=1.0
- Aquatic Animals: Acute=0.5; Chronic=1.0
- Plants: 1.0

[1] RQs reflect exposure estimates for parent and maximum application rates allowed on labels.

[2] RQs for freshwater fish are applicable to aquatic-phase amphibians for which fish serve as surrogates.

[3] RQs for birds apply to reptiles and terrestrial-phase amphibians for which birds serve as surrogates.

[4] RQs for terrestrial invertebrates are applicable to honey bees (*Apis mellifera*), which are also a surrogate for other species of *Apis* and non-*Apis* bees. Risks to other terrestrial invertebrates (*e.g.*, earthworms, beneficial arthropods) are only characterized when toxicity data are available.

2 Introduction

This Ecological Risk Assessment (ERA) examines the potential ecological risks on non-target organisms not listed under the Endangered Species Act associated with proposed Section 3 uses of the new chemical tiafenacil. Federally listed threatened/endangered species ("listed") are not evaluated in this document.

This assessment relies on the best available scientific information on the use, environmental fate and transport, and ecological effects of tiafenacil. 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

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 tiafenacil. The problem formulation identifies the objectives for the risk assessment and provides a plan for analyzing the data and characterizing the risk.

3.1 Mode of Action and Target Pests

Tiafenacil falls within the Light Dependent Peroxidizing Herbicide (LDPH) family of herbicides. Tiafenacil belongs to the uracil class of protoporphyrinogen IX oxidase (PPO) inhibitor herbicides. The chemical is proposed for use as a nonselective, post-emergence contact burndown herbicide to control or suppress a wide range of broadleaf and grass weeds or as a pre-harvest desiccant (HRAC[2] Class E, WSSA[3] Group 14). In target plants, tiafenacil inhibits the PPO enzyme, preventing the conversion of protoporphyrinogen IX (protogen) to protoporphyrin IX (proto), leading to an increase of cytosol protogen and proto levels. The excess proto generates singlet oxygen under photolytic (*e.g*., direct sunlight) conditions which leads to lipid peroxidation and eventual destruction of the cell (Park *et al.*, 2018). Since porphyrins are precursors to chlorophyll, the accumulation of these precursor in plants and the generation of reactive oxygen within plant can lead to the destruction of plant cells. However, the PPO enzyme is also utilized in the biosynthesis of hemoglobin; therefore PPO inhibitors can cause adverse effects on some animals as a result of excess porphyrin production (*e.g*., porphyria) particularly under enhanced lighting conditions (Ajioka *et al.*, 2006; Birchfield and Casida, 1997).

[2] Herbicide Resistance Action Committee https://hracglobal.com/tools/classification-lookup (accessed 7-29-2019)
[3] Weed Science Society of America http://wssa.net/wssa/weed/herbicides/ (accessed 7-29-2019)

3.2 Label and Use Characterization

3.2.1 Label Summary

There are two proposed end use product labels for tiafenacil:

- Tiafenacil 70WG (70% active ingredient (a.i.)/lb as a water dispersible granule); and,
- Tiafenacil 339SC (30% a.i. as a soluble concentrate).

Both formulations are proposed for use as pre-plant/pre-emergence burndown on corn (all types except sweet corn), cotton, soybeans, and wheat, as post-emergence burndown on fallow and non-cropped areas, as directed spray to the base of grape vines, and as a preharvest desiccant to cotton. Tiafenacil is intended to serve as a post-emergence herbicide with no pre-emergent activity. The proposed use patterns for tiafenacil are summarized in **Table 3-1** along with their maximum proposed annual application rate. The label indicates that different use patterns (*e.g.*, cotton pre-emergence and cotton desiccation, wheat pre-plant and fallow) can be combined up to a maximum annual application rate of 0.223 lb active ingredient per acre per year (a.i./A/Y).

Restrictions identified on all of the proposed label labels and which apply to all of the proposed use patterns include:

- Total maximum annual application rate across all use patterns of 0.223 lb a.i./A/Y;
- Do not apply more than 2 feet above the ground or plant foliage canopy;
- Applicators are required to use medium to coarse droplet size;
- Do not apply when wind speeds at the application site exceed 10 miles per hr (MPH); and,
- Do not apply during temperature inversions.

Other common restrictions include:

- 1 week retreatment interval for cotton desiccation applications; and,
- 2 week retreatment interval for corn, cotton burndown, fallow, grape, soybean, wheat, and non-crop area applications.

The maximum number of applications per year are not specified. The estimated values are based on the proposed minimum single application rate and maximum annual rate listed on the label.

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

Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/y	Max Annual Rate lbs ai/A/y	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)	Crop Specific Drift Restrictions
Corn (except sweet corn)	SC, WG	Foliage/ Plant	Broad	G	Preplant, Preemergence	0.067	NS	0.134	14	NS	-	Do not apply more than 2 feet above ground or plant foliage canopy. Medium to coarse droplet size
Cotton	SC, WG	Foliage/ Plant	Broad	G	Preplant, Preemergence	0.067	NS	0.134	14	NS	Can be combined with desiccation use	
					Preharvest desiccation	0.067	NS	0.067	7	3	Can be combined with cotton preplant/ preemergence use	
Non-cropped areas	SC, WG	Foliage/ Plant	Broad	G	Postemergence	0.067	NS	0.201	14	NS	-	
Soybeans	SC, WG	Foliage/ Plant	Broad	G	Preplant, Preemergence	0.067	NS	0.134	14	NS	-	
Wheat	SC, WG	Foliage/ Plant	Broad	G	Preplant, Preemergence	0.067	NS	0.134	14	NS	-	
Grape	SC, WG	Foliage/ Plant	Directed spray	G	Postemergence	0.067	NS	0.201	14	NS	Directed spray to soil below the crop canopy. Do not allow spray to contact green stems	Do not apply more than 2 feet above ground. Medium to coarse droplet size.
Fallow	SC, WG	Foliage/ Plant	Broad	G	Postemergence	0.067	NS	0.201	14	NS	Can be used in conjunction with any other registered use patterns. Maximum of 0.223 lb a.i./A/y can be applied across all use patterns	Do not apply more than 2 feet above ground or plant foliage canopy. Medium to coarse droplet size

App=application; equip=equipment; --=not specified; SC=soluble concentrate; WG=water dispersible granule; Broad=broadcast; MRI = Minimum retreatment interval; PHI=preharvest interval; G=ground; ai=active ingredient; d=day; NS=not specified; Values in parenthesis were calculated based on the proposed minimum single application rate and the maximum total application rate information specified on the label; however, these specific values are not on the label.

* Listed maximum proposed annual application rate for specific crop. Non-fallow uses can be used in conjunction with fallow application up to a maximum annual application rate of 0.223 lb a.i./A/y across all uses.

4 Residues of Concern

In this risk assessment, the stressors are those chemicals that may exert adverse effects on non-target organisms. Collectively, the stressors of concern are known as the Residues of Concern (ROC). The ROCs usually include the active ingredient, or parent chemical, and may include one or more degradates that are observed in laboratory or field-based 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 (chemical moieties) in the degradate, or they may be quantitative, using programs such as the Ecological Structure-Activity Relationships (ECOSAR[4]) model.

Tiafenacil degrades into multitude products under biotic and abiotic conditions. There are 24 identified major (*i.e.*, ≥10% of applied parent) and 5 minor (*i.e.*, <10% of applied parent) degradates. A proposed degradation pathway for the formation of the major degradates is depicted in **Figure 4-1**. There are several common processes that occur during the degradation of tiafenacil, including:

- cleavage of the ester or amide sidechain (*e.g.*, parent→M-01, M-01→M-12, M-1→M-13);
- reduction of the pyimidinedione ring (*e.g.*, M-12→M-16);
- opening of the pyimidinedione ring (*i.e.*, parent→M-49; parent→M-50); and,
- oxidation of the sulfur moiety (*e.g.*, M-16→M-36, M-36→M-35, M-63→M-73).

Compounds M-01, M-12, and M-13 were selected as ROCs for generating EECs for aquatic organisms (**Appendix H**). The selection was based on measured toxicity data for several degradates of tiafenacil, identified structure-activity relationships (SARs) for tiafenacil and the herbicide saflufenacil, a structurally similar compound with the same mode of action as tiafenacil, and the deliberations of the Resides of Concern Knowledgebase Subcommittee (ROCKS) regarding the identification of ROC for human health.

No foliar dissipation data are available for tiafenacil. Unless foliar dissipation data are available, fate data are not used in the models used to estimate exposure to terrestrial animals. Additionally, no toxicity data are available to indicate that the transformation products are more toxic than the parent. Therefore, the ROC for terrestrial animals were not identified as selecting ROC would not impact the risk conclusion. If this changes in the future, a more complete analysis of the residues of concern for terrestrial animals will be made.

[4] https://www.epa.gov/tsca-screening-tools/ecological-structure-activity-relationships-program-ecosar-operation-manual-v20

The *N*-aryl uracil moiety (highlighted in **Figure 4-2**) found in the parent compound and a number of the degradates (*i.e.*, M-01, M-12, M-13, M-35, M-36, M-72, and M-85) is associated with PPO inhibition and herbicidal activity, therefore these compounds were initially considered as potential residues of concern (Selby *et al.*, 2015) . Submitted toxicity data for the sulfur oxides M-36 and M-53 showed that they are 3-4 orders of magnitude less toxic than the parent to green algae (MRIDs 50486889, 50486890). While there is uncertainty with relying on algae data to inform ROC selection for animals, there is evidence that the mechanism of action in plant and animals are similar. Increased liver porphyrin concentrations, a known symptom of PPO inhibition, were observed in the 2-generation reproductive toxicity study in rats (MRID 50486832) (Gupta, 2007). A decrease in toxicity to plants is also correlated to a decrease in toxicity to animals with saflufenacil (see below). Based on these data the sulfur oxide degradates of tiafenacil (*i.e*., M-35, M-36, M-53, M-63, M-69, M-72, M-73) were not included as ROCs.

While no data are available for the open-ring products and the reduced uracil ring products of tiafenacil, experimental data are available for two analogous degradates of saflufenacil, *i.e*., M800H07 and M800H08 (USEPA, 2009, DP Barcode 349855)(**Figure 4-2**). A comparison of toxicity endpoints for saflufenacil and its degradates (M800H07 and M800H08) are shown in **Table 4-1**. The toxicity data for M800H07 (where the uracil ring was opened) showed no adverse effects on vascular aquatic plants, non-vascular aquatic plants, minimal effects to terrestrial plants, and that the degradate was at least one order of magnitude less toxic to aquatic invertebrates. The M800H08 degradate (with the loss of a double bond in the uracil ring) is approximately 140 to 600 times less toxic to aquatic plants as compared to parent saflufenacil, and approximately 30 to 130 times less toxic to terrestrial plants in seedling emergence tests as compared to saflufenacil. A similar trend was noted between the toxicity of M-36 and M-53 (**Table 6-1**). Both saflufenacil and degradate M800H08 showed no adverse effects on earthworms, which is consistent with the observed toxicity of tiafenacil. Based on these lines of evidence, EFED concludes that the ring opening (*i.e*., M-06, M-07, M-39, M-49, and M-50) and reduced degradates of tiafenacil are likely to be less toxic than the parent and as such, these degradates are excluded as ROCs.

Based on the submitted toxicity data for tiafenacil and saflufenacil, compounds M-01, M-12, and M-13 were considered potential ROCs. They all contain the intact uracil ring and unoxidized sulfur moiety. Analysis of these degradates using the ECOSAR program did not provide any useful guidance into the selection of ROCs, as there was a poor agreement between the measured and predicted chronic toxicity values for the parent compound.

The photodimer (M-85) and ring opening products M-32, M-33, and M-34 (trifluoroacetic acid, trifluoroacetone, and 1,1,1-trifluoroisopropanol, respectively) are excluded due to their structural differences from the parent compound. Additionally, M-32, M-33, and M-34 were not included as residues of concern in previous risk assessments of structurally similar pesticides considered by the Residue of Concern Knowledgebase Subcommittee (ROCKS) (USEPA, 2019, DP Barcode 448636) and were not considered ROC for saflufenacil. The degradates M-36 and M-53 were initially considered as potential residues of concern due to their persistence in laboratory studies, high mobility and they were detected in field dissipation studies; however, they were ultimately excluded due to low measured toxicity (see **Section 6.1** for additional information on toxicity data). Compound M-73 was similarly excluded because it contains both an oxidized sulfur moiety and reduced uracil ring, both of which are associated with decreased in biological activity (see above). Ultimately, only degradates that have an intact, unreduced uracil ring and unoxidized sulfur moiety were selected as ROCs for this assessment: tiafenacil; M-01; M-12; and, M-13.

Table 4-1. Comparison of Acute Toxicity Between Parent Saflufenacil and Saflufenacil Degradates H800M07 and H800M08.

Test Species	LC/EC_{50} (95% C.I.)		
	Saflufenacil	**M800H07**	**M800H08**
Mysid shrimp (*Americamysis bahia*)	**LC_{50} = 8.5 mg a.i./L** (MRID 47127903)	LC_{50} = >98 mg a.i./L (MRID 47560303)	N/A
Earthworm (*Eisenia fetida*)	**14-day LC_{50} = >1000 mg a.i./kg dw soil** (MRID 47127927)	N/A	14-day LC_{50} = >1000 mg a.i./kg dw soil (MRID 47560307)
Freshwater green algae (*Pseudokirchneriella subcapitata*)	**96-hr EC_{50} = 0.042 mg a.i./L** (MRID 47127923)	96-hr EC_{50} = >29 mg a.i./L (MRID 47560301)	96-hr EC_{50} = 25 mg a.i./L (MRID 47560305)
Duckweed (*Lemna gibba*)	**7-D EC_{50} = 0.087 mg a.i./L** (MRID 47127922)	7-D EC_{50} = >30 mg a.i./L (MRID 47560302)	7-D EC_{50} = 12 mg a.i./L (MRID 47560306)

N/A = No study data available

Figure 4-1. Environmental Degradation of Tiafenacil, Major Degradates

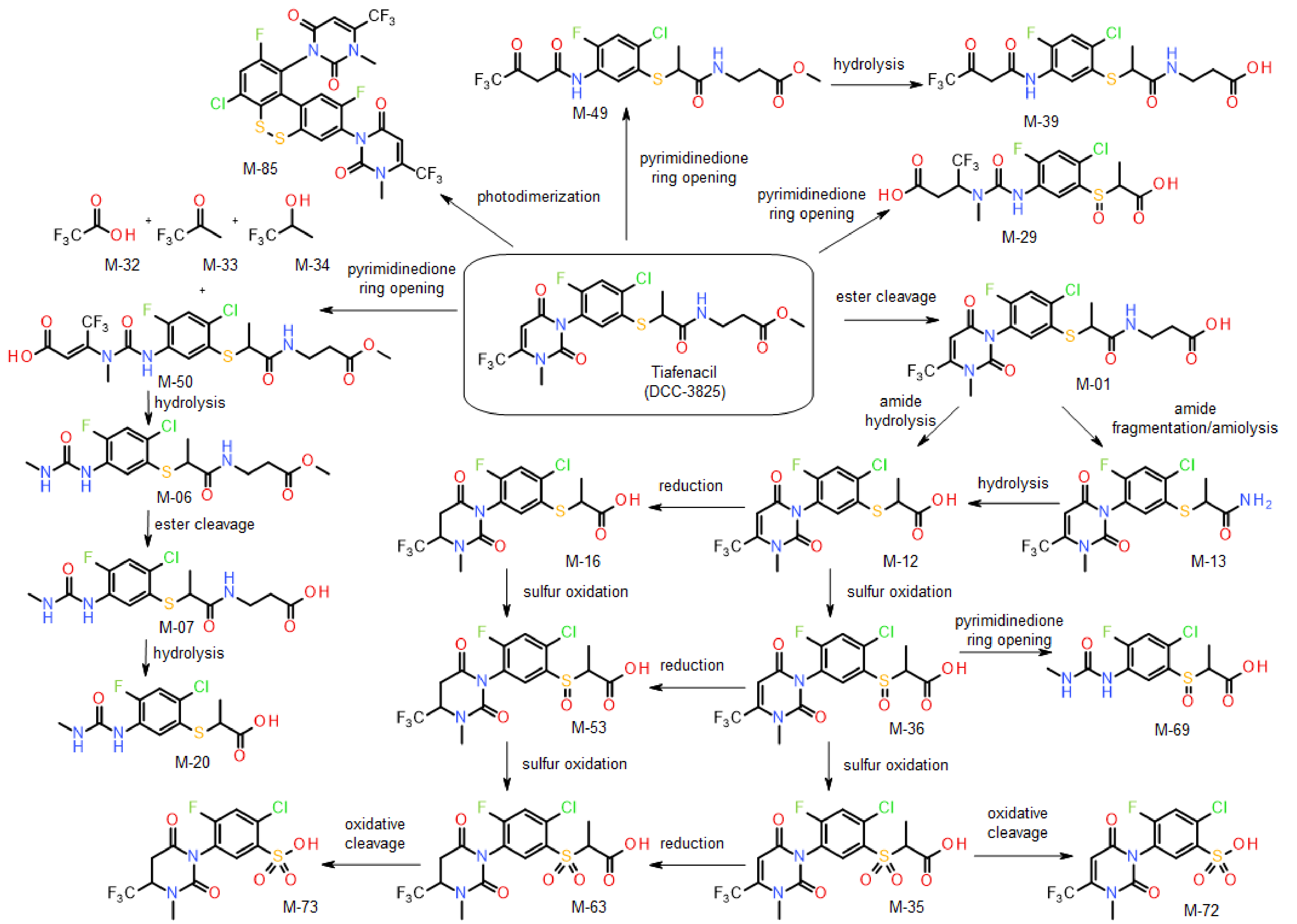
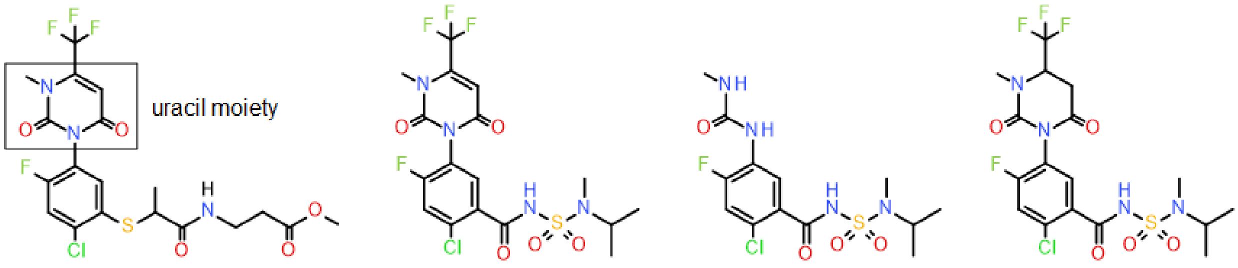


Figure 4-2. Structural Comparison of Tiafenacil, Saflufenacil, and Degradates of Uracil Herbicide Saflufenacil



Tiafenacil Saflufenacil M800H07 M800H08

5 Environmental Fate Summary

Table 5-1 and **Table 5-2** summarize the submitted chemical and environmental fate data for tiafenacil. The compound is nonvolatile (vapor pressure ≤1.12×10^{-10} Torr) and highly soluble in water (110 mg/L) (FAO, 2000). Tiafenacil was shown to be too unstable to acquire reliable sorption measurements via batch equilibrium (MRID 50493822). Instead the organic-carbon normalized sorption coefficient (K_{OC}) was estimated via High Performance Liquid Chromatography (HPLC) (OECD Test 121). Based on HPLC measurements, tiafenacil is classified as slightly mobile in soil (mean HPLC estimated K_{OC} = 1,965 L/kg-organic carbon) (FAO, 2000). Supplemental sorption data are available for 16 degradates, with average K_{OC} values ranging from 7.8 to 175 L/kg_{oc} (highly mobile to moderately mobile) (**Table 5-3**). The average K_{OC} value for 14/16 of the degradates with measured sorption values were below 100 L/kg_{oc}, indicating that they are more mobile than the parent. Based on these properties, tiafenacil may be transported to surface water via spray drift and runoff. The parent compound is classified as slightly mobile and was not detected below 15 cm in any of the field dissipation studies, and the ROCs are classified as mobile and were not detected below 30 cm in any field dissipation study. There is the potential for the more persistent degradates to reach groundwater. The mobility of the degradates is supported by the detection of several degradates (*e.g.*, M-36, M-73) near or at the maximum sampling depth in several field dissipation studies, but none of the compounds detected at those depths are considered residues of concern (**Table 5-6**). The log octanol-water partition coefficient (K_{OW}) of tiafenacil is 1.95, indicating a low likelihood of bioaccumulation. The K_{OW} of tiafenacil is too low to trigger the need for a bioconcentration factor (BCF) study, and a waiver for the BCF study has been submitted by the technical registrant (USEPA, 2007).

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

Parameter	Value[1]	Source/ Study Classification/ Comment
Molecular Weight (g/mole)	511.88	MRID 50486803
Water Solubility at 20 °C (mg/L)	110	MRID 50486803

Parameter	Value[1]	Source/ Study Classification/ Comment
Vapor Pressure at 20 °C (Torr)	≤1.12x10^{-10}	MRID 50486803 Below the limit of quantification of the analytical method.
Henry's Law constant at 25°C (atm-m^3/mole)	6.86x10^{-13} (estimated)	Estimated[1] from vapor pressure and water solubility at 20°C. There is uncertainty in this value as a definitive vapor pressure is not available.
Log Dissociation Constant (pKa)	Not applicable	--
Octanol-water partition coefficient (K_{ow}) at 20°C (unitless)	89.3 (log K_{OW} = 1.95)	MRID 50486803 Not likely to bioconcentrate.
Air-water partition coefficient (K_{AW}) (unitless)	2.85×10^{-11} (log K_{AW} = -10.5) (estimated)	Estimated[1] from vapor pressure and water solubility at 20°C and pH 7. Nonvolatile from water. There is uncertainty in this value as a definitive vapor pressure is not available.
Organic carbon normalized distribution coefficients (K_{OC} in L/kg-organic carbon)	1,965	MRID 50493823, Supplemental K_{OC} estimated with High Performance Liquid Chromatography due to instability of the parent compound on soil
Steady State Bioconcentration Factor (BCF) L/kg-wet weight fish	--	No bioconcentration data submitted due to K_{OW}<3. Waiver for BCF study has been submitted.

[1]All estimated values were estimated according to "*Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in Problem Formulations for Registration Review, Registration Review Risk Assessments, Listed Species Litigation Assessments, New Chemical Risk Assessments, and Other Relevant Risk Assessments*" (USEPA, 2010b).

Table 5-2 Summary of Environmental Degradation Data for Tiafenacil and Tiafenacil plus Residues of Concern (ROCs).

Study	System Details	Dissipation Rates (days) (kinetic model)[1]				Representative Model Input Half-Lives[2] (d)		Source/Study Classification/Comment
		Parent		ROC[3]				
		DT_{50}	DT_{90}	DT_{50}	DT_{90}	Parent	ROC	
Abiotic Hydrolysis	pH 4, 50 °C	Stable	Stable	Stable	Stable	-	-	MRID 50493812, Supplemental. No experiment was conducted at pH 7 25°C, temperature range for the, pH 7, 45°C was outside the guideline recommendations.
	pH 7, 25 °C	41[4]	138[4]	-	-	-	-	
	pH 7, 35 °C	24 (SFO)	79.7 (SFO)	39.1 (SFO)	130 (SFO)	-	-	
	pH 7, 40 °C	12.7 (SFO)	42 (SFO)	18.9 (DFOP)	79.1 (DFOP)	-	-	
	pH 7, 45 °C	5.86 (SFO)	19.5 (SFO)	28.9 (SFO)	96 (SFO)	-	-	
	pH 9, 15 °C	4.33 (SFO)	14.4 (SFO)	-	-	-	-	
	pH 9, 20 °C	1.99 (SFO)	6.62 (SFO)	-	-	-	-	
	pH 9, 25 °C	0.973 (SFO)	3.23 (SFO)	-	-	-	-	
Atmospheric Degradation	Hydroxyl Radical	0.271 (SFO)				-	-	Estimated value with EPIWeb 4.1, based on parent only

Study	System Details	Dissipation Rates (days) (kinetic model)[1]				Representative Model Input Half-Lives[2] (d)		Source/Study Classification/Comment
		Parent		ROC[3]				
		DT_{50}	DT_{90}	DT_{50}	DT_{90}	Parent	ROC	
Aqueous Photolysis	pH 7, 25°C 36 °N spring sunlight	18.9 (SFO)	62.9 (SFO)	18.9 (SFO)	62.9 (SFO)	18.9	18.9	50493814, Acceptable. Based on average solar radiation between April and June.
Soil Photolysis	ND Sandy loam, 20 °C, pH 6.8 30-50 °N sunlight	404 (SFO)	4352 (SFO)	404 (SFO)	4352 (SFO)	-	-	MRID 50493814, Acceptable
Aerobic Soil Metabolism	ND sandy loam/sandy clay loam 20°C, pH 6.2-6.4	0.03 (IORE)	0.25 (IORE)	1.24 (SFO)	4.11 (SFO)	0.08	1.24	50493815, Supplemental. Material balances were outside 90-110% guideline thresholds at several time points. The degradation rates between sterilized and nonsterile soil samples were comparable.
	ND clay loam 20°C, pH 6.8-7.2	0.03 (SFO)	0.10 (SFO)	0.615 (SFO)	2.04 (SFO)	0.03	0.62	
	WY clay 20°C, pH 8.0-8.1	0.04 (DFOP)	0.15 (DFOP)	4.33 (SFO)	14.4 (SFO)	0.05	4.33	
	CA loamy sand 20°C, pH 6.7-7.1	0.10 (IORE)	0.49 (IORE)	4.97 (SFO)	15.9 (SFO)	0.15	4.97	
Anaerobic Soil Metabolism	ND sandy loam/sandy clay loam 20°C, pH 6.1	6.66 (DFOP)	44.7 (DFOP)	-	-	-	-	50493819, Supplemental. Material balances for the pyrimidinyl labeled compound were outside the 90-110% guideline thresholds at several timepoints. Soil was under a nitrogen atmosphere instead of an oxygen atmosphere for seven days prior to treatment and was flooded immediately after treatment
	ND clay loam 20°C, pH 6.9	5.86 (IORE)	44.4 (IORE)	-	-	-	-	
	WY clay 20°C, pH 7.9	6.98 (DFOP)	53.7 (DFOP)	-	-	-	-	
	CA loamy sand 20°C, pH 7.1	32.9 (DFOP)	214 (DFOP)	-	-	-	-	
Aerobic Aquatic Metabolism	UK Calwich Abbey Lake silt loam sediment 20°C, water pH 7.9, sediment pH 7.4	3.17 (SFO)	10.5 (SFO)	17.5 (IORE)	204 (IORE)	3.17	61.4	50493820, Acceptable
	UK Swiss Lake sand sediment 20°C, water pH 6.7, sediment pH 5.1	8.16 (SFO)	27.1 (SFO)	102 (SFO)	340 (SFO)	8.16	102	
Anaerobic Aquatic Metabolism	UK Calwich Abbey Lake silt loam sediment	2.52 (SFO)	8.36 (SFO)	4.42 (IORE)	77.4 (IORE)	2.52	23.3	50493821, Supplemental. Material balance for one of the two labeled

Study	System Details	Dissipation Rates (days) (kinetic model)[1]				Representative Model Input Half-Lives[2] (d)		Source/Study Classification/Comment
		Parent		ROC[3]				
		DT_{50}	DT_{90}	DT_{50}	DT_{90}	Parent	ROC	
	20°C, water pH 7.5, sediment pH 7.2							compounds was below guideline thresholds from day 50 onward. The parent compound had degraded to below the detection limit before that occurred.
	UK Swiss Lake sand sediment 20°C, water pH 6.6, sediment pH 5.3	4.88 (SFO)	16.2 (SFO)	10.5 (IORE)	97.3 (IORE)	4.88	29.3	

DT_X=time for concentration/mass to decline by X percentage; SFO=single first order; DFOP=double first order in parallel; IORE=indeterminate order (IORE); SFO DT_{50}=single first order half-life; T_{IORE}=the half-life of a SFO model that passes through a hypothetical DT_{90} of the IORE fit; DFOP slow DT_{50}=slow rate half-life of the DFOP fit

- No half-life provided because the study is not used as a modeling input parameter.

[1] DT_{50} and DT_{90} values were calculated using nonlinear regression and SFO, DFOP, or IORE equations. The equations can be found in the document, *Standard Operating Procedure for Using the NAFTA Guidance to Calculate Representative Half-life Values and Characterizing Pesticide Degradation* (USEPA, 2012b).

[2] The value used to estimate a model input value is the calculated SFO DT_{50}, T_{IORE}, or the DFOP slow DT_{50} from the DFOP equation. The model chosen is consistent with that recommended using the, *Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media (NAFTA, 2012)*. The same kinetic equation used to determine the representative model input value was used to describe the DT_{50} and DT_{90} results based on standard kinetic equations listed as the model used in the DT_{50} and DT_{90} columns**.** Values are only reported for studies that are utilized in aquatic modeling.

[3] Residues of Concern consist of the parent compound, M-01, M-12, and M-13.

[4] Estimated using the Arrhenius equation and hydrolysis rates measured at 35 °C, 40 °C, and 45 °C and pH 7.

Table 5-3 Sorption coefficients for selected degradates of tiafenacil on 5 soils.

Compound	K_d (L/kg)					Average	CV[1]	K_{OC} (L/kg$_{oc}$)					Average	CV
	HCB-SL-PF	PD-Soil	MCL-PF	MSL-PF	CA-SL			HCB-SL-PF	PD-Soil	MCL-PF	MSL-PF	CA-SL		
M-01	**0.70**	**0.19**	**0.52**	**0.27**	**0.06**	**0.35**	**0.66**	**17.6**	**25.4**	**14.1**	**17.1**	**14.9**	**17.82**	**0.23**
M-07	6.33	1.19	6.56	5.11	0.24	3.89	0.68	158	159	177	320	60.8	174.96	0.48
M-10	2.25	0.45	1.08	1.28	0.07	1.03	0.73	56.3	59.4	29.3	80.0	18.5	48.70	0.45
M-12	**0.34**	**0.08**	**0.22**	**0.19**	**0.09**	**0.18**	**0.52**	**8.5**	**10.9**	**5.84**	**11.8**	**21.9**	**11.79**	**0.46**
M-13	**3.02**	**0.40**	**2.14**	**1.07**	**0.18**	**1.36**	**0.79**	**75.5**	**53.3**	**57.8**	**67.1**	**44.0**	**59.54**	**0.18**
M-20	3.01	0.54	3.62	2.04	0.16	1.87	0.72	75.3	72.2	97.8	127	39.3	82.32	0.35
M-29	0.27	0.17	0.21	0.15	0.06	0.17	0.40	6.65	2.22	5.77	9.59	15.4	7.93	0.56
M-30	0.09	0.14	0.08	0.08	0.04	0.09	0.37	2.23	19.1	2.20	5.30	10.1	7.79	0.82
M-35	0.16	0.06	0.17	0.10	0.06	0.11	0.43	4.09	7.93	4.48	6.48	16.0	7.80	0.56
M-36	0.41	0.16	0.31	0.23	0.05	0.23	0.53	10.2	21.4	8.51	14.6	11.9	13.32	0.34
M-39	0.87	0.32	0.99	0.55	0.08	0.56	0.60	21.7	43.0	26.8	34.3	18.9	28.94	0.30
M-53	0.55	0.12	0.51	0.28	0.08	0.31	0.63	13.8	15.4	13.8	17.2	19.4	15.92	0.13
M-63	1.04	0.39	0.66	0.42	0.11	0.52	0.59	26.0	50.8	17.9	26.2	26.7	29.52	0.38
M-69	3.94	0.49	4.05	2.48	0.19	2.23	0.74	98.4	65.6	110	155	46.6	95.12	0.39
M-72	0.17	0.09	0.06	0.06	0.14	0.10	0.42	4.34	12.6	1.76	3.47	36.0	11.63	1.10
M-73	0.24	0.15	0.12	0.10	0.18	0.16	0.31	6.05	20.5	3.29	6.39	45.1	16.27	0.96

CV=coefficient of variation; K_{oc}= organic carbon normalized distribution coefficient; K_d=soil sorption coefficient.
Bold values are for the compounds identified as Residues of Concern

Soil Descriptions:

- **HCB-SL-PF**: Clay loam (4.0% organic carbon (OC), pH 7.5)
- **PD-Soil**: Sandy loam (0.75% OC, pH 6.3)
- **MCL-PF**: Clay loam (3.7% OC, pH 7.0)

- **MSL-PF**: Sandy clay loam (1.6% OC, pH 7.0)
- **CA-SL**: Loamy sand (0.4% OC, pH 7.6)

Tiafenacil degrades rapidly under biotic conditions with aerobic soil and aquatic metabolism study DT_{50} values ranging from 0.03 to 0.10 and 3.17 to 8.16 days, respectively. Anaerobic soil and aquatic metabolism study DT_{50} values range from 0.24 to 1.37 and 2.52 to 4.88 days, respectively. Tiafenacil degrades gradually under aqueous photolysis conditions ($t_{1/2}$=18.9 d at 36 °N latitude) but is essentially stable to soil photolysis ($t_{1/2}$=1,307 d at 36 °N latitude). It was stable to hydrolysis at pH 4 but hydrolyzed in neutral ($t_{1/2}$=24 d at pH 7, 35 °C) and basic systems ($t_{1/2}$=0.973 d at pH 9, 25 °C). A measured hydrolysis half-life at pH 7 and 25 ℃ was not available; therefore, it was estimated via linear regression to be 41 days using the Arrhenius equation and hydrolysis rates measured at 35 ℃, 40 ℃, and 45 ℃ and pH 7.

The degradation pathway consists of four major processes: degradation of the thiophenol ether sidechain; oxidation of the thiophenol; reduction of the uracil ring; and, opening and subsequent degradation of the uracil ring. These processes can occur in different orders to generate a wide range of degradates (see **Figure 4-1** for proposed degradation pathways for the formation of the major degradates). There are 23 major degradates and five minor degradates of tiafenacil formed in soil and aquatic systems. A complete list of structures and maximum and final percentage formed in all systems and studies is presented in **Appendix A**.

Many of the degradates (*i.e.*, M-01, M-07, M-12, M-13, M-36, M-53 and M-63) of tiafenacil are more persistent than the parent compound in soil and aquatic systems. The aerobic soil and aerobic aquatic half-lives of the degradates with sufficient data to calculate degradation kinetics are shown in **Table 5-4**. These DT_{50} values are calculated from the peak concentration observed in the studies and are not for use in modeling because they do not take into account the potential for formation of the compound over the course of the study.

Table 5-4 Estimated tiafenacil degradate time to 50% dissipation (DT_{50}) values.

Study	System Name/ Characteristics	Parent DT_{50} (d)	Degradate DT_{50} (d)							MRID, Study Classification
			M-01	M-07	M- 12	M-13	M-36	M-53	M-63	
Aerobic Soil Metabolism	ND sandy loam/sandy clay loam (20°C, pH 6.2-6.4)	0.075	0.74	NC[1]	1.00	6.41	25.3	297	NC[1]	50493815, Supplemental
	ND clay loam (20°C, pH 6.8-7.2)	0.030	0.17	NC[1]	0.468	0.77	16.6	219	247	
	WY clay (20°C, pH 8.0-8.1)	0.051	0.36	NC[1]	4.98	1.62	62.1	40.9	NC[1]	
	CA loamy sand (20°C, pH 6.7-7.1)	0.150	NC[1]	NC[1]	5.34	5.03	167	213	NC[1]	
Aerobic Aquatic	UK Calwich Abbey Lake water:silt loam sediment (20°C, water pH 7.9, sediment pH 7.4)	3.17	8.14	32.7	NC[1]	31.6	NC[1]	NC[1]	NC[1]	50493820, Acceptable

Study	System Name/ Characteristics	Parent DT_{50} (d)	Degradate DT_{50} (d)							MRID, Study Classification
			M-01	M-07	M- 12	M-13	M-36	M-53	M-63	
	UK Swiss Lake water:sand sediment (20°C, water pH 6.7, sediment pH 5.1)	8.16	30.6	NC[1]	NC[1]	81.9	NC[1]	NC[1]	NC[1]	

DT_X=time for concentration/mass to decline by X percentage
[1] NC=Not calculable from the study data

While a complete fate database is not available for degradates, there are mobility data for the majority of the tiafenacil degradation products (**Table 5-3**). Many of the degradates are significantly more mobile than the parent, with K_{OC} values ~2-3 orders of magnitude smaller than the parent. Therefore, the degradates have a higher potential to reach surface and groundwater via water runoff or leaching. There were eleven major degradates that reached their maximum concentration at the final timepoint of one or more studies, indicating that the concentration was potentially still increasing at the termination of the study (See **Appendix A**). Degradates M-32, M-33, M-34 (trifluoroacetic acid, trifluoroacetone, and 1,1,1-trifluoroisopropanol, respectively) are known degradates of other herbicides including saflufenacil (USEPA, 2004). Carbon dioxide formation was a major product in the aerobic soil metabolism (up to 10.2% CO_2) and anaerobic soil metabolism (up to 21.5% CO_2) studies and a minor product in soil photolysis (up to 2.30% CO_2). It was not detected in any of the other fate studies.

There were unextracted residues in all of the submitted soil and sediment metabolism studies. A separate extraction protocol study (MRID 50493811) was submitted to examine whether a more thorough extraction would liberate additional residues. These additional extractions included solvents with a range of dielectric constants as recommended in the *Guidance for Addressing Unextracted Residues in Laboratory Studies* (USEPA, 2014b) and which resulted in recoveries ranging from ≤0.1% to 7.5% of additional radioactive material, with no single metabolite present in >5%. Therefore, the unextracted residues are considered largely bound to the soil and are not a source of significant uncertainty as to whether they contribute to exposure.

As indicated in **Section 4**, the parent compound and degradates M-01, M-12, and M-13 are included as ROC is generating EECs. While there are limited fate data available for the ROCs, they are all 3x to 100x more persistent than the parent compound, but still are classified as non-persistent in aerobic soil and have half-lives ranging from weeks to months in aerobic aquatic environments (**Table 5-4**).[5] The maximum and final amount of the ROCs formed in the

[5] Goring *et al*. (1975) provides the following persistence scale for aerobic soil metabolism half-lives:

- Non-persistent less than 15 days
- Slightly persistent for 15-45 days

laboratory fate studies are shown in **Table 5-5**. All three compounds are major degradates in aerobic soil and aerobic aquatic metabolism studies, with maximum percent formed ranging from 38.4 to 63.4% of the applied radioactivity (%AR) in aerobic soil and 28.7 to 62.1 %AR in aerobic aquatic studies. Compound M-12 was detected at 45.4 %AR at the termination of the aerobic aquatic metabolism study, indicating that the compound can persist in aquatic environments.

Table 5-5 Summary of Maximum Amount of Tiafenacil Residues of Concern (ROCs) Formed in Biotic and Abiotic Environmental Fate Studies.

Compound	Maximum Percent Applied Radioactivity (%AR) Associated with Degradate (day) **Amount Detected at Final Sampling Interval (day) (bold value)**							
	Hydrolysis pH 7	**Aqueous Photolysis**	**Soil Photolysis**	**Aerobic Soil**	**Anaerobic Soil**	**Aerobic Aquatic**	**Anaerobic Aquatic**	**Observed in Field Dissipation**
M-01	21.2 (30) **21.2 (30)**			63.4 (0.25) **ND (180)**	99.2 (7) **18.9 (180)**	62.1 (28) **1.9 (100)**	36.4 (28) **7.3 (100)**	Yes
M-12				52.3 (3) **ND (180)**	41.1 (7) **6.4 (180)**	56.7 (50,75) **45.4 (100)**	5.4 (50) **2.4 (100)**	Yes
M-13				38.4 (1) **ND (180)**	8.4 (14) **1.7 (180)**	28.7 (14) **9.6 (100)**		Yes

Grey boxes indicate that the compound was not detected in the given study.

Dissipation rates and representative model input half-lives were calculated for both the parent and ROCs using a Total Residues approach (**Table 5-2**). These representative model input values often are different from the actual time to 50 percent decline (DT_{50}) of the residues as degradation kinetics were often biphasic with the rate of degradation slowing over time. The representative degradation half-life is designed to provide an estimate of degradation for biphasic degradation curves that will not overestimate degradation when assuming a single first-order (SFO) decline curve in modeling. With the exception of photolysis, the model input half-lives for the parent range from <1 to 8.16 days; whereas, the ROC model input half-lives range from 1.24 to 102 days. The half-lives for the parent and ROC for aqueous and soil photolysis are identical, as none of the degradates of concern were detected in the photolysis studies.

A summary of terrestrial field dissipation data is provided in **Table 5-6**. Terrestrial field dissipation studies indicate the parent compound dissipates rapidly on soil, with DT_{50} values ranging from <1 h to 0.610 d (DT_{90} values ranging from 2.43 to 29.3 d). The parent compound was not detected below 15 cm in any study, likely due to the low mobility coupled with the rapid degradation rate. Several metabolites were regularly detected at lower depths, primarily M-36, M-53, and M-73. Degradates M-36 was detected at the lowest sampling depth (75-90 cm) at 21 days after treatment in one study but was not detected at subsequent sampling intervals. Due to the mobility of these degradates there is some uncertainty as to whether any

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- Moderately persistent for 45-180 days, and
- Persistent for greater than 180 days.

of the compounds leached below the maximum sampling depth between sampling events. This supports the analysis that degradates of tiafenacil have the potential to leach to groundwater in some environments. Although several degradates were detected at or near the maximum sampling depth, none of the ROCs were detected below 15 cm, except for M-01, which was detected between 15-30 cm in the Washington sand field dissipation study. While field dissipation studies are designed to capture a range of loss processes; laboratory studies are designed to capture loss from one process (*e.g.*, hydrolysis, aerobic metabolism, *etc.*). Thus, the values from laboratory studies are not directly comparable to the values from the field studies; however, it is informative to have some understanding of how the laboratory data compare to the loss rates in the field dissipation studies. These data support the aerobic soil metabolism studies that show rapid degradation of tiafenacil in soil, and the degradate batch equilibrium studies showing that the degradates are more mobile than the parent.

Table 5-6 Summary of Terrestrial Field Dissipation Data for Tiafenacil.

System Details	Dissipation Rate (d) (Kinetic Model)				Max Leaching Depth (cm)		Source/ Classification/ Comment
	DT_{50}		DT_{90}				
	Parent	ROC	Parent	ROC	Parent	ROC	
California Bare plot Sandy loam pH 6.5	0.481 (DFOP)	5.19 (SFO)	29.3 (DFOP)	17.2 (SFO)	7.5-15	7.5-15	MRID 40693840, acceptable. Parent not detected after 7 days after treatment. Degradate M-36 detected at 15-30 cm. M-01, M-12, and M-13 detected between 0-15 cm
Washington Bare plot Sand pH 8.4	7.38×10^{-4} (IORE)	1.9 (DFOP)	2.43 (IORE)	11.9 (DFOP)	0-7.5	15-30	MRID 50493841 Parent not detected after 5 days after treatment. Degradate M-36 detected at 75-90 cm. M-01 detected between 0-30 cm, M-12 and M-13 detected between 0-15 cm.
North Dakota Bare plot Sandy loam pH 6.4	0.610 (DFOP)	5.31 (SFO)	8.42 (DFOP)	17.6 (SFO)	0-7.5	7.5-15	MRID 50493842 Parent not detected after 14 days after treatment. Degradate M-53 detected at 30-45 cm. M-01 detected between 0-15 cm, M-12 and M-13 detected between 0-7.5 cm
North Carolina Bare plot Sand pH 6.4	0.369 (IORE)	0.81 (IORE)	4.13 (IORE)	5.32 (IORE)	0-7.5	0-7.5	MRID 50493843 Parent not detected after 3 days after treatment. Degradate M-73 detected at 60-75 cm. M-01 detected between 0-7.5 cm. M-12, and M-13 were not detected.

DT_X=time for concentration/mass to decline by X percentage; DFOP=double first order in parallel; IORE=indeterminate order (IORE); SFO DT_{50}=single first order half-life.

6 Ecotoxicity Summary

Ecological effects data are used to estimate the toxicity of tiafenacil to non-target organisms through the use of surrogate species. The ecotoxicity data for tiafenacil and its associated products are summarized in **Section 6.1** and **Section 6.2.** Various studies with mammals, birds, bees, fish, aquatic invertebrates, terrestrial and aquatic plants exposed to either TGAI or typical end-use (formulated) products (TEP) of tiafenacil have been submitted and the results of these studies are described briefly in this section with additional details presented in **Appendix I.**

A search of the public ECOTOXicology Knowledgebase (https://cfpub.epa.gov/ecotox/) in August 2019 yielded no additional data than those used from the studies submitted to support the registration of tiafenacil.

Table 6-1 and **Table 6-2** summarize the most sensitive measured toxicity endpoints available across taxa. **Table 6-2** also summarizes the toxicity endpoints available for tiafenacil degradates. These endpoints are not likely to capture the most sensitive toxicity endpoint for a particular taxon but capture the most sensitive endpoint across tested species for each taxon. All studies in **Table 6-1** and **Table 6-2** are classified as acceptable or supplemental. Non-definitive endpoints are designated with a greater than (>) or less than (<) value.

6.1 Aquatic Toxicity

Some of the toxicity studies submitted on aquatic organisms did not include lighting intensity under which the study was conducted. Tiafenacil is a protoporphyrinogen inhibitor (Park *et al*. 2018) and as such is a light-dependent peroxidizing herbicide (LDPH) for which toxicity to aquatic organisms (especially fish) may be influenced by the amount of light during the conduct of the study.

Acute and chronic toxicity endpoints for the most sensitive aquatic taxa are summarized in **Table 6-1.** No effects were observed up to 75.6 and 13.6 mg ai/L in acute toxicity studies with tiafenacil TGAI for the freshwater fish Rainbow Trout (*O. mykiss*; MRID 50486852) and the estuarine/marine fish Sheepshead Minnow (*C. variegatus*; 50486863), respectively. Therefore, tiafenacil is classified as no more than slightly toxic to fish on an acute exposure basis.

With respect to freshwater invertebrates, no effects were observed up to 75.5 mg/L in an acute toxicity study with tiafenacil TGAI for the freshwater invertebrate waterflea (*D. magna*; MRID 50486857); therefore, tiafenacil is classified as no more than slightly toxic to freshwater invertebrates on an acute exposure basis. With respect to estuarine/marine invertebrates, tiafenacil is classified as highly toxic to the Mysid shrimp *A. bahia* (48-hr EC_{50} =0.65 mg/L; MRID 50486862) on an acute exposure basis.

In a 33-day early life stage (ELS) study with the freshwater Fathead Minnow (*P. promelas*; MRID 50486866) using TGAI the no observed adverse effect concentration (NOAEC) is 0.016 mg ai/L, based on a 4.9 and 15% reduction in total length and dry weight, respectively at the LOAEC of 0.04 mg ai/L. A 34-day ELS study with the estuarine/marine Sheepshead Minnow (*C. variegatus*) exposed to TGAI (MRID 50486867) resulted in a NOAEC value of 0.12 mg ai/L, based on a 60% reduction in post-hatch survival at the LOAEC of 0.42 mg ai/L.

In a 21-day life cycle toxicity test of TGAI with *D. magna* the NOAEC is 0.61 mg ai/L based on a 9% reduction in the number of offspring per female at a LOAEC of 1.2 mg ai/L (MRID 50486864). Chronic exposure of mysid shrimp to TGAI (MRID 50486865) resulted in a NOAEC of 0.086 mg ai/L and a LOAEC of 0.175 mg ai/L, at which there was a 79% reduction in the number of offsprings per female, and a 10.6% increase in time to first brood.

Exposure of the non-vascular freshwater green alga (*Raphidocelis subcapitata*) to tiafenacil TGAI resulted in NOAEC and IC_{50} values of 0.00237 and 0.00474 mg/L, respectively based on a 61% reduction in yield at the LOAEC of 0.00511 mg ai/L (MRID 50486886). Exposure of *R. subcapitata* to tiafenacil TEP (DCC-3825 30 SC; 30.7% ai) resulted in NOAEC and IC_{50} values of 0.00257 and 0.00455 mg/L, respectively, with 95% reductions in yield and 94.5% reductions in biomass at the LOAEC of 0.00506 mg ai/L (MRID 50486888). In another study of *R. subcapitata*, exposure of tiafenacil TEP (DCC-3825 70 WG; 71.47% ai) resulted in similar toxicity estimates with NOAEC and IC_{50} values of 0.00254 and 0.00459 mg/L, respectively; biomass (area under the curve; AUC) was reduced by 69% at the LOAEC of 0.00527 mg ai/L (MRID 50486887). The available data indicate that tiafenacil is algicidal rather than algistatic.

Exposure of *R. subcapitata* tiafenacil degradate M-36 resulted in NOAEC and IC_{50} values of 0.237 and 0.814 mg ai/L, respectively (MRID 50486889). Exposure of *R. subcapitata* to the tiafenacil degradate M-53 resulted in a NOAEC and IC_{50} values of 0.646 and 1.47 mg ai/L, respectively, where there was a 59% reduction in biomass at the LOAEC of 1.660 mg ai/L (MRID 50486890).

A 7-day study of the vascular aquatic plant duckweed (*Lemna gibba*) with the tiafenacil TEP DCC-3825 70% WG (70% ai) resulted in IC_{50} and NOAEC values of 0.00557 and 0.000769 mg a.i./L, respectively; there was a 29% reduction in the frond number yield at a LOAEC of 0.00212 mg/L (MRID 50486882).

Table 6-1 Aquatic Toxicity Endpoints Selected for Risk Estimation for Tiafenacil.

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in mg a.i./L (unless otherwise specified)[1]	MRID or ECOTOX No./ Classification	Comments
Freshwater Fish (surrogates for vertebrates)					
Acute	TGAI (97.3% ai)	Rainbow trout (*Oncorhynchus mykiss*)	96-h LC_{50} >75.60 (Mortality)	50486852 Acceptable	No effect observed up to the highest concentration tested (75.60 mg ai/L).
Chronic (ELS)	TGAI (98.6% ai)	Fathead minnow (*Pimephales promelas*)	33-day NOAEC = 0.016 LOAEC = 0.040	50486866 Acceptable	4.9% reduction in total length, 10% reduction in wet weight and a 15% reduction in dry wet at the LOAEC.
Estuarine/marine Fish (Surrogates for vertebrates)					

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in mg a.i./L (unless otherwise specified)[1]	MRID or ECOTOX No./ Classification	Comments
Acute	TGAI (98.04% ai)	Sheepshead minnow (*Cyprinodon variegatus*)	96-h LC_{50} >13.60 (Mortality)	50486863 Acceptable	No effect observed up to the highest concentration tested (13.60 mg ai/L).
Chronic (ELS)	TGAI (98.6% ai)	Sheepshead minnow (*Cyprinodon variegatus*)	34-day (28-days post-hatch) NOAEC = 0.120 LOAEC = 0.420	50486867 Acceptable	60% reduction in post-hatch survival at the LOAEC.
Freshwater Invertebrates (Water-Column Exposure)					
Acute	TGAI (97.3% ai)	Waterflea (*Daphnia magna*)	48-h EC_{50} >75.50	50486857 Acceptable	No effect observed up to the highest concentration tested (75.50 mg ai/L).
Chronic	TGAI (98.04% ai)		21-day NOAEC = 0.605 LOAEC = 1.200	50486864 Acceptable	9% reduction in offspring production at the LOAEC.
Estuarine/ marine invertebrates (Water Column Exposure)					
Acute	TGAI (99% ai)	Mysid shrimp (*Americamysis bahia*)	96-h LC_{50} = 0.650	50486862 Acceptable	Highly toxic.
Chronic	(TGAI 98.6 % ai)	Mysid shrimp (*Americamysis bahia*)	30-day NOAEC =0.086 LOAEC = 0.175	50486865 Acceptable	79% reduction in the number of offsprings per female and 10.6% increase in time to first brood at the LOAEC.
Aquatic plants and algae					
Vascular	TEP (DCC-3825 70% WG; 70% ai)	Duckweed (*Lemna gibba*)	7-day IC_{50} = 0.006 NOAEC = 0.001 LOAEC = 0.002	50486882 Acceptable	Very highly toxic. The most sensitive endpoint is frond number yield based on a 29% reduction at the LOAEC.
Non-vascular	TEP (DCC-3825 30 SC; 30.7% ai)	Freshwater alga, (*Raphidocelis subcapitata*)	96-h IC_{50} = 0.005 NOAEC = 0.003 LOAEC = 0.005	50486888 Acceptable	Very highly toxic. Most sensitive endpoints are yield and biomass (AUC) based on 95 and 94% reductions, respectively at the LOAEC.
Endpoints for Tiafenacil Degradates					
Freshwater Invertebrates (Water-Column Exposure)					
Acute	Degradate (M-36; 97.6%)	Waterflea (*Daphnia magna*)	48-h EC_{50} = >100	50486860 Acceptable	Practically non-toxic
Aquatic plants and algae					
Vascular	Degradate (M-36; 97.6%)	Duckweed (*Lemna gibba* G3)	7-day IC_{50} = 0.335 NOAEC = 0.023 LOAEC = 0.059	50486884 Acceptable	Most sensitive endpoint is frond number yield based on a 23% reduction at the LOAEC.

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in mg a.i./L (unless otherwise specified)[1]	MRID or ECOTOX No./ Classification	Comments
Vascular	Degradate (M-53; 92.5% ai)	Duckweed (*Lemna gibba* G3)	7-day IC_{50} = 1.260 NOAEC = 0.239 LOAEC = 0.819	50486885 Acceptable	Most sensitive endpoint is final biomass based on a 33% reduction at the LOAEC.
Non-vascular	Degradate (M-36; 97.6%)	Freshwater alga, (*Raphidocelis subcapitata*)	96-h IC_{50} = 0.814 NOAEC = 0.237	50486889	Most sensitive endpoint could not be determined
Non-vascular	Degradate (M-53; 92.5% ai)	Freshwater alga, (*Raphidocelis subcapitata*)	96-h IC_{50} = 1.470 NOAEC = 0.646 LOAEC = 1.660	50486890	Most sensitive endpoint is biomass (AUC) based on a 59% reduction at the LOAEC.

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

[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

Acute and chronic toxicity endpoints for the most sensitive terrestrial taxa are summarized in **Table 6-2**. The available data indicate that based on an LD_{50} of >2,000 mg ai/kg-bw for Zebra Finch (*Taeniopygia guttata*; MRID 50486845), TGAI is classified as practically non-toxic to birds on acute oral exposure basis. Since birds serve as surrogates for terrestrial-phase amphibians and reptiles, tiafenacil TGAI is classified as practically non-toxic to these taxa as well. Similar results with birds were recorded in acute toxicity studies with Bobwhite Quail (*Colinus virginianus*; LD_{50} of >2,250 mg ai/kg-bw; MRID 50486846) and Mallard Ducks (*Anas platyrhynchos;* LD_{50} of >2,250 mg ai/kg-bw; 50486847). Tiafenacil is also practically non-toxic to Bobwhite Quail (LC_{50} of 5,636 mg ai/kg-diet; MRID 50486848) and Mallard Duck (LC_{50} of 5,455 mg ai/kg-diet; MRID 50486849) on sub-acute dietary exposure basis.

A 23-week avian reproduction study (MRID 50486850) using Bobwhite Quail resulted in a NOAEC of 56 mg/kg-diet based on a 4.6% reduction in eggshell thickness at the LOAEC of 187 mg ai/kg diet (MRID 50486850). The biological relevancy of this effect in the absence of other effects in terms of cracked eggs is uncertain though. In another avian reproduction study with Mallard ducks, the NOAEC was 1,438 mg ai/kg diet based on a 21% decrease in the number of viable embryos per eggs set, a 22% decrease in the number of live embryos per eggs set, 27% reduction in the number of hatchlings per eggs set, a 28% reduction in the number of surviving hatchlings, and a 5.4% reduction in 14-day survivor weight at the LOAEC of 5,099 mg ai/kg diet (MRID 50486851).

Tiafenacil is classified as practically non-toxic to rats (*Rattus norvegicus*) on an acute oral (LD_{50} > 2000 mg/kg; MRID 50486804) exposure basis. A two-generation reproduction toxicity study

(MRID 50486832) with *R. norvegicus* resulted in no toxic effect on survival and growth with NOAEC and LOAEC values of 150 and >150 mg/kg-diet (equivalent to 8.01 and >8.01 mg/kg-bw/day), respectively. Since no effects were observed in the study at the highest tested concentration, it is uncertain whether effects would occur at the predicted concentrations based on the use pattern. The toxicity test did not test high enough to evaluate the potential for effects to occur at the predicted concentrations.

It should be noted that liver porphyrin concentrations (total porphyrin content) increased significantly in both sexes of parental rats (P generation) and F1 weanlings when exposed to tiafenacil at a dose of 8.01 mg/kg-bw. Other hematological changes (indicating microcytic hypochromic anemia) were also observed at a concentration of 330 mg/kg-diet in a 90-day repeated dose oral toxicity test with tiafenacil (MRID 50486817). As stated above, PPO inhibitors can cause adverse effects on mammals as a result of excess porphyrin production particularly under enhanced lighting conditions. In a similar two generation rat reproduction study with saflufenacil (another PPO inhibiting herbicide), microcytic hypochromic anemia resulting from hepatic heme synthesis disruption in experimental animals, and increased liver porphyrins were observed with a NOAEC and LOAEC of 15 and 50 mg a.i./kg-bw, respectively (MRID 47128117). This suggest that sublethal hematologic effects (anemia) may be associated with the LDPH mode of action.

Tiafenacil TGAI showed no effect on honey bee larvae up to the highest dose tested on an acute (single dose) exposure basis (LD_{50} >0.005 mg ai/larva; MRID 50486876) and is therefore classified as no more than moderately toxic to honey bee larvae on an acute exposure basis. Tiafenacil TGAI is practically non-toxic to young adult honey bees on both an acute contact and oral exposure basis (LD_{50} > 0.1 mg ai/bee; MRID 50486873). Exposure of honey bee larvae to tiafenacil TGAI in a chronic (repeat dose) toxicity test resulted in no detectable effects on either larval/pupal mortality or adult emergence with NOAEC, LOAEC and EC_{50} values of 149, >149 and >149 mg ai/kg diet, respectively (corresponding to doses of 5.63, >5.63 and >5.63 µg ai/larva/day, respectively (MRID 50486878). A 10-day chronic (repeat dose) toxicity study with adult honey bees using TGAI resulted in a NOAEL of 0.022 mg ai/bee/day, based on a 10% increase in mortality at the LOAEL of 0.047 mg ai/bee/day with an LD_{50} of >0.084 mg ai/bee/day (MRID 50486875).

In a vegetative vigor study of terrestrial plants with the tiafenacil TEP DCC-3825 70 WG (70% ai; MRID 50486880), corn (*Zea mays*) was the most sensitive monocotyledon (monocot) tested with NOAEC and IC_{25} values of 0.000075 and 0.0000815 lb ai/A, respectively, based on a 29% reduction in plant dry weight at the LOAEC of 0.00021 lbs ai/A. Soybean (*Glycine max*) was the most sensitive dicotyledonous (dicot) species with NOAEC and IC_{25} values of <0.000075 and 0.000197 lb ai/A, respectively, based on a 12% reduction in plant height at the LOAEC of 0.000075 lbs ai/A. A seedling emergence test with the TEP DCC-3825 70 WG (MRID 50486879) indicated that the most sensitive monocot was ryegrass (*Lolium perenne*) with NOAEC and IC_{25} values of 0.016 and 0.0206 lbs ai/A, respectively, based on a 60% reduction in dry weight at the LOAEC of 0.049 lbs ai/A. The most sensitive dicot was cabbage (*Brassica oleracea*) with NOAEC and IC_{25} values of 0.00301 (EC_{05} value) and 0.00722 lbs ai/A, respectively, based on a 25 % reduction in survival at the LOAEC of 0.017 lbs ai/A.

Table 6-2 Terrestrial Toxicity Endpoints Selected for Risk Estimation for Tiafenacil.

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value[1]	MRID or ECOTOX No./ Classification	Comments
Birds (surrogates for terrestrial amphibians and reptiles)					
Acute Oral	TGAI (95-98% a.i.)	Zebra finch (*Taeniopygia guttata*)	LD_{50} >2,000 mg a.i./kg-bw	50486845 Acceptable	Practically non-toxic.
Sub-acute dietary	TGAI (99.5% a.i.)	Mallard duck (*Anas platyrhynchos*)	8-day LC_{50} >5,455 mg a.i./kg-diet	50486849 Acceptable	Practically non-toxic.
Chronic	TGAI (97.9% a.i.)	Bobwhite Quail (*Colinus virginianus*)	23-weeks NOAEC = 56 LOAEC = 187 mg/kg-diet	50486850 Acceptable	Based on a 4.6% reduction in eggshell thickness at the LOAEC.
Mammals					
Acute Oral	TGAI 98.2% a.i.	Sprague Dawley rat (*Rattus norvegicus*)	Oral LD_{50} >2000 mg ai/kg	50486804 Acceptable	No effect observed up to the highest level tested (2000 mg ai/kg).
Acute Dermal			Dermal LD_{50} >2000 mg ai/kg	50486805 Acceptable	
Chronic	TGAI		NOAEL =8.01 mg/kg-bw LOAEL > mg/kg-bw NOAEC =150 mg/kg-diet LOAEC >150 mg/kg-diet	50486832 Acceptable	No effect was observed at the highest tested concentration. Therefore, it is uncertain whether effects would occur at the predicted concentrations based on the use pattern.
Terrestrial invertebrates					
Acute oral and contact (adult)	TGAI (97.3% a.i.)	Honey bee (*Apis mellifera* L.)	48-hour LD_{50} >0.101 mg a.i./bee	50486873 Acceptable	Practically non-toxic.
Acute oral (larvae)	TGAI (98.6% a.i.)	Honey bee (*Apis mellifera* L.)	72-hour LD_{50} >0.005 mg ai/larva	50486876 Acceptable	No effect observed up to the highest dose tested (0.005 mg ai/larva).
Chronic (repeated dose; larvae)	TGAI (98.6% a.i.)	Honey bee (*Apis mellifera* L.)	EC_{50} for emergence >5.63 NOAEC = 5.63 µg ai/larva/day LOAEC >5.63 µg ai/larva/day	50486878 Acceptable	No effect on mortality, emergence and weight at emergence.

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value[1]	MRID or ECOTOX No./ Classification	Comments
Chronic oral (adult)	TGAI (97.8% a.i.)	Honey bee (*Apis mellifera* L.)	LD_{50} >0.084 mg ai/bee/day NOAEL = 0.022 mg ai/bee/day LOAEL = 0.047 mg ai/bee/day	50486875 Acceptable	Based on a 10% increase in mortality at the LOAEL.
Terrestrial and wetland plants					
Vegetative vigor	TEP (DCC-3825 70 WG; 70% ai)	Various species	Dicots: IC_{25} = 0.000197 lb ai/A; NOAEC <0.000075 lb ai/A; LOAEC = 0.000075 lbs ai/A	50486880 Acceptable	The most sensitive dicot species is soybean (*Glycine max*) based on a 12% reduction in plant height at the LOAEC.
			Monocots: IC_{25} = 0.000082 lb ai/A; NOAEC = 0.000075 lb ai/A; LOAEC = 0.00021 lbs ai/A		The most sensitive monocot species is corn (*Zea mays*) based on a 29% reduction in plant dry weight at the LOAEC.
Seedling Emergence	TEP (DCC-3825 70 WG; 70% ai)	Various species	Dicots: IC_{25} = 0.0072 lb ai/A; NOAEC = 0.0030 lb ai/A; LOAEC = 0.017 lbs ai/A	50486879 Acceptable	The most sensitive dicotyledon species is cabbage (*Brassica oleracea*) based on a 25 % reduction in survival at the LOAEC.
			Monocots: IC_{25} = 0.0206 lb ai/A; NOAEC = 0.016 lb ai/A; LOAEC = 0.049 lbs ai/A		The most sensitive monocot species is ryegrass (*Lolium perenne*) based on a 60% reduction in dry weight at the LOAEC.

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

[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.

A review of submitted studies indicated a range of toxicity effects of tiafenacil to other terrestrial invertebrates. Toxicity tests of tiafenacil with earthworms (*Eisenia foetida*) resulted in an LC_{50} >1000 mg ai/kg soil (MRID 50486894; 50486895); tests with the predatory mite (*Typhlodromus pyri*) resulted in an EC_{50} >978 mg ai/kg soil; MRID 50486896). A 28-day exposure of tiafenacil TGAI to collembola (*Folsomia candida*) had no effect on either survival or reproduction (NOAEC = 244.6 mg ai kg/soil, LOAEC >244.6 mg ai kg/soil; MRID 50486897). Exposure of *T. pyri* to tiafenacil TEP (DCC-3825 5% ME; 5.1% ai) resulted in an EC_{50} at concentrations equivalent to an application rate of 13 g ai/ha (0.012 lb ai/A) and a NOAEC equivalent to an application rate of 1.9 g ai/ha (0.002 lb ai/A; based on a 25% reduction in the number of eggs per female at the LOAEC of 7.3 g ai/ha (0.006 lb ai/A; MRID 50486898). Exposure of parasitoid wasps (*Aphidius rhopalosiphi*) to the same TEP (DCC-3825 5% ME) resulted in an LC_{50} equivalent to an application rate of 49 g ai/ha (0.044 lb ai/A) and a NOAEC of 24 g ai/ha (0.021 lb ai/A) based on a 100% mortality at the LOAEC of 98 g ai/ha (0.087 lb ai/A; MRID 50486899). Therefore, the available data indicate that beneficial insects could be affected by exposure to tiafenacil given that the maximum single application rate is 0.067 lb ai/A.

6.3 ECOSAR Analysis

The ECOSAR predictive model (version 2.0;(USEPA, 2018) was used to determine whether major degradates should be included as ROC; the toxicity estimates provided through the ECOSAR analysis were not used in estimating risk. The ECOSAR estimates were compared to measured toxicity data for parent and degradates (**Appendix H**). Based on EFED guidance (USEPA, 2018) for evaluating the toxicity of degradates, the ECOSAR estimates specific to the parent compound classes (*i.e.*, esters, amides and carbonyl ureas) generally showed poor agreement with measured toxicity endpoint for tiafenacil parent and were therefore classified as poor (*i.e.* endpoint estimates are greater than 10x the measured estimates). As a result, the model was not used in determining whether degradates should be included as a ROC.

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 EEC 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 non-listed birds, mammals, fish and aquatic invertebrates, the LOCs are 0.5 and 1.0, respectively, and for non-listed aquatic and terrestrial 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) are 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 (**Table 7-1**). The specific models used in this assessment are discussed further below.

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

Environment	Taxa of Concern	Exposure Media	Exposure Pathway	Model(s) or Pathway
Aquatic	Vertebrates/ Invertebrates	Surface water	Runoff and spray drift to water and sediment	PWC version 1.52[2]
	Aquatic Plants (vascular and nonvascular)			
Terrestrial	Vertebrate	Dietary items	Dietary residues from liquid sprays (includes residues on foliage, seeds/pods, arthropods, and soil)	T-REX version 1.5.2[3] -Kenaga nomoagram (for liquid foliar sprays)
	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

[1] Sediment analysis is recommended when the soil-water distribution coefficient (K_d) ≥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 risk quotients (RQs) will exceed levels of concern (LOCs) even if the sediment is not the primary exposure media.

[2] 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.

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

8 Aquatic Organisms Risk Assessment

8.1 Aquatic Exposure Assessment

8.1.1 Modeling Inputs

Surface water aquatic modeling was conducted using the Pesticide in Water Calculator (PWC version 1.52) for the proposed terrestrial uses. Parent and ROC chemical input parameters used in modeling were calculated from the physical-chemical data and representative model input half-lives found in **Table 5-1** and **Table 5-2** with model inputs in **Table 8-1**. Input parameters specific to the application scenario are specified in **Table 8-2** based on the use information described in **Section 3.2**. Input parameters were selected in accordance with EFED's guidance documents (USEPA, 2009; USEPA, 2010c; USEPA, 2012a; USEPA, 2013a; USEPA, 2013b; USEPA, 2014a; USEPA, 2014b; USEPA and Health Canada, 2013). See **Section 7.2** of the analysis plan for an explanation of the models used in aquatic modeling. Application dates were selected based on PWC scenario dates and crop specific agricultural practices.

Since the sorption coefficient for the parent compound could not be accurately measured by batch equilibrium, the HPLC-derived value was used as the model input value for the parent. Based on the current model input parameter guidance, the batch equilibrium derived sorption coefficient for the most mobile degradate, M-12, was used as the model input value for ROC modeling. Degradate M-12 is the most mobile of the three degradates as well the only one that is present in >10% of the applied radioactivity at the termination of the aerobic aquatic metabolism studies, indicating that is the most persistent in aquatic environments. This makes it both the conservative choice and an accurate representation of the ROCs that are likely to be present in aquatic environments.

Spray drift and application efficiency parameters for the different application methods are given in **Table 8-3** The proposed end use product labels state that only ground applications are permitted and specify medium to coarse droplet size for all applications. The fine to medium/coarse droplet size was selected because it was the option in AgDRIFT™ closest to droplet size specified on the label. For application to grapes, the proposed label states that it is to be "applied as a directed spray" and "do not allow spray solution to contact green stems (except suckers) or foliage". Based on these instructions, the Below Crop PWC application method was selected in and the spray drift parameters were calculated in AgDRIFT™ assuming a low boom application height and fine to medium/coarse droplet size. In AgDRIFT™, a low boom is 20 inches in height and a high boom is 50 inches in height (USEPA, 2013b). This was to capture that the chemical should not be intercepted by the crop foliage and that the sprayer heads will be positioned closer to the ground. For all other application the Above Crop application method was selected since tiafenacil specifically targets emerged weeds and therefore would be applied above the crop/weed foliage. The spray drift parameters for Above Crop were calculated in AgDRIFT™ assuming a high boom height and fine to medium/coarse droplet size distribution.

The modeling input parameters for the use patterns resulting in the lowest overall 60-day average EEC and the highest 60-day average EECs for each use site are shown in **Table 8-2**. These scenarios were selected as representative examples of the lower- and upper-bound chronic EECs for each use pattern. A complete list of model input parameters for all modeled uses can be found in **Appendix B**. Application timing was based on the label instructions and the emergence and harvest dates of the individual PWC scenarios. In general, the maximum single application rate and minimum retreatment interval was assumed whenever possible. All use patterns except for grapes, non-cropped areas, and fallow fields were modeled both with and without post-harvest fallow applications. For uses modeled with additional post-harvest fallow applications the final application was a partial application to not exceed the maximum annual application rate of 0.223 lb a.i./A/y. Most patterns mandate a 14-day retreatment interval, the only exception being the cotton desiccation use. The following assumptions on application timing were made based on the proposed label instructions and agronomic practices (Darrin *et al.*, 2017):

- Pre-plant burndown: 21 days before emergence;
- Pre-emergence burndown: 7-days before emergence;
- Post-emergence burndown: 0, 14, and 28 days after emergence;
- Pre-harvest desiccation (cotton only): 14 days before harvest; and,
- Post-harvest fallow: 14, 28, 42 days after harvest

Table 8-1 Aquatic Modeling Input Parameters for Chemical Tab for Tiafenacil and Tiafenacil Residues of Concern (ROC).[1]

Parameter (units)	Value (s)		Source	Comments
	Parent	ROC[2]		
K_{OC} (L/kg-OC)	1965	11.8	MRID 50493823 (Parent) 50493826 (M-12)	Calculated from HPLC data for parent. For ROC, the average organic carbon normalized sorption value for the most mobile degradate (M-12) on five soils. The coefficient of variation for M-12 was 46% for K_{OC} and 52% for K_d, indicating that K_{OC} is a better predictor of the variability in sorption than K_d.
Water Column Metabolism Half-life (days) at 20°C	13.3	144	MRID 50493820	Represents the 90 percent upper confidence bound on the mean of 2 representative half-life values from aerobic aquatic metabolism studies.
Benthic Metabolism Half-life (days) at 20°C	7.3	35.5	MRID 50493821	Represents the 90 percent upper confidence bound on the mean of 2 representative half-life values from anaerobic aquatic metabolism studies.
Aqueous Photolysis Half-life (days)@ pH 5	18.9 at 36°N	18.9 at 36°N	MRID 50493813	One measured value for parent. Value measured at pH 5 due to instability of the parent compound in neutral and basic solutions.
Hydrolysis Half-life (days)	0	0	MRID 50493812	Assumed that the aquatic metabolism studies capture both biotic and abiotic degradation. Therefore, hydrolysis degradation rate was set to 0 (stable) to prevent double counting loss.

Parameter (units)	Value (s)		Source	Comments
	Parent	ROC[2]		
Soil Half-life (days) at 20ºC	0.12	4.57	MRID 50493815	Represents the 90 percent upper confidence bound on the mean of 4 representative half-life values from aerobic soil metabolism studies.
Foliar Half-life (days)	--	--	-	No data available
Molecular Weight (g/mol)	511.88		MRID 50486803	Parent value
Vapor Pressure (Torr) at 25ºC	$\leq 1.12 \times 10^{-10}$		MRID 50486803	Parent value. Below the limit of quantification of the analytical method.
Solubility in Water (mg/L) at 25 °C	110		MRID 50486803	Parent value
Henry's Law constant at 25ºC (unitless)	2.8e-11 (estimated)		-	Estimated[3] from vapor pressure and water solubility of parent at 25 ºC. There is uncertainty in this value as a definitive vapor pressure is not available.

HPLC=high performance liquid chromatograph
[1] Crop specific input parameters for the applications tab are shown in **Table 8-2**
[2] Residues of concern (ROC) include the parent compound, M-01, M-12, and M-13
[2]All estimated values were estimated according to "*Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in Problem Formulations for Registration Review, Registration Review Risk Assessments, Listed Species Litigation Assessments, New Chemical Risk Assessments, and Other Relevant Risk Assessments*" (USEPA, 2010b).

The PWC scenarios are used to specify soil, climatic, and agronomic inputs in the Pesticide Root Zone Model (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. The Barton Springs Salamander (BSS) Right-of-Way scenario was used to model the non-cropped areas because there is no standard non-cropped area scenario. The BSS scenarios were developed in support of risk assessments conducted to evaluate potential risk to the Federally endangered Barton Springs Salamander (*Eurycea sosorum*) in Texas. These scenarios have similar issues as the scenarios developed for the organophosphate (OP) assessments, except that they were not chosen based on proximity to drinking water intakes, but rather to evaluate specific uses of pesticides in Texas. They may not be representative of vulnerable areas across the United States.

Table 8-2 Selected Pesticide in Water Calculator (PWC) Model Input Parameters Specific to Use Patterns for Tiafenacil and Tiafenacil Residues of Concern (ROC; Applications Tab and Crop/land Tab).

Run Name[1]	Use Site	PWC Scenario	Application Date Relative to Emergence[2]	App. Rate in lbs a.i./A (kg a.i./ha)	App. Type	App Method
RightOfWayBSS_Postemerg_3x0.067	Noncropped	RightOfWayBSS	0, 14, 28	3x0.067 (0.075)	Ground	Above Crop
Cagrapes_WirrigSTD_Postemerg_3x0.067	Grapes	Cagrapes_WirrigSTD	0, 14, 28	3x0.067 (0.075)	Ground	Below Crop

Run Name[1]	Use Site	PWC Scenario	Application Date Relative to Emergence[2]	App. Rate in lbs a.i./A (kg a.i./ha)	App. Type	App Method
NYgrapesSTD_Postemerg_3x0.067	Grapes	NYgrapesSTD	0, 14, 28	3x0.067 (0.075)	Ground	Below Crop
NDwheatSTD_Fallow_3x0.067	Fallow	NDwheatSTD	Aug 19, Sept 2, Sept 16	3x0.067 (0.075)	Ground	Above Crop
MScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Corn + Fallow	MScornSTD	-21, -7, 159, 173	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Cotton + Fallow	MScottonSTD	April 10, April 24, Sept 8, Oct 6	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
MSsoybeansSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Soybeans + Fallow	MSsoybeanSTD	-21, -7, 201, 215	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
NDwheatSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Wheat + Fallow	NDwheatSTD	-21, -7, 95, 109	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop

[1] The run name in this table corresponds to the run name in **Table 8-4.**.

[2] Application dates were either set relative to the PWC emergence date or, in the case of cotton and wheat fallow, as absolute calendar dates.

Table 8-3 Spray Drift and Application Efficiency Parameters.

Application Parameter	App Type		Source
	Above Crop	Below Crop	
Droplet Size[1]	Fine to Medium/Coarse[2]	Fine to Medium/Coarse[2]	End use product label
Boom Height[1]	High Boom	Low Boom	-
Spray Drift Fraction	0.017	0.011	(USEPA, 2013b)
Application Efficiency	0.99	0.99	

[1] Application parameter from AgDRIFT™

[2] While the label specifies medium to coarse droplet size, only two droplet size options are available for ground application in AgDrift™: very fine to fine and fine to medium/coarse. Fine to medium/coarse was selected as the most similar to the specified droplet size distribution.

8.1.2 Modeling Results

Selected surface water EECs calculated for tiafenacil parent and tiafenacil ROC are shown **Table 8-4.**. For the parent, the scenarios with the lowest and highest maximum EECs are presented. For tiafenacil ROC, the scenario with the highest 60-day average water column EEC for each use site is presented, as well as the scenario with the lowest overall 60-day average water column EEC. The maximum calculated 1-day, 21-day, and 60-day average EECs for tiafenacil are 0.095, 0.064, and 0.043 µg/L, respectively. The maximum calculated 1-day, 21-day, and 60-day average EECs for tiafenacil ROC are 4.45, 4.31, and 3.97 µg/L, respectively. For tiafenacil parent, the maximum EECs are for the proposed non-cropped area use. For tiafenacil ROC the maximum values are for the Mississippi cotton use pattern that includes the pre-harvest desiccation use and subsequent fallow applications. The ROC EECs are 47 to 166-times higher than the parent only EECs. Parent only EECs are 2 to 42 percent of total residue EECs. See **Appendix D** for complete modeling results.

Table 8-4. Surface Water Estimated Environmental Concentrations (EECs) for Tiafenacil Parent and Residues of Concern (ROC; Calculated Using PWC version 1.52).

Run Name[1]	Use Site	PWC Scenario	App Rate lbs a.i./A	1-in-10 year mean EEC Water Column (µg/L)		
				1-day	21-day	60-day
Parent						
RightOfWayBSS_Postemerg_3x0.067_7_RightOfWayBSS	Non-cropped	RightOfWayBSS	3x0.067	**0.095**	**0.064**	**0.043**
NYgrapesSTD_Postemerg_3x0.067_7_NYGrapesSTD	Grapes	NYgrapesSTD	3x0.067	0.058	0.038	0.025
ROC						
RightOfWayBSS_Postemerg_3x0.067_7_RightOfWayBSS	Non-cropped	RightOfWayBSS	3x0.067	2.13	2.01	1.79
Cagrapes_WirrigSTD_Preplant_Preemerg_3x0.067_7_CAgrapes_WirrigSTD	Grapes	Cagrapes_WirrigSTD	3x0.067	0.221	0.214	0.201
NYgrapesSTD_Preplant_Preemerg_3x0.067_7_NYGrapesSTD	Grapes	NYgrapesSTD	3x0.067	0.619	0.591	0.563
NDwheatSTD_Fallow_3x0.067_7_NDwheatSTD	Fallow	NDwheatSTD	3x0.067	2.26	2.26	2.15
MScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScornSTD	Corn + Fallow	MScornSTD	3x0.067, 1x0.022	**4.45**	**4.31**	**3.97**
MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScottonSTD	Cotton + Fallow	MScottonSTD	3x0.067, 1x0.022	3.94	3.82	3.54
MSsoybeansSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MSsoybeanSTD	Soybeans + Fallow	MSsoybeanSTD	3x0.067, 1x0.022	3.62	3.49	3.16
NDwheatSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_NDwheatSTD	Wheat + Fallow	NDwheatSTD	3x0.067, 1x0.022	1.57	1.5	1.47

Maximum EECs for parent and ROC are shown in bold.
[1] The 'Run Name' in this table corresponds to the run name in **Table 8-2**

8.2 Aquatic Organism Risk Characterization

For evaluating potential risk to aquatic animals, acute RQs for freshwater and estuarine/marine fish and invertebrates are calculated using the 1-day mean EEC; chronic RQs for freshwater and estuarine/marine fish and invertebrate are calculated using the 60-day mean and 21-day mean, respectively. The RQs are then compared to Office of Pesticide Programs' (OPP) Levels of Concern (LOCs) for acute or chronic risk. These LOCs are used by OPP to analyze potential risk to non-target organisms and the need to consider regulatory action.

Estimated exposure concentrations were determined for parent tiafenacil and tiafenacil ROC. The parent tiafenacil and ROC EECs and RQs summarized in **Tables 8-5** through **8-9** represent comparisons made to the most conservative EEC values (*i.e.*, highest). For taxa without any LOC exceedances, the table contains only the minimum and maximum EECs or RQs.

8.2.1 Aquatic Vertebrates

Table 8-5 and **Table 8-6** summarize the minimum and maximum acute and chronic RQs for freshwater and estuarine/marine fish. **Table 8-7** contains chronic RQ values for the fish which take into account potential toxicity that may occur under enhanced lighting conditions (using a molar equivalency NOAEC that was calculated (**EQ 1)** based on the guidance memo for LDPH chemicals; US EPA, 2016). The guidance memo suggests conducting the risk assessment using the laboratory-derived NOAEC endpoints under standard lighting conditions as well as using the molar equivalency adjusted NOAEC which provides correction for the potential for enhanced toxicity of LDPHs to fish in the presence of *uV* light. This provides an additional safety factor to the fish chronic assessment. The molar threshold NOAEC accounts for the potential enhanced toxicity of LDPH chemicals under natural sunlight. The molar threshold approach is based on the observation that regardless of the NOAEC value determined under standard laboratory lighting for the three surrogate chemicals, the effect level under high intensity *uV* lighting conditions was relatively consistent (*i.e.*, 0.002 to 0.02 µmoles/L). Thus, 0.002 µmol/L is considered the Molar Threshold, regardless of the chemical. This is converted to units specific to a chemical of interest using a molecular weight of the chemical of interest using **EQ 1**. It is noted that the data supporting the molar threshold (0.002 µmoles/L) are limited to a single species (*i.e*., Fathead Minnows; *P. promelas*) and three chemicals and may not reflect the extent of variability in *uV*-enhanced toxicity across species and chemicals.

Molecular Equivalency NOAEC = Molar Threshold * Molecular weight of Tiafenacil **EQ 1**

Chronic RQs were calculated for both the parent and the ROC based on both the laboratory -derived NOAEC and the molar equivalency-adjusted NOAEC to capture the uncertainty associated with the nature and mechanism of the biological activity of the ROCs. All three degradates (*i.e*., M-01, M-12, and M-13) contain the same pyrimidinedione pharmacophore that is associated with the toxicity of the parent, EFED assumes that these compounds could operate under a similar mechanism and thus could demonstrate the same type of increased toxicity under enhanced lighting conditions. Therefore, RQs were calculated with the more conservative molar equivalency NOAEC endpoint to be protective of the potential exposure concerns.

Available data indicate that acute exposure of tiafenacil TGAI is no more than slightly toxic to freshwater and estuarine/marine fish. Chronic exposure of tiafenacil to freshwater fish led to a 4.9 and 15% reduction in total length and dry weight, respectively. Chronic exposure to estuarine/marine fish led to a 60% reduction in post-hatch survival.

The RQs do not exceed the acute risk to non-listed species LOC of 0.5 or the chronic risk LOC of 1.0 for freshwater or estuarine/marine fish for any of the proposed tiafenacil uses evaluated based on either tiafenacil parent or ROC (**Table 8-5** and **8-6**)**.** However, using the molar equivalency-adjusted chronic NOAEC, the freshwater and estuarine/marine fish chronic risk LOC of 1.0 is exceeded when exposure is based on ROC for some of the proposed uses **(Table 8-7)**.

Therefore, based on ROC, there are chronic risks of concern for fish and aquatic-phase amphibians inhabiting shallow, clear water in direct sunlight. The extent to which the tiafenacil parent and degradates demonstrate enhanced toxicity under *uV* lighting conditions is uncertain, but in the absence of light-enhanced toxicity data, EFED assumes that the degradates are of similar toxicity as the parent and follow the molar equivalency approach.

Table 8-5 Acute and Chronic Risk Quotients (RQs) for Freshwater and Estuarine/Marine Fish Based on Tiafenacil Parent Alone from Proposed Uses of Tiafenacil at Maximum Application Rates.

Use Sites (Use Scenario)	Tiafenacil 1-in-10 Yr EEC µg/L		Risk Quotient or Ratio of EEC to Highest Level Tested			
			Freshwater		Estuarine/Marine	
	Daily Mean	60-day Mean	Acute[1]	Chronic[2]	Acute	Chronic[2]
			LC_{50} > 75,600 µg a.i./L	NOAEC = 16 µg a.i./L	LC_{50} > 13,600 µg a.i./L	NOAEC = 120 µg a.i./L
RightOfWayBSS_Postemerg_3x0.067_7_RightOfWayBSS	0.09	0.04	<0.01	<0.01	<0.01	<0.01
NYgrapesSTD_Preplant_Preemerg_3x0.067_7_NYGrapesSTD	0.06	0.03	<0.01	<0.01	<0.01	<0.01

NA: Not available
The acute risk to non-listed species level of concern (LOC) is 0.5; the chronic risk LOC is 1.0. The acute and chronic toxicity endpoints listed in the table are those used to calculate the RQ.
[1] The estimated environmental concentrations (EECs) used to calculate acute RQs are based on the 1-in-10-year mean 1-day average value from **Table 8-4.**
[2] The EECs used to calculate chronic RQs are based on the 1-in-10-year 60-day average value from **Table 8-4.**

Table 8-6 Acute and Chronic Risk Quotients (RQs) for Freshwater and Estuarine/Marine Fish Based on Residues of Concern (ROC) from Proposed Uses of Tiafenacil at Maximum Application Rates.

Use Sites (Use Scenario)	ROC 1-in-10 Yr EEC µg/L		Risk Quotient or Ratio of EEC to Highest Level Tested			
			Freshwater		Estuarine/Marine	
	Daily Mean	60-day Mean	Acute[1]	Chronic[2]	Acute	Chronic[2]
			LC_{50} > 75,600 µg a.i./L	NOAEC = 16 µg a.i./L	LC_{50} > 13,600 µg a.i./L	NOAEC = 120 µg a.i./L
Cagrapes_WirrigSTD_Preplant_Preemerg_3x0.067_7_CAgrapes_WirrigSTD	0.22	0.20	<0.01	0.01	<0.01	<0.01
MScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScornSTD	4.46	3.97	<0.01	0.25	<0.01	0.03

NA: Not available
The acute risk to non-listed species level of concern (LOC) is 0.5; the chronic risk LOC is 1.0. The acute and chronic toxicity endpoints listed in the table are those used to calculate the RQ.

[1] The estimated environmental concentrations (EECs) used to calculate acute RQs are based on the 1-in-10-year mean 1-day average value from **Table 8-4.**
[2] The EECs used to calculate chronic RQs are based on the 1-in-10-year 60-day average value from **Table 8-4.**

Table 8-7 Chronic Risk Quotients (RQs) for Freshwater and Estuarine/Marine Fish Based on Molar Equivalency-Adjusted Chronic NOAEC from Tiafenacil Parent Alone and Residues of Concern (ROC) at Maximum Application Rates.

Use Sites (Use Scenario)	1-in-10 Yr EEC µg/L 60-day Mean		Risk Quotient[1]	
			Parent (Tiafenacil)	Residues of Concern
	Parent	ROC	NOAEC = 1.02 µg a.i./L	NOAEC = 1.02 µg a.i./L
RightOfWayBSS_Postemerg_3x0.067_7_RightOfWayBSS	0.04	1.79	0.04	**1.75**
Cagrapes_WirrigSTD_Preplant_Preemerg_3x0.067_7_CAgrapes_WirrigSTD	0.03	0.20	0.03	0.20
NYgrapesSTD_Preplant_Preemerg_3x0.067_7_NYGrapesSTD	0.03	0.56	0.03	0.55
NDwheatSTD_Fallow_3x0.067_7_NDwheatSTD	0.04	2.15	0.04	**2.1**
MScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScornSTD	0.03	3.97	0.03	**3.88**
MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScottonSTD	0.03	3.54	0.03	**3.46**
MSsoybeansSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MSsoybeanSTD	0.03	3.16	0.03	**3.09**
NDwheatSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_NDwheatSTD	0.04	1.47	0.04	**1.43**

Bolded values exceed the chronic risk level of concern (LOC) of 1.0. The chronic toxicity endpoint listed in the table is that used to calculate the RQ.
[1] The EECs used to calculate chronic RQs are based on the 1-in-10-year 60-day average value for from **Table 8-4.**

8.2.2 Aquatic Invertebrates

Tiafenacil is no more than slightly toxic to freshwater invertebrates but is highly toxic to estuarine/marine invertebrates on an acute exposure basis. Chronic exposure resulted in a 9% reduction in the number of offspring produced in freshwater invertebrates and a 79% reduction in the number of offspring produced per female in estuarine/marine invertebrates at the LOAEC for each of the species. The RQs do not exceed the acute risk to non-listed species LOC of 0.5 nor the chronic risk LOC of 1.0 for either freshwater or estuarine/ marine invertebrates for any of the proposed tiafenacil uses evaluated for both parent and ROC (**Table 8-8** and **Table 8-9** summarize the minimum and maximum RQs across). Therefore, the likelihood of adverse effects to freshwater and estuarine/marine invertebrates from either acute or chronic exposure as a result of the proposed uses of tiafenacil is expected to be low.

Table 8-8 Acute and Chronic Risk Quotients (RQs) for Freshwater and Estuarine/Marine Invertebrates Based on Tiafenacil Parent Alone from Proposed Uses of Tiafenacil.

Use Sites (Use Scenario)	Tiafenacil 1-in-10 Year EEC µg/L		Risk Quotient[3]			
			Freshwater		Estuarine/Marine	
	Daily Mean	21-day Mean	Acute[1]	Chronic[2]	Acute[1]	Chronic[2]
			LC_{50} > 75,500 µg a.i./L	NOAEC = 605 µg a.i./L	LC_{50} = 650 µg a.i./L	NOAEC = 86 µg a.i./L
RightOfWayBSS_Postemerg_3x0.067_7_RightOfWayBSS	0.09	0.06	<0.01	<0.01	<0.01	<0.01
NYgrapesSTD_Preplant_Preemerg_3x0.067_7_NYGrapesSTD	0.06	0.04	<0.01	<0.01	<0.01	<0.01

The acute risk to non-listed aquatic invertebrate species level of concern (LOC) for is 0.5; the chronic risk LOC is 1.0. The acute and chronic toxicity endpoints listed in the table are those used to calculate the RQ.
[1] The estimated environmental concentrations (EECs) used to calculate acute RQs are based on the 1-in-10-year mean 1-day average value from **Table 8-4.**
[2] The EECs used to calculate chronic RQs are based on the 1-in-10-year 21-day average value from **Table 8-4.**
[3] For the acute freshwater vertebrate endpoint, no effects were observed up to the highest level tested and the ratio of the predicted EEC to the highest level tested is shown instead of the risk quotient.

Table 8-9 Acute and Chronic Risk Quotients (RQs) for Freshwater and Estuarine/Marine Invertebrates Based on Residues of Concern (ROC) from Proposed Uses of Tiafenacil.

Use Sites (Use Scenario)	ROC 1-in-10 Year EEC µg/L		Risk Quotient[3]			
			Freshwater		Estuarine/Marine	
	Daily Mean	21-day Mean	Acute[1]	Chronic[2]	Acute[1]	Chronic[2]
			LC_{50} > 75,500 µg a.i./L	NOAEC = 605 µg a.i./L	LC_{50} = 650 µg a.i./L	NOAEC = 86 µg a.i./L
Cagrapes_WirrigSTD_Preplant_Preemerg_3x0.067_7_CAgrapes_WirrigSTD	0.22	0.22	<0.01	<0.01	<0.01	<0.01
MScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScornSTD	4.45	4.31	<0.01	<0.01	0.01	0.05

The acute risk to non-listed aquatic invertebrate level of concern (LOC) is 0.5; the chronic risk LOC is 1.0. The acute and chronic toxicity endpoints listed in the table are those used to calculate the RQ.
[1] The estimated environmental concentrations (EECs) used to calculate acute RQs are based on the 1-in-10-year mean 1-day average value from **Table 8-4.**
[2] The EECs used to calculate chronic RQs are based on the 1-in-10-year 21-day average value from **Table 8-4.**
[3] For the acute freshwater vertebrate endpoint, no effects were observed up to the highest level tested and the ratio of the predicted EEC to the highest level tested is shown instead of the risk quotient.
Since risk quotients do not exceed the risk LOC, the likelihood of adverse effects to invertebrates from exposure is expected to be low.

Since tiafenacil has a mean K_{OC} of 1,965 L/kg-organic carbon, standard assessment procedures would predict potential exposure in sediment and that risk to sediment-dwelling organisms should be evaluated (USEPA, 2014); however, based on the rapid degradation of parent tiafenacil to residues that are much more mobile, exposure in sediment was not considered a primary exposure pathway of concern.

8.2.3 Aquatic Plants

Potential risks to vascular and non-vascular aquatic plants were estimated by dividing the 1-in-10 year 1-day mean EEC (based on exposure from runoff and drift) by the most sensitive IC/EC_{50} value. The RQ was then compared to the LOC of 1.0. **Table 8-10** and **Table 8-11** summarize the minimum and maximum RQ values for aquatic vascular and non-vascular plants based on the proposed maximum application rate for each use pattern for tiafenacil for parent and ROC, respectively.

Based on the available toxicity data, RQs do not exceed the LOC of 1.0 for risk to either aquatic vascular or non-vascular plants for any of the proposed uses based on either parent tiafenacil alone or ROC. Therefore, the likelihood of adverse effects to aquatic plants from exposure as a result of the proposed uses of parent tiafenacil or ROC is expected to be low.

Table 8-10 Risk Quotients (RQs) for Vascular and Non-vascular Aquatic Plants Based on Parent Tiafenacil Alone from Proposed Uses of Tiafenacil at Maximum Application Rates.

Use Sites (Use Scenario)	1-in-10 Y EEC µg/L	Risk Quotient	
	Daily Mean	Non-vascular plant	Vascular Plant
		IC_{50} = 4.55 µg a.i./L	IC_{50} = 5.57 µg a.i./L
RightOfWayBSS_Postemerg_3x0.067_7_RightOfWayBSS	0.09	0.02	0.02
NYgrapesSTD_Preplant_Preemerg_3x0.067_7_NYGrapesSTD	0.06	0.01	0.01

The level of concern (LOC) for risk to non-listed aquatic plants is 1. The toxicity endpoints listed in the table are those used to calculate the RQs.
The estimated environmental concentrations (EECs) used to calculate RQs are based on the 1-in-10-year peak 1-day average value from **Table 8-4.**

Table 8-11 Risk Quotients (RQs) for Vascular and Non-vascular Aquatic Plants Based on Residues of Concern (ROC) from Proposed Uses of Tiafenacil at Maximum Application Rates.

Use Sites (Use Scenario)	1-in-10 Yr EEC µg/L	Risk Quotient	
	Daily Mean	Non-vascular plant	Vascular Plant
		IC_{50} = 4.55 µg a.i./L	IC_{50} = 5.57 µg a.i./L
MScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScornSTD	4.45	0.98	0.80
Cagrapes_WirrigSTD_Preplant_Preemerg_3x0.067_7_CAgrapes_WirrigSTD	0.22	0.05	0.04

The level of concern (LOC) for risk to non-listed aquatic plants is 1. The toxicity endpoints listed in the table are those used to calculate the RQs.
The estimated environmental concentrations (EECs) used to calculate RQs are based on the 1-in-10-year peak 1-day average value from **Table 8-4.**

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. Since tiafenacil is applied through ground spray, potential dietary exposure for terrestrial wildlife in this assessment is based on consumption of tiafenacil residues on food items following spray (foliar or soil) using the Kenaga nomogram (Hoerger and Kenaga, 1972).

The EECs for mammals and birds (which are used as surrogates for reptiles and terrestrial-phase amphibians) from consumption of dietary items on the treated field were calculated with T-REX v.1.5.2, using a default foliar dissipation half-life of 35 days. The default foliar dissipation half-life of 35 days was used because data on tiafenacil foliar dissipation half-lives are not available.

9.1.1 Dietary Items on the Treated Field

For the foliar uses, EECs are based on proposed application rates, number of applications, and re-application intervals presented in **Table 3-1** Chronic EECs take into consideration the foliar dissipation rate.

For foliar applications of tiafenacil, upper-bound Kenaga values are used to derive EECs for tiafenacil exposures to different-sized mammals and birds on the field of application based on a 1-year time period. Dose-based exposures are estimated for three weight classes of birds, *i.e.*, 20 g (small-sized), 100 g (mid-sized), and 1,000 g (large-sized); and three weight classes of mammals, *i.e.*, 15 g (small-sized), 35 g (medium-sized), and 1,000 g (larger-sized). Different types of feeding strategies, such as herbivores, insectivores, and granivores are considered. Since there is a 137-day interval between the second and third application dates for the maximum annual application (0.067 lbs ai/A X 3 +0.022 lbs ai/A) scenario, the herbicide is expected to dissipate after the second application (*i.e.* before the third application date). Therefore, the EEC and RQ values for the maximum annual application rate is the same as the minimum annual application rate (0.067 lbs ai/A X 2). Scenarios with multiple applications at shorter retreatment intervals produced the highest effects. Representative summaries of use patterns with low and high EECs and RQs for birds and mammals are in **Table 9-1, Table 9-2,** and **Table 9-3.** See **Appendix E** for a sample output for T-REX. **Appendix F** contains additional information for the terrestrial vertebrate exposure assessment including EECs and RQs for all use patterns.

Table 9-1 Summary of Dietary (mg a.i./kg-diet) and Dose-based Estimated Environmental Concentrations (EECs; mg a.i./kg-bw) as Food Residues for Birds, Reptiles, Terrestrial-Phase Amphibians and Mammals from Proposed Uses of Tiafenacil (T-REX v. 1.5.2, Upper-Bound 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)
Maximum annual application scenario: Corn + Fallow (0.067 lbs ai/A X 3 + 0.022 lbs ai/A app, 14-d minimum retreatment interval; ground)							
Short grass	28.27	32.19	18.36	8.22	26.95	18.63	4.32
Tall grass	12.96	14.75	8.41	3.77	12.35	8.54	1.98
Broadleaf plants/small insects	15.90	18.11	10.33	4.62	15.16	10.48	2.43
Fruits/pods/seeds (dietary only)	1.77	2.01	1.15	0.51	1.68	1.16	0.27
Arthropods	11.07	12.61	7.19	3.22	10.56	7.30	1.69
Seeds (granivore)	NA	0.45	0.25	0.11	0.37	0.26	0.06
Minimum annual application scenario: Soybean (0.067 lbs ai/A X 2 app, 14-d minimum retreatment interval; ground)							
Short grass	28.27	32.19	18.36	8.22	26.95	18.63	4.32
Tall grass	12.96	14.75	8.41	3.77	12.35	8.54	1.98
Broadleaf plants/small insects	15.90	18.11	10.33	4.62	15.16	10.48	2.43
Fruits/pods/seeds (dietary only)	1.77	2.01	1.15	0.51	1.68	1.16	0.27
Arthropods	11.07	12.61	7.19	3.22	10.56	7.30	1.69
Seeds (granivore)	NA	0.45	0.25	0.11	0.37	0.26	0.06
Annual application scenario with the highest EEC: Cotton (0.067 lbs ai/A X 3 app, 7-d minimum retreatment interval; ground)							
Short grass	37.50	42.71	24.36	10.90	35.76	27.85	6.46
Tall grass	17.19	19.58	11.16	5.00	16.39	12.76	2.96
Broadleaf plants/small insects	21.09	24.02	13.70	6.13	20.11	15.67	3.63

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)
Fruits/pods/seeds (dietary only)	2.34	2.67	1.52	0.68	2.23	1.74	0.40
Arthropods	14.69	16.73	9.54	4.27	14.00	10.91	2.53
Seeds (granivore)	NA	0.59	0.34	0.15	0.50	0.39	0.09

NA=not applicable

9.2 Terrestrial Vertebrate Risk Characterization

Tables 9-2, 9-3 and **9-4** summarize RQ and toxicity values from modeled minimum and maximum scenarios for birds and mammals; these values are based on the upper-bound EECs discussed above.

Based on an LD_{50} of >2,000 mg a.i./kg-bw and an LC_{50} > 5,455 mg a.i./kg-diet, tiafenacil is practically non-toxic to birds on an acute exposure basis. Since the toxicity study tested high enough to cover potential exposure (with no mortality detected at the highest dose tested), the likelihood of direct adverse effects on birds from acute exposure to tiafenacil residues in their diet from the proposed uses is expected to be low.

Chronic dietary-based RQs using upper-bound Kenaga exposure values at the maximum application rate for all proposed use patterns range from 0.03 – 0.67 (**Table 9-2**), based on a 4.6% reduction in eggshell thickness with a NOAEC of 56 mg ai/kg diet at the LOAEC of 187 mg ai/kg diet. Therefore, dietary-based RQ values fall below the chronic risk LOC of 1.0 for birds for all of the proposed uses.

Based on the available data, the likelihood of direct acute or chronic adverse effects on birds, reptiles and terrestrial-phase amphibians from exposure to tiafenacil as a result of the proposed uses is low.

Table 9-2 Chronic Risk Quotient (RQ) Values for Birds, Reptiles, and Terrestrial-Phase Amphibians from modeled Maximum and Minimum scenarios from Proposed Uses of Tiafenacil (T-REX v. 1.5.2, Upper-Bound Kenaga values)[1].

Chronic Dietary RQ NOAEC = 56 mg a.i./kg-diet			
Food Type	**Maximum application scenario: Corn + Fallow (0.067 lbs ai/A X 3 + 0.022 lbs ai/A app, 14-d minimum retreatment interval; ground)**	**Minimum application scenario: Soybean (0.067 lbs ai/A X 2 app, 14-d minimum retreatment interval; ground)**	**Application with the highest RQs: Cotton (0.067 lbs ai/A X 3 app, 7-d minimum retreatment interval; ground)**
Herbivores/Insectivores			
Short grass	0.50	0.50	0.67
Tall grass	0.23	0.23	0.31
Broadleaf plants	0.28	0.28	0.38
Fruits/pods/seeds	0.03	0.03	0.04
Arthropods	0.20	0.20	0.26
Granivores			
Seeds	N/A	N/A	N/A

[1] The toxicity endpoints listed in the table are those used to calculate the RQs.
Chronic risk to non-listed species level of concern (LOC) = 1.0
NA=Not applicable.

Based on an LD_{50} >2000 mg/kg, tiafenacil is categorized as practically non-toxic to mammals on an acute oral exposure basis. Since the toxicity study tested high enough to cover potential exposure (with no mortality up to the highest dose tested), the likelihood of direct adverse effects on mammals from acute exposure to tiafenacil residues in their diet from the proposed uses is expected to be low.

A two-generation reproduction toxicity study with laboratory rat resulted in no toxicity on survival or growth with a NOAEC and LOAEC values of 150 and >150 mg/kg-diet. Chronic dietary-based RQs (0.01-0.28) using upper-bound Kenaga exposure values at the maximum application rate for all proposed use patterns fall below the chronic risk LOC of 1.0 for mammals of all size classes foraging on all food types **(Table 9-3)**.

Chronic-dose based RQs range from 0.02 to 2.29 for all sized mammals. For mammals feeding on fruits/pods and seeds, dose-based RQ values fall below the chronic risk LOC of 1.0 for all proposed use patterns at their maximum application rates. The chronic risk LOC of 1 is exceeded for small- and medium-sized mammals feeding on short grass for all proposed use patterns at their maximum application rates. For tiafenacil use on cotton only, dose-based RQs exceed the chronic risk LOC for large-sized mammals feeding on short grass; small sized mammals feeding on tall grass; and small- and medium-sized mammals feeding on broadleaf plants. For tiafenacil use on grapes, fallow and non-crop areas, the chronic risk LOC of 1 is exceeded for small-sized mammals feeding on broadleaf plants. These LOC exceedances are based on a study where no effects were observed at the highest level tested; thus, it is uncertain whether effects may occur with exposure as the toxicity study did not test high enough to determine the potential effects at predicted exposure concentrations.

Therefore, based on the most conservative estimates (highest EECs), there are potential risks of concern for mammals, from chronic exposure to tiafenacil residues in their diet from all the proposed use patterns. However, if RQs were based on mean Kenaga values (where exposure is expected to exceed this level about half the time) instead of upper-bound Kenaga values, the chronic dose-based RQs would range from <0.01 to 0.81 and will fall below the chronic risk LOC of 1 for all the proposed uses of tiafenacil. All RQs for all proposed uses fall below the chronic risk LOC of 1 when the foliar dissipation rate is reduced to 4 days or less. Furthermore, the dissipation of the herbicide between the second and third treatment dates (137-day retreatment interval) for the highest annual application rates results in RQ values that are equal to that of the lowest annual application rates. These suggest that the dissipation half-life of the herbicide may be driving the dose-based chronic risk LOC exceedances. However, there is no available data that supports a reduced foliar dissipation rate. Furthermore, the RQs are based on the highest concentration tested (150 mg/kg-diet) because the LOAEC was non-definitive (*i.e.* >150 mg/kg-diet). Therefore, the risk estimation is uncertain.

The T-REX model assumes that mammals will derive all their food from dietary items contaminated with upper-bound tiafenacil residues on the application sites. However, terrestrial vertebrates obtain food from a variety of sources and do not forage exclusively on agricultural fields. Furthermore, since tiafenacil degrades rapidly and it is a fast-acting herbicide mainly used as a pre-plant/pre-emergence burndown, preharvest desiccant or post-emergence burndown, residues on the treatment field is expected to vary over a short time.

Table 9-3 Minimum and Maximum Chronic Risk Quotient (RQ) values for Mammals for Proposed Maximum Use Rates of Tiafenacil (T-REX v. 1.5.2, Upper-Bound Kenaga)[1].

Food Type	Chronic Dose-Based RQ NOAEL = 4.26 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 50 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Maximum application scenario: Corn + Fallow (0.067 lbs ai/A X 3 + 0.022 lbs ai/A app, 14-d minimum retreatment interval; ground)				
Herbivores/Insectivores				
Short grass	**1.53**	**1.31**	0.70	0.19
Tall grass	0.70	0.60	0.32	0.09
Broadleaf plants	0.86	0.74	0.39	0.11
Fruits/pods/seeds	0.10	0.08	0.04	0.01
Arthropods	0.60	0.51	0.27	0.07
Granivores				
Seeds	0.02	0.02	0.01	N/A
Minimum application scenario: Soybean (0.067 lbs ai/A X 2 app, 14-d minimum retreatment interval; ground)				
Herbivores/Insectivores				
Short grass	**1.53**	**1.31**	0.70	0.19
Tall grass	0.70	0.60	0.32	0.09
Broadleaf plants	0.86	0.74	0.39	0.11
Fruits/pods/seeds	0.10	0.08	0.04	0.01
Arthropods	0.60	0.51	0.27	0.07
Granivores				
Seeds	0.02	0.02	0.01	N/A
Application scenario with the highest RQs: Cotton (0.067 lbs ai/A X 3 app, 7-d minimum retreatment interval; ground)				
Herbivores/Insectivores				
Short grass	**2.29**	**1.96**	**1.05**	0.28
Tall grass	**1.05**	0.90	0.48	0.13
Broadleaf plants	**1.29**	**1.10**	0.59	0.16
Fruits/pods/seeds	0.14	0.12	0.07	0.02
Arthropods	0.90	0.77	0.41	0.11
Granivores				
Seeds	0.03	0.03	0.01	N/A

Bolded values exceed the chronic risk level of concern (LOC) of 1.0.
[1]The toxicity endpoints listed in the table are those used to calculate the RQ.

10 Terrestrial Invertebrate Risk Assessment

10.1 Bee Exposure Assessment

The bee risk assessment framework assumes honey bees are a surrogate for both *Apis* and non-*Apis* bees (USEPA *et al.*, 2014). The first step in risk assessment is to consider if bees are likely to be exposed while foraging on a treated field either through dietary matrices (*e.g*., pollen/nectar) of bee-attractive plants or interception of spray droplets (contact). Based on the U.S. Department of Agriculture (USDA) list of pollinator-attractive crops, corn, cotton, soybean and grape are considered to be an attractive source of pollen and/or nectar for *Apis* and/or non-*Apis* bees and may represent potential exposure for pollinators on the field (**Table 10-1**) (USDA, 2015). Off-field assessments are conducted for foliar sprays regardless of whether the crop is attractive or not. Therefore, bees (both *Apis* and non-*Apis*) may be exposed on and off the field for all proposed uses of tiafenacil.

Table 10-1 Summary of Information on the Attractiveness of Registered Use Patterns for Tiafenacil to Honey Bees (*Apis mellifera*), social Non-*Apis* Bees (*e.g*., Bumble Bees; *Bombus* spp) and Solitary Non-*Apis* Bees. (Source: USDA 2018).

Crop Name	Honey Bee Attractive?[1]	Bumble Bee Attractive?[1]	Solitary Bee Attractive?[1]	Acreage in the U.S.	Notes
Cotton (*Gossypium* spp.)	Y (nectar)[1]	Yes[1]	+ Yes[1]	7.6 million	Historical use of bees for hybrid seed production; however, hybrid cotton seed production is no longer considered economically viable. Used by some beekeepers for honey production.
Corn (*Zea mays*)	Y (pollen)[1]	Yes[1]	+ Yes[1]	87.7 million	Wind pollinated, but can be visited during pollen shedding
Grapes (*Vitis vinifera)*	Y (pollen)[1]	No	No	962,100	Wind pollinated
Wheat (*Triticum* spp.)	No	No	No	45.1 million	
Soybeans (*Glycine soja)*	Y (pollen and nectar)[1]	Yes[1]	+ Yes[1]	75.9 million	

[1] attractiveness rating is a single "+", denoting a use pattern is opportunistically attractive to bees. Y= yes.

10.2 Bee 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 oral (dietary) routes of exposure from foliar applications. See **Appendix G** for a sample output from BeeREX for tiafenacil. Additional information on bee-related exposure estimates, and the calculation of risk estimates in BeeRex can be found in the *Guidance for Assessing Risk to Bees* (USEPA *et al.*, 2014). These EECs are then divided by acute (LD_{50}) and chronic (NOAEL) toxicity endpoints to derive RQs. Acute RQs are compared to an acute risk LOC of 0.4. For chronic risk, the LOC is 1.0.

In cases where the Tier I RQs exceed the acute and chronic risk LOCs, 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, 2012b).

10.3 Bee Risk Characterization (Tier I)

10.3.1 Tier I Risk Estimation (Contact Exposure)

On-Field Risk

Since potential exposure of bees is identified for tiafenacil uses on corn, cotton, soybean and grapes both on and off the treated field, the next step in the risk assessment process is to conduct a Tier 1 risk assessment. By design, the Tier 1 assessment begins with model-generated (for foliar) estimates of exposure via contact and oral (dietary) routes. For contact exposure, only the adult worker foragers (females) and drones (males) are considered since these bees spend time outside the colony; whereas, the queen and younger bees primarily remain within the hive (except during swarming events) and would be less subject to contact exposure. Furthermore, laboratory-based contact toxicity testing protocols have only been developed for adult bee acute exposures. Effects are defined by laboratory exposures to groups of individual bees (which serve as surrogates for solitary non-*Apis* bees and individual social non-*Apis* bees).

An acute contact honey bee study with tiafenacil TGAI reported non-definitive LD_{50} value of >100.5 µg a.i./bee. Since the adult contact LD_{50} is non-definitive and higher than the highest dose tested, risk to honey bees from contact exposure to tiafenacil is expected to be low. When a conservative LD_{50} value of 100.5 µg a.i./bee is used to calculate RQ values, the highest RQ of <0.01 is below the acute risk LOC of 0.4 **(Table 10-2)**. Therefore, based on the toxicity information, and the conservative exposure estimates derived from the uses of tiafenacil with the highest application rates, there are no risks of concern from acute contact exposure of bees to tiafenacil.

Table 10-2 Default Tier 1 Adult, Acute Contact Risk Quotients (RQs) for Honey Bees (*Apis mellifera*) Based on Proposed Maximum Single Application Rate of Tiafenacil (BeeRex; ver. 1.0).

Use Pattern	Bee Attractiveness	Max. Single Application Rate (lb a.i./A)	Dose (µg a.i./bee per 1 lb a.i./A)	Tiafenacil Contact Dose (µg a.i./bee)	Acute RQ[1]
All uses	Yes	0.067	2.7	0.18	<0.01

[1]Based on a 48-h acute contact LD_{50} of 100.5 µg a.i./bee for tiafenacil. Actual 48-h acute contact LD_{50} is >100.5 µg a.i./bee (MRID 50486873).

10.3.2 Tier I Risk Estimation (Oral Exposure)

On-Field Risk

For oral exposure, the Tier 1 assessment first considers the caste of bees with the greatest oral exposure (*i.e.*, nectar foraging adults). If risks of concern are identified, then other factors are considered for refining the Tier 1 risk estimates. These factors include other castes of bees and available information on measured residues in pollen and nectar which are deemed applicable to the crops of interest. These exposure data may have been collected on surrogate crops (*e.g.*, phacelia, buckwheat, alfalfa) which are known to be attractive sources of both pollen and nectar for bees.

On the basis of acute oral exposure for adult nectar foragers and larval worker honey bees, acute RQs range from 0.02 to 0.20 (**Table 10-3**), based on the maximum proposed single application rates for all of the tiafenacil uses evaluated, and are below the acute risk LOC of 0.4. With respect to chronic exposure for larval and adult honey bees, RQs range from <0.01 to 0.17 (**Table 10-3**), based on the maximum single application rates for all proposed tiafenacil uses evaluated, and are below the chronic risk LOC of 1.0.

Based on the available data, the likelihood of direct acute or chronic adverse effects on bees of all life stages and castes from exposure to tiafenacil as a result of the proposed uses is low.

Table 10-3 Tier 1 (Default) Oral Risk Quotients (RQs) for Adult Nectar Forager and Larval Worker Honey Bees (*Apis mellifera*) (BeeRex (ver. 1.0).

Use Pattern	Max. Single Appl. Rate (lb a.i./A)	Bee Caste/Task	Unit Dose (µg a.i./bee per 1 lb a.i./A)	Oral Dose (µg a.i./bee)	Acute Oral RQ[1]	Chronic Oral RQ
All uses	0.067	Adult nectar forager	32	2.15	0.02	0.10
		Larval worker	13.6	0.91	0.20	0.16

[1] Based on a 48-h acute oral LD_{50} of >100.5 µg a.i./bee for adults (MRID 50486873), 10-d LD_{50} of >84 µg a.i./bee for adult (MRID 50486875); a 72-h acute oral LD_{50} of >4.6 µg ai/larva (MRID 50486876), and 4-d EC_{50} of >5.63 µg ai/larva/day (MRID 50486878).

11 Terrestrial Plant Risk Assessment

Terrestrial plants are sensitive to tiafenacil with effects detected at application rates orders of magnitude below the proposed rates and at which there were pronounced adverse effects on plant survival and growth (height and dry weight). Based on the most sensitive monocots and dicots, RQs exceed the LOC of 1 for risk to terrestrial plants. Therefore, it is considered likely that terrestrial plants will be adversely affected from the proposed uses of tiafenacil, which would be expected of a broad-spectrum herbicide.

11.1 Terrestrial Plant Exposure Assessment

The EECs for terrestrial plants are calculated using TERRPLANT v.1.2.2. Exposure is estimated for a single application considering spray drift and runoff. The RQ values for plants in dryland and semi-aquatic areas are based upon the summation of the exposure from spray drift and runoff combined as well as exposure from spray drift alone. It is important to note that for spray drift, the TERRPLANT exposure estimate corresponds to an equivalent AgDrift™-estimated deposition for fine-medium droplets at approximately 200 feet from the edge of the treated field. For runoff, there are a few assumptions regarding the ratio of treated area to receiving non-target area that have an impact on the exposure estimation. In a dry area adjacent to the treatment site, exposure is estimated as sheet runoff. Sheet runoff is the amount of pesticide in water that runs off of the soil surface of a target area of land that is equal in size to the non-target area (1:1 ratio of areas). This differs for semi-aquatic areas, where runoff exposure is estimated as channel runoff. Channel runoff is the amount of pesticide that runs off of a target area 10 times the size of the non-target area (10:1 ratio of areas).

Exposures from runoff and spray drift are compared to measures of survival and growth (*e.g.*, effects to seedling emergence and vegetative vigor) to develop RQ values. Resulting upper-bound EECs for terrestrial and semi-aquatic (wetland) plants adjacent to the treated field are in **Table 11-1.** These EECs are based on the maximum proposed single application rate for terrestrial uses, tiafenacil solubility (110 mg/L), and spray drift fraction based on ground (1%) applications. The EECs represent residues from off-site exposure via spray drift and/or run-off to non-target plants found near application sites.

Table 11-1 TerrPlant Calculated Estimated Environmental Concentrations (EECs) for Terrestrial and Semi-Aquatic Plants near Proposed Terrestrial Use Areas when Tiafenacil is Applied at the Maximum Application Rate.

Use Site	Single Max. Application Rate (lb a.i./A)	EECs (lb a.i./A)[1]		
		Ground[2]		
		Dry Areas (Total)	Semi-Aquatic Areas (Total)	Spray Drift
All uses	0.067	0.00402	0.03417	0.00067

[1] Based on a runoff fraction of 5%. [2] Based on a drift fraction of 1% [3] Based on a drift fraction of 5%.
NA= not applicable.

11.2 Terrestrial Plant Risk Characterization

Based on the toxicity and the EECs calculated using TerrPlant v.1.2.2, RQ values for monocots and dicots in semi-aquatic areas exposed to tiafenacil through runoff and/or spray drift exceed the LOC of 1 for risk to non-listed plants for all of the evaluated uses of tiafenacil (**Table 11-2**). Therefore, there are risks of concern for the growth and survival of non-target terrestrial plants from the proposed uses of tiafenacil.

It is useful to know how far from the edge of the field tiafenacil spray drift exposure could result in risk to other terrestrial plants (*i.e.*, "distance of effect"). Similar to what was done for aquatic organisms, AgDrift™ version 2.1.1 {Spray Drift Task Force Spray Software, #492} was used to determine potential risk to terrestrial plants from spray drift exposure to tiafenacil off the site of application. The terrestrial spray drift distance was determined using Tier I ground and terrestrial point deposition estimates. In the AgDrift™ model there are only options for very fine to fine or fine to medium/coarse droplet size for ground applications. The fine to medium/coarse droplet size option was used as the most similar modeling option to the label specifications. This could lead to overestimation of the spray drift distance. Assuming a low boom height, the American Society of Agricultural Engineers (ASAE) Fine to Medium to Coarse droplet size distribution and a 90th data percentile, distance from edge of field where spray drift could result in RQs greater than LOCs for terrestrial plants is 500 ft Changing the boom height from low to high boom changes the drift distance to 700 ft for all the proposed uses of tiafenacil. Potential direct adverse effects to non-target plants could lead to risks of indirect risks for animals that depend upon the affected plants for food and shelter.

Table 11-2 Terrestrial Plant Risk Quotients (RQs) Applications of Tiafenacil.

Type of Plant	Ground spray RQs		
	Dry Areas	Semi-Aquatic Areas	Spray Drift Only
All proposed uses			
Monocotyledon[1]	0.20	**1.66**	**8.17**
Dicotyledon[2]	0.56	**4.75**	**3.40**

Bolded values exceed the risk level of concern (LOC) of 1.0.

[1]Based on a seedling emergence test with NOAEC and IC_{25} values of 0.016 and 0.0206 lbs ai/A, respectively; and a vegetative vigor test with NOAEC and IC_{25} values of 0.000075 and 0.0000815 lb ai/A, respectively.

[2]Based on a seedling emergence test with NOAEC and IC_{25} values 0.00301 and 0.00722 lbs ai/A, respectively; and a vegetative vigor test with NOAEC and IC_{25} values of <0.000075 and 0.000197 lb ai/A, respectively.

NA= not applicable.

12 Conclusions

Although tiafenacil degrades rapidly and is classified as slightly mobile, its degradates of concern are more persistent than the parent and highly to moderately mobile in soil, and can move off the site of application and into surface water through run-off and spray drift. **Table 12-1** summarizes environmental fate characteristics of potential concern.

Table 12-1 Potential Environmental Fate Concerns Identified for Tiafenacil

Bioconcentration/ Bioaccumulation[1]	Groundwater Contamination	Sediment	Persistence[2]	Residues of Concern	Volatilization
No, log K_{ow}<3	Yes, mainly for degradates	No[3]	Non-Persistent	Parent, Degradates M-01, M-12, and M-13	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.

[3] Based on rapid transformation to more mobile degradates.

Given the proposed uses of tiafenacil and its environmental fate properties, there is a likelihood of exposure of tiafenacil and ROC (*i.e*., parent plus the degradates M-01, M-12, and M-13) for non-target terrestrial and aquatic organisms. When used in accordance with the proposed label, such exposure may result in adverse effects upon the survival and growth of non-target plants, mammals and fish.

Consistent with the fact that tiafenacil intended for use as an herbicide, there is a potential for direct adverse effects on non-target terrestrial plant growth and survival from exposure to tiafenacil as a result of the proposed uses. Potential direct effects on non-target plants from exposure as a result of runoff and/or spraydrift (spray drift distance = 500 feet, based on fine to medium/coarse droplet size) could lead to indirect risks to animals that depend upon affected plants for food and shelter.

Since tiafenacil is classified as an LDPH, a molar equivalency adjustment (USEPA, 2016) chronic NOAEC was applied to both the parent only and ROC to ensure that the assessment is protective for potential increased sensitivity of fish in shallow, clear waters where there may be increased light penetration in the water. While the chronic risk LOC of 1 is not exceeded for tiafenacil parent even with this adjustment, there are exceedances of the LOC for the LDPH-adjusted NOAEC (RQ= 0.20-3.88) when exposure is based on ROC. The extent to which the tiafenacil and degradates demonstrate LDPH-activity is unknown, but in the absence of light-enhanced toxicity data, EFED assumes that there is a potential for direct chronic adverse effects to fish and aquatic-phase amphibians inhabiting shallow, clear water in which light of sufficient frequency and duration may penetrate.

Chronic exposure to tiafenacil as a result of the proposed maximum use rates result in EECs that exceed the highest level tested where no effects occurred for mammals foraging on short grass, tall grass and broadleaf plants. The toxicity test did not test high enough to determine whether effects would have occurred at the expected exposures concentrations. It should be noted these risk estimates are based on a non-definitive LOAEC (the NOAEC was the highest concentration tested). Therefore, risk estimation is uncertain.

Since tiafenacil is a fast-acting herbicide that degrades relatively rapidly in soil and is mainly used as a pre-plant/pre-emergence burndown, preharvest desiccant or post-emergence burndown, residues on the treatment field is expected to vary over time. A more in-depth summary of the risk conclusions is available in the Executive Summary Section 1.

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830.7550 Partition coefficient (n-octanol/water), shake flask method

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50486853 Hermes, H.; Emnet, P. (2017) DCC-3825 TGAI: Acute Toxicity to Pimephales promelas (fathead minnow) in a 96-hour Semi Static Test. Project Number: 106911230. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 49p.

50486854 Bouwman, L. (2010) 96-HOUR ACUTE TOXICITY STUDY IN CARP WITH DCC-3825 (STATIC). Project Number: 494445. Unpublished study prepared by Notox B.V. 30p.

50486855 Kim, J. (2017) DCC-3825 70 WG (DCC-3825 70% WG): Acute Toxicity Test in Common carp (Cyprinus carpio). Project Number: G316057. Unpublished study prepared by Korea Institute of Toxicology. 55p.

50486856 Brougher, D.; Keller, K.; Gallagher, S.; et al. (2017) DCC-3825 30%SC: A 96-HOUR STATIC-RENEWAL ACUTE TOXICITY TEST WITH THE COMMON CARP (CYPRINUS CARPIO). Project Number: 548A/112A. Unpublished study prepared by Wildlife International Ltd. 52p.

50486863 Brougher, D.; VanEvera, S.; Gallagher, S.; et al. (2015) DCC-3825: A 96-HOUR STATIC-RENEWAL ACUTE TOXICITY TEST WITH THE SHEEPSHEAD MINNOW (Cyprinodon variegatus). Project Number: 548A/102. Unpublished study prepared by Wildlife International Ltd. 49p.

850.1300 Daphnid chronic toxicity test

50486864 Jenkins, C. (2016) DCC-3825: Daphnia magna Reproduction Toxicity Test. Project Number: TBF0013. Unpublished study prepared by ENVIGO CRS. 53p.

850.1350 Mysid chronic toxicity test

50486865 Milligan, A.; Keller, K.; Gallagher, S. (2017) DCC-3825: A FLOW-THROUGH LIFE-CYCLE TOXICITY TEST WITH THE SALTWATER MYSID (Americamysis bahia). Project Number: 548A/104. Unpublished study prepared by Wildlife International Ltd. 116p.

850.1400 Fish early-life stage toxicity test

50486866 Milligan, A.; Keller, K.; Gallagher, S.; et al. (2017) DCC-3825 TGAI: AN EARLY LIFE-STAGE TOXICITY TEST WITH THE FATHEAD MINNOW (Pimephales promelas). Project Number: 548A/110B. Unpublished study prepared by Wildlife International Ltd. 92p.

50486867 Minderhout, T.; Keller, K.; Gallagher, S. (2017) DCC-3825 TGAI: AN EARLY LIFE-STAGE TOXICITY TEST WITH THE SHEEPSHEAD MINNOW (Cyprinodon variegatus). Project Number: 548A/105A. Unpublished study prepared by Wildlife International Ltd. 103p.

850.1730 Fish BCF

50486869	Gelin, M. (2018) Waiver Request for a Fish Bioaccumulation Study with Tiafenacil. Project Number: IB/2018/MG/002/01. Unpublished study prepared by ISK BIOSCIENCES CORPORATION. 4p.

850.2100 Avian acute oral toxicity test

50486845	Hubbard, P. (2016) DCC-3825: AN ACUTE ORAL TOXICITY STUDY WITH THE ZEBRA FINCH. Project Number: 548/111. Unpublished study prepared by EAG Laboratories. 38p.
50486846	Hubbard, P.; Beavers, J.; Temple, D. (2017) DCC-3825: AN ACUTE ORAL TOXICITY STUDY WITH THE NORTHERN BOBWHITE. Project Number: 548/103. Unpublished study prepared by Wildlife International Ltd. 36p.
50486847	Hubbard, P.; Beavers, J.; Temple, D. (2017) DCC-3825: AN ACUTE ORAL TOXICITY STUDY WITH THE MALLARD. Project Number: 548/104. Unpublished study prepared by Wildlife International Ltd. 36p.

850.2200 Avian dietary toxicity test

50486848	Hubbard, P.; Martin, K.; Beavers, J.; et al. (2017) DCC-3825: A DIETARY LC50 STUDY WITH THE NORTHERN BOBWHITE. Project Number: 548/105. Unpublished study prepared by Wildlife International Ltd. 67p.
50486849	Hubbard, P.; Martin, K.; Beavers, J.; et al. (2017) DCC-3825: A DIETARY LC50 STUDY WITH THE MALLARD. Project Number: 548/106. Unpublished study prepared by Wildlife International Ltd. 67p.

850.2300 Avian reproduction test

50486850	Dias, N. (2017) DCC-3825: ASSESSMENT TO DETERMINE THE EFFECTS ON REPRODUCTION IN THE BOBWHITE QUAIL. Project Number: TBF0014. Unpublished study prepared by ENVIGO CRS. 287p.

50486851 Elliot, S.; Martin, K.; Frey, L.; et al. (2016) DCC-3825: A REPRODUCTION STUDY WITH THE MALLARD. Project Number: 548/113. Unpublished study prepared by Wildlife International Ltd. 245p.

50486895 Taylor, K. (2016) DCC-3825: To Determine the Effects on Reproduction and Growth of the Earthworm Eisenia fetoda. Project Number: TBF0012. Unpublished study prepared by ENVIGO CRS. 33p.

850.3020 Honey bee acute contact toxicity

50486873 Sekine, T. (2010) Effects of DCC-3825 (Acute Contact and Oral) on Honey Bees (Apis mellifera L.) in the Laboratory. Project Number: 56211035. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 38p.

850.4100 Terrestrial plant toxicity, Tier 1 (seeding emergence)

50486879 Gray, J. (2017) DCC-3825 70 WG: Seedling Emergence and Seedling Growth Test. Project Number: RJ53DP. Unpublished study prepared by ENVIGO CRS. 246p.

850.4150 Terrestrial plant toxicity, Tier 1 (vegetative vigor)

50486880 Gray, J. (2017) DCC-3825 70 WG: Vegetative Vigor. Project Number: YL13NH. Unpublished study prepared by ENVIGO CRS. 254p.

850.4400 Aquatic plant toxicity test using Lemna spp. Tiers I and II

50486881 Dobbins, L.; Chafey, K.; Porch, J.; et al. (2015) DCC-3825: A 7-DAY STATIC-RENEWAL TOXICITY TEST WITH DUCKWEED (Lemna gibba G3). Project Number: 548P/102. Unpublished study prepared by Wildlife International Ltd. 60p.

50486882 Arnie, J.; Dobbins, L.; Keller, K.; et al. (2017) DCC-3825 70%WG: A 7-DAY STATIC-RENEWAL TOXICITY TEST WITH DUCKWEED (Lemna gibba G3). Project Number: 548P/107. Unpublished study prepared by Wildlife International Ltd. 64p.

50486883 Arnie, J.; Keller, K.; Porch, J.; et al. (2017) DCC-3825 30%SC: A 7-DAY STATIC-RENEWAL TOXICITY TEST WITH DUCKWEED (Lemna gibba G3). Project Number: 548P/113. Unpublished study prepared by Wildlife International Ltd. 59p.

50486884 Arnie, J.; Siddiqui, A.; Porch, J.; et al. (2017) M-36: A 7-DAY STATIC-RENEWAL TOXICITY TEST WITH DUCKWEED (Lemna gibba G3). Project Number: 548P/109. Unpublished study prepared by Wildlife International Ltd. 58p.

50486885 Arnie, J.; Siddiqui, A.; Porch, J.; et al. (2017) M-53: A 7-DAY STATIC-RENEWAL TOXICITY TEST WITH DUCKWEED (Lemna gibba G3). Project Number: 548P/111. Unpublished study prepared by Wildlife International Ltd. 59p.

850.4500 Algal Toxicity

50486886 Arnie, J.; Dobbins, L.; Keller, K.; et al. (2016) DCC-3825: A 96-HOUR TOXICITY TEST WITH THE FRESHWATER ALGA (Pseudokirchneriella subcapitata). Project Number: 548P/103B. Unpublished study prepared by Wildlife International Ltd. 60p.

50486887 Arnie, J.; Dobbins, L.; Keller, K.; et al. (2017) DCC-3825 70%WG: A 96-HOUR TOXICITY TEST WITH THE FRESHWATER ALGA (Pseudokirchneriella subcapitata). Project Number: 548P/105. Unpublished study prepared by Wildlife International Ltd. 65p.

50486888 Arnie, J.; Keller, K.; Porch, J. (2017) DCC-3825 30%SC: A 96-HOUR TOXICITY TEST WITH THE FRESHWATER ALGA (Pseudokirchneriella subcapitata). Project Number: 548P/112. Unpublished study prepared by Wildlife International Ltd. 61p.

50486889 Arnie, J.; Siddiqui, A.; Porch, J.; et al. (2017) M-36: A 96-HOUR TOXICITY TEST WITH THE FRESHWATER ALGA (Pseudokirchneriella subcapitata). Project Number: 548P/108. Unpublished study prepared by Wildlife International Ltd. 56p.

50486890 Arnie, J.; Siddiqui, A.; Porch, J.; et al. (2017) M-53: A 96-HOUR TOXICITY TEST WITH THE FRESHWATER ALGA (Pseudokirchneriella subcapitata). Project Number: 548P/110. Unpublished study prepared by Wildlife International Ltd. 57p.

50486891 Hefner, N. (2015) DCC-3825: Toxicity to Navicula pelliculosa in a 96-Hour Algal Growth Inhibition Test. Project Number: D95495. Unpublished study prepared by Harlan Laboratories Ltd. 58p.

50486892 Dobbins, L.; Chafey, K.; Porch, J.; et al. (2015) DCC-3825: A 96-HOUR TOXICITY TEST WITH THE MARINE DIATOM (Skeletonema costatum). Project Number: 548P/101. Unpublished study prepared by Wildlife International Ltd. 61p.

850.4550 Cyanobacteria (Anabaena flos-aquae) Toxicity

50486893	Hefner, N. (2015) DCC-3825: Toxicity to Anabaena flos-aquae in a 96-Hour Algal Growth Inhibition Test. Project Number: D95506. Unpublished study prepared by Harlan Laboratories Ltd. 55p.

850.6100 Environmental Chemistry Methods and Associated Independent Laboratory Validation

50493805	Lee, J. (2016) Residue Analytical Method of Tiafenacil and Its Metabolites in Soil. Project Number: PC/2018/MDG/004/01. Unpublished study prepared by Farm Hannong Co., Ltd. 23p.
50493806	Schoenau, E. (2018) Independent Laboratory Validation of Dongbu Farm Hannong Co., Ltd.'s Residue Analytical Method for the Determination of Tiafenacil and Metabolites in Soil. Project Number: 150608. Unpublished study prepared by Golden Pacific Laboratories, LLC (GPL). 596p.
50493807	Tasaki, S. (2017) Validation of an Analytical Method for the Determination of DCC-3825 and its Metabolites (M-01, M-12, M-13, M-36, M-53) in Surface Water and Drinking Water. Project Number: MFT03717E. Unpublished study prepared by Ishihara Sangyo Kaisha Ltd. 103p.
50493808	Perez, R. (2018) Independent Laboratory Validation of Method MFT03717E: "Validation of an Analytical Method for the Determination of DCC-3825 and its Metabolites (M-01, M-12, M-13, M-36, M-53) in Surface Water and Drinking Water''. Project Number: 17E1104. Unpublished study prepared by ADPEN Laboratories, Inc. 292p.
50493809	Ogawa, K. (2017) Validation of an Analytical Method for the Ddetermination of DCC-3825 and its Metabolites (M-01, M-12, M-13, M-36, M-53) in Sediment. Project Number: MFT03817E. Unpublished study prepared by Ishihara Sangyo Kaisha Ltd. 102p.
50493810	Perez, R. (2017) Independent Laboratory Validation of Method MFT03817E: "Validation of an analytical method for the determination of DCC-3825 and its metabolites (M-01, M-12, M-13, M-36, M-53) in Sediment". Project Number: 17E1004. Unpublished study prepared by ADPEN Laboratories, Inc. 254p.

860.1380 Storage stability data

50493844 Schoenau, E. (2018) Freezer Storage Stability of Tiafenacil and Five of Its Metabolites (DCC-3825-M-01, DCC-3825-M-12, DCC-3825-M-13, DCC-3825-M-36, and DCC-3825-M-53) in Soil. Project Number: 150609. Unpublished study prepared by Golden Pacific Laboratories, LLC (GPL). 405p.

50493845 Schoenau, E. (2017) Freezer Storage Stability of Eight Tiafenacil Metabolites (DCC-3825-M-20, DCC-3825-M-29, DCC-3825-M-30, DCC-3825-M-35, DCC-3825-M-63, DCC-3825-M-69, DCC-3825-M-72, and DCC-3825-M-73) in Soil. Project Number: 150638. Unpublished study prepared by Golden Pacific Laboratories, LLC (GPL). 516p.

50493862 Schoenau, E. (2018) Freezer Storage Stability of Tiafenacil and Metabolites in Grape, Raisin, Grape Juice, Soybean Seed, Wheat Forage, Wheat Straw and Wheat Grain. Project Number: 150612. Unpublished study prepared by Golden Pacific Laboratories, LLC (GPL). 1330p.

870.3100 90-Day oral toxicity in rodents

50486817 Robertson, B. (2016) A 90 Day Toxicity Study of DCC-3825 by Oral (Dietary) Administration in Rats. Project Number: 523268. Unpublished study prepared by Charles River Laboratories. 298p.

50486818 Robertson, B. (2016) A 90 Day Toxicity Study of DCC-3825 by Oral (Dietary) Administration in Mice. Project Number: 523273. Unpublished study prepared by Charles River Laboratories. 258p.

50486819 Robertson, B. (2016) A 90 Day Toxicity Study of DCC-3825 by Oral (Dietary) Administration in Mice. Project Number: 526520. Unpublished study prepared by Charles River Laboratories. 289p.

870.3150 90-day oral toxicity in nonrodents

50486816 Chesher, C. (2017) DCC-3825: 28-Day Toxicity Study by Oral Capsule Administration to Beagle Dogs. Project Number: TBF0002. Unpublished study prepared by ENVIGO CRS. 116p.

50486820 Grasiewicz, H. (2016) DCC-3825: 90 Day Toxicity Study by Oral Capsule Administration to Beagle Dogs. Project Number: TBF0003. Unpublished study prepared by ENVIGO CRS. 243p.

870.3700 Prenatal developmental toxicity study

50486827 McConnachie, K. (2016) Preliminary Developmental Toxicity Study of DCC-3825 by Oral Gavage Administration in Rats. Project Number: 469109. Unpublished study prepared by Charles River Laboratories. 48p.

50486828 McConnachie, K. (2016) Preliminary Development Toxicity Study of DCC-3825 by Oral (Gavage) Administration in the Rabbit. Project Number: 496114. Unpublished study prepared by Charles River Laboratories. 110p.

50486829 MConnachie, K. (2016) A Developmental Toxicity Study of DCC-3825 by Oral Gavage Administration in Rats. Project Number: 486135. Unpublished study prepared by Charles River Laboratories. 135p.

50486830 McConnachie, K. (2016) A Developmental Toxicity Study of DCC-3825 by Oral Gavage in Rabbits. Project Number: 496140. Unpublished study prepared by Charles River Laboratories. 205p.

870.3800 Reproduction and fertility effects

50486831 Fujii, S. (2016) Tiafenacil TGAI: Rat One-Generation Preliminary Reproduction Study. Project Number: SR13372. Unpublished study prepared by Safety Research Institute for Chemical Compounds Co., Ltd. 243p.

50486832 Hojo, H. (2016) Tiafenacil TGAI: Reproduction Toxicity Study in Rats. Project Number: IET/14/0106. Unpublished study prepared by Institute of Environmental Toxicology. 833p.

870.4100 Chronic toxicity

50486824 Strepka, C. (2017) A 104 Week Carcinogenicity Study with a Combined 52 Week Toxicity Study of DCC-3825 by Dietary Administration in Rats REPORT AMENDMENT 1. Project Number: 525312. Unpublished study prepared by Charles River Laboratories. 3809p.

50486825 Arrowsmith, W. (2016) DCC-3825: 52 Week Toxicity Study by Oral Capsule Administration to Beagle Dogs. Project Number: TBF0024. Unpublished study prepared by ENVIGO CRS. 323p.

870.3050 Repeated dose 28-day oral toxicity in rodents

50486812	Robertson, B. (2016) A 14 Day Dose Range Finding Study of DCC-3825 by Oral (Dietary) Administration in Rats. Project Number: 523226. Unpublished study prepared by Charles River Laboratories. 115p.
50486813	Robertson, B. (2016) A 14 Day Dose Range Finding Study of DCC-3825 by Oral (Dietary) Administration in Mice. Project Number: 523231. Unpublished study prepared by Charles River Laboratories. 93p.
50486814	Robertson, B. (2016) A 28 Day Toxicity Study of DCC-3825 by Oral (Dietary) Administration in Rats. Project Number: 523247. Unpublished study prepared by Charles River Laboratories. 342p.
50486815	Robertson, B. (2016) A 28 Day Toxicity Study of DCC-3825 by Oral (Dietary) Administration in Mice. Project Number: 523252. Unpublished study prepared by Charles River Laboratories. 222p.

850.1735 Whole sediment: acute freshwater invertebrates

50486868	Martin, K.; Keller, K. (2017) ANALYTICAL METHOD VERIFICATION FOR THE DETERMINATION OF DCC-3825 IN SEDIMENT. Project Number: 548C/107. Unpublished study prepared by Wildlife International Ltd. 63p.

850.1740 Whole sediment: acute marine invertebrates

50486868	Martin, K.; Keller, K. (2017) ANALYTICAL METHOD VERIFICATION FOR THE DETERMINATION OF DCC-3825 IN SEDIMENT. Project Number: 548C/107. Unpublished study prepared by Wildlife International Ltd. 63p.

850.1790 Chironomid Sediment Toxicity Test

50486868 Martin, K.; Keller, K. (2017) ANALYTICAL METHOD VERIFICATION FOR THE DETERMINATION OF DCC-3825 IN SEDIMENT. Project Number: 548C/107. Unpublished study prepared by Wildlife International Ltd. 63p.

850.1735 Whole sediment: acute freshwater invertebrates

50486870 Thomas, S.; Keller, K.; Gallagher, S. (2017) DCC-3825: A 10-DAY ACUTE TOXICITY TEST WITH THE FRESHWATER AMPHIPOD (Hyalella azteca) USING SPIKED WHOLE SEDIMENT. Project Number: 548A/108. Unpublished study prepared by Wildlife International Ltd. 80p.

850.1740 Whole sediment: acute marine invertebrates

50486871 Thomas, S.; Keller, K.; Gallagher, S. (2017) DCC-3825: A 10-DAY TOXICITY TEST WITH THE SALTWATER AMPHIPOD (Leptocheirus plumulosus) USING SPIKED WHOLE SEDIMENT. Project Number: 548A/109. Unpublished study prepared by Wildlife International Ltd. 78p.

850.1735 Whole sediment: acute freshwater invertebrates

50486872 Thomas, S.; Keller, K.; Gallagher, S. (2017) DCC-3825: A 10-DAY ACUTE TOXICITY TEST WITH THE MIDGE (Chironomus dilutus) USING SPIKED WHOLE SEDIMENT. Project Number: 548A/107. Unpublished study prepared by Wildlife International Ltd. 80p.

850.7100 Data reporting for environmental chemistry methods

50486897 Straube, D. (2016) DCC-3825 TGAI: Effects on Reproduction of the Collembola Folsomia candida in Artificial Soil with 5% Peat. Project Number: 106911016. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 30p.

50486898 Taylor, K. (2017) DCC-3825 5% ME Acute Toxicity to Typhlodromus pyri in the Laboratory. Project Number: TBF0018. Unpublished study prepared by ENVIGO CRS. 40p.

50486899 Taylor, K. (2017) DCC-3825 5% ME Acute Toxicity to Aphidius rhopalosiphi in the Laboratory. Project Number: TBF0028. Unpublished study prepared by ENVIGO CRS. 38p.

Non-Guideline Study

50486875 Haupt, S.; Knebel, N. (2017) DCC-3825 TGAI: Chronic Oral Toxicity Test on the Honey Bee (Apis mellifera L.) in the Laboratory. Project Number: 106911136. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 59p.

50486876 Haupt, S.; Eichler, M. (2017) DCC-3825 TGAI: Honey Bee (Apis mellifera L.) Larval Toxicity Test, Single Exposure. Project Number: 106913032. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 56p.

50486877 Lockard, L.; Martin, K. (2017) ANALYTICAL METHOD VERIFICATION FOR THE DETERMINATION OF DCC-3825 IN LARVAL DIET. Project Number: 548H/101. Unpublished study prepared by Wildlife International Ltd. 38p.

50486878 Tome, H.; Porch, J.; Lockard, L. (2017) DCC-3825: A CHRONIC LARVAL TOXICITY STUDY WITH THE HONEY BEE (Apis mellifera). Project Number: 548H/102. Unpublished study prepared by Wildlife International Ltd. 62p.

50486894 Gray, J. (2017) DCC-3825: Acute Toxicity (LC50) to the Earthworm. Project Number: TBF0029. Unpublished study prepared by ENVIGO CRS. 23p.

50493801 Gobmann, A. (2016) DCC-3825 5% ME: Effects on the Predatory Mite Typhlodromus pyri, Extended Laboratory Study - Dose Response Test. Project Number: 106891062. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 49p.

50493802 Gobmann, A. (2016) DCC-3825 5% ME: Effects on the Parasitoid Aphidius rhopalosiphi, Extended Laboratory Study - Dose Response Test. Project Number: 106891002. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 53p.

50493803 Schmitzer, S. (2017) DCC-3825 5% ME: Effects on the Reproduction of Rove Beetles Aleochara bilineata - Extended Laboratory Study - Dose Response Test. Project Number: 106891071. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 38p.

50493804 Gobmann, A. (2017) DCC-3825 5% ME: Effects on the Ladybird Beetle Coccinella septempunctata, Extended Laboratory Study - Dose Response Test. Project Number: 106891012. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 43p.

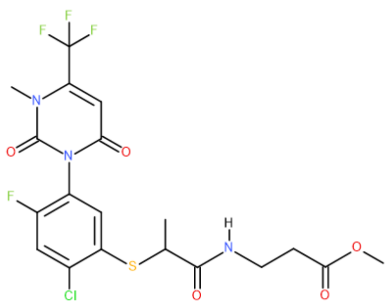
50493823 Clipston, A.; Dixon, S.; Bailey, J. (2016) DCC-3825: Estimation of Adsorption Coefficient (Koc) on Soil and Sewage Sludge using HPLC. Project Number: 224465, 36543. Unpublished study prepared by Elphinstone Research Centre. 34p.

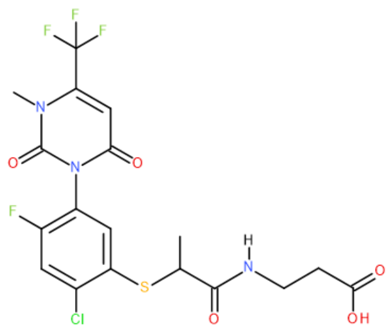
50493878 Matthews, K. (2015) Validation of Methodologies for the Formulation and Analysis of DCC-3825 in Oral (Gavage) Dosing Formulations. Project Number: 429556, 33808. Unpublished study prepared by Elphinstone Research Centre. 60p.

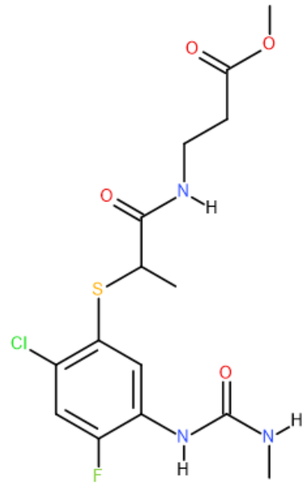
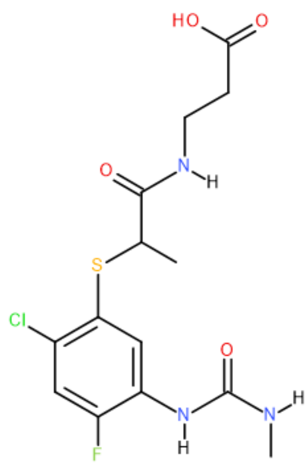
50493879 Rogers, E. (2015) Validation of Methodologies for the Formulation and Analysis of DCC-3825 in Ratand Mouse No. 1 Dietary Formulations. Project Number: 429142. Unpublished study prepared by Elphinstone Research Centre. 86p.

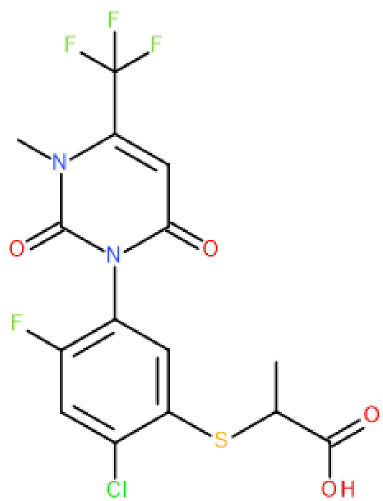
Appendix A. ROCKS table

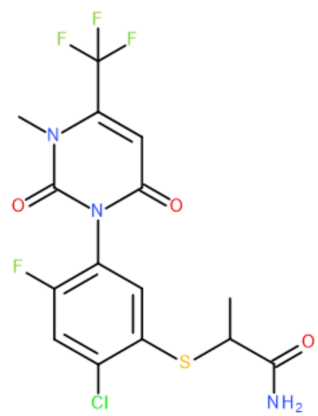
Table A1. Chemical Names and Structures of Tiafenacil and its Transformation Products

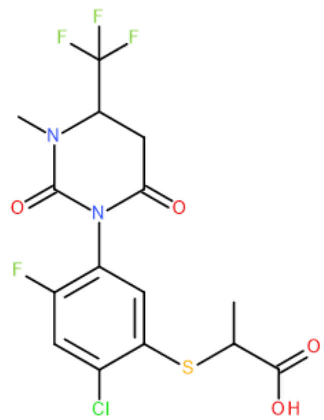
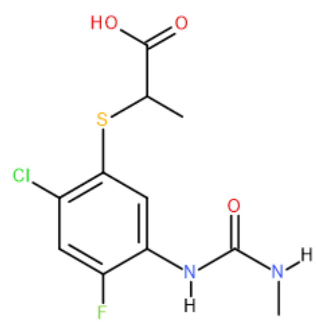
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
PARENT						
Tiafenacil (DCC-3825) **IUPAC: Methyl 3-[(2RS)-2-{2-chloro-4-fluoro-5-[1,2,3,6-tetrahydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)pyrimidin-1(6H)-yl]phenylthio}propionamido]propionate** **CAS: Methyl N-[2-[[2-chloro-5-[3,6-dihydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)-1(2H)-pyrimidinyl]-4-fluorophenyl]thio]-1-oxopropyl]-β-alaninate** **CAS No.: 1220411-29-9** **Formula: $C_{19}H_{18}ClF_4N_3O_5S$** **MW: 511.87 g/mol** **SMILES:** **O=C(C=C(C(F)(F)F)N1C)N(C2=C(F)C=C(Cl)C(SC(C)C(N([H])CCC(OC)=O)=O)=C2)C1=O**		Hydrolysis	50493812	pH 7, 35 ℃		35.4 (30)
				pH 7, 40 ℃		20.1 (30)
				pH 7, 45 ℃		37.1 (10)
				pH 9, 15 ℃		32.9 (14)
				pH 9, 20 ℃		17.1 (6)
				pH 9, 25 ℃		7.6 (5)
		Aqueous Photolysis	50493813	pH 5		23.5 (15)
		Soil Photolysis	50493814	SL, pH 6.8		94.77 (30)
		Aerobic Soil	50493815	SL/SCL 6.2-6.4		ND (180)
				CL pH 6.8-7.2		ND (180)
				C, pH 8.0-8.1		ND (180)
				LS, pH 6.7-7.1		ND (180)
		Anaerobic Soil	50493819	SCL, pH 6.1		ND (180)
				CL, pH 6.9		ND (180)
				C, pH 7.9		ND (180)
				SL, pH 7.1		ND (180)
		Aerobic Aquatic	50493820	SL, pH 5.1		ND (100)
				S, pH 7.4		ND (100)
		Anaerobic Aquatic	50493821	SL, pH 7.5		ND (100)
				S, pH 6.6		ND (100)
		Field Dissipation[1]	50493840	California		ND (176)
			50493841	Washington		ND (60)
			50493842	North Dakota		ND (366)
			50493843	North Carolina		ND (90)
MAJOR (>10%) TRANSFORMATION PRODUCTS						
		Hydrolysis	50493812	pH 7, 35 ℃	**21.2 (30)**	**21.2 (30)**

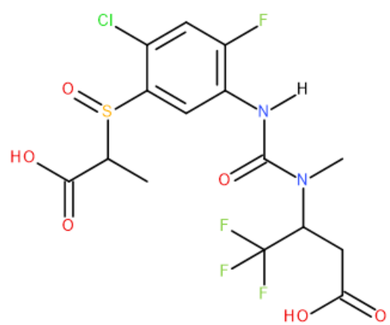
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
DCC-3825-M-01 (M-01) **IUPAC: 3-(2-((2-Chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)-3,6-dihydropyrimidin-1(2H)-yl)phenyl)thio)propanamido)propanoic acid** **Formula: $C_{18}H_{16}ClF_4N_3O_5S$** **MW: 497.85 g/mol** **SMILES:** **O=C(C=C(C(F)(F)F)N1C)N(C2=C(F)C=C(Cl)C(SC(C)C(N([H])CCC(O)=O)=O)=C2)C1=O**				pH 7, 40 °C	**16.6 (20)**	**16.4 (30)**
				pH 7, 45 °C	**17.1 (10)**	**17.1 (10)**
				pH 9, 15 °C	**20.8 (10)**	**20.7 (14)**
				pH 9, 20 °C	**21.2 (6)**	**21.2 (6)**
				pH 9, 25 °C	**29.2 (3)**	**19.0 (5)**
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	**63.4 (0.25)**	ND (180)
				CL pH 6.8-7.2	**45.4 (0.25)**	ND (180)
				C, pH 8.0-8.1	**67.3 (0.25)**	ND (180)
				LS, pH 6.7-7.1	**53.9 (0.5)**	ND (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	**99.2 (7)***	**17.8 (180)***
				CL, pH 6.9	**66.1 (2)***	**12.6 (180)***
				C, pH 7.9	**73.1 (2)***	**18.0 (180)***
				SL, pH 7.1	**66.3 (7)***	**18.9 (180)***
		Aerobic Aquatic	50493820	SL, pH 7.9	**43.2 (10)**	1.8 (100)
				S, pH 6.7	**62.1 (28)**	1.9 (100)
		Anaerobic Aquatic	50493821	SL, pH 7.5	**28.7 (28)**	4.7 (100)
				S, pH 6.6	**36.4 (28)**	7.3 (100)
		Field Dissipation[1]	50493840	California	**36.9 (1)**	ND (176)
			50493841	Washington	**48.4 (0.3)**	ND (60)
			50493842	North Dakota	**43.5 (2)**	ND (366)
			50493843	North Carolina	**48.6 (0.04)**	ND (90)
DCC-3825-M-06 (M-06) **IUPAC: Methyl 3-(2-((2-chloro-4-fluoro-5-(3-methylureido)phenyl)thio)propanamido)propanoate** **Formula: $C_{15}H_{19}ClFN_3O_4S$** **MW: 391.84 g/mol** **SMILES:** **[H]N(C)C(N(C1=CC(SC(C)C(N([H])CCC(OC)=O)=O)=C(Cl)C=C1F)[H])=O**		Hydrolysis	50493812	pH 7, 35 °C	**36.6 (30)**	**36.6 (30)**
				pH 7, 40 °C	**30.9 (30)**	**30.9 (30)**
				pH 7, 45 °C	**33.6 (7)**	**31.4 (10)**
				pH 9, 15 °C	**24.4 (10)**	**23.3 (14)**
				pH 9, 20 °C	**26.3 (6)**	**26.3 (6)**
				pH 9, 25 °C	**26.6 (2)**	**23.3 (5)**
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND

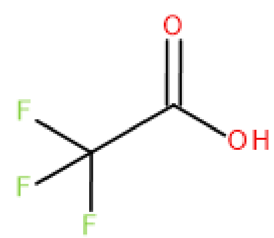
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	2.9 (30)	ND (180)
				C, pH 7.9	2.1 (60)	ND (180)
				SL, pH 7.1	5.3 (7)	ND (180)
		Aerobic Aquatic	50493820	SL, pH 5.1	**10.2 (77)**	ND (100)
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	**25.5 (7)**	ND (100)
				S, pH 6.6	**25.6 (7)**	ND (100)
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
DCC-3825-M-07 (M-07) **IUPAC: 3-(2-((2-Chloro-4-fluoro-5-(3-methylureido)phenyl)thio)propanamido)propanoic acid** **Formula: $C_{14}H_{17}ClFN_3O_4S$** **MW: 377.82 g/mol** **SMILES: [H]N(C)C(N(C1=CC(SC(C)C(N([H])CCC(O)=O)=O)=C(Cl)C=C1F)[H])=O**		Hydrolysis	50493812	pH 7, 35 ℃	8.9 (30)	8.9 (30)
				pH 7, 40 ℃	**19.4 (30)**	**19.4 (30)**
				pH 7, 45 ℃	**11.9 (7)**	9.2 (10)
				pH 9, 15 ℃	**28.1 (14)**	**28.1 (14)**
				pH 9, 20 ℃	**21.6 (6)**	**21.6 (6)**
				pH 9, 25 ℃	**32.3 (5)**	**32.3 (5)**
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	**40.9 (180)**	**40.9 (180)**
				CL, pH 6.9	**37.8 (120)**	**24.5 (180)**
				C, pH 7.9	**48.4 (90)**	**22.2 (180)**

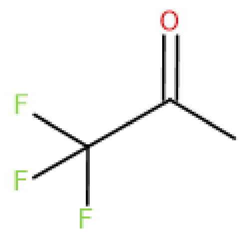
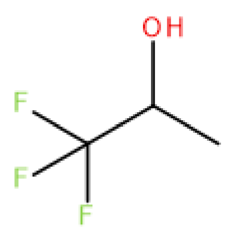
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
				SL, pH 7.1	**48.8 (60)**	**10.4 (180)**
		Aerobic Aquatic	50493820	SL, pH 5.1	**14.3 (14)**	1.6 (100)
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	**52.3 (28)**	**36.7 (100)**
				S, pH 6.6	**58.0 (50)**	**52.6 (100)**
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
DCC-3825-M-12 **IUPAC: 2-((2-Chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)-3,6-dihydropyrimidin-1(2H)-yl)phenyl)thio)propanoic acid** **Formula: $C_{15}H_{11}ClF_4N_2O_4S$** **MW: 426.77 g/mol** **SMILES:** **O=C(C=C(C(F)(F)F)N1C)N(C2=C(F)C=C(Cl)C(SC(C)C(O)=O)=C2)C1=O**		Hydrolysis	50493812	pH 7, 35 °C	ND	ND
				pH 7, 40 °C	ND	ND
				pH 7, 45 °C	ND	ND
				pH 9, 15 °C	ND	ND
				pH 9, 20 °C	ND	ND
				pH 9, 25 °C	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	**18.2 (1)**	ND (180)
				CL pH 6.8-7.2	**24.7 (0.5)**	ND (180)
				C, pH 8.0-8.1	**52.2 (3)**	ND (180)
				LS, pH 6.7-7.1	**42.4 (3)**	ND (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	**22.4 (14)**	6.4 (180)
				CL, pH 6.9	**41.1 (7)**	1.6 (180)
				C, pH 7.9	**19.4 (2)**	ND (180)
				SL, pH 7.1	**21.6 (7)**	ND (180)
		Aerobic Aquatic	50493820	SL, pH 5.1	**22.4 (50)**	**21.6 (100)**
				S, pH 7.4	**56.7 (50, 75)**	**45.4 (100)**
		Anaerobic Aquatic	50493821	SL, pH 7.5	5.4 (50)	2.4 (100)
				S, pH 6.6	3.1 (28)	1.2 (100)
		Field Dissipation[1]	50493840	California	2.8 (10)	ND (176)
			50493841	Washington	5.6 (7)	ND (60)

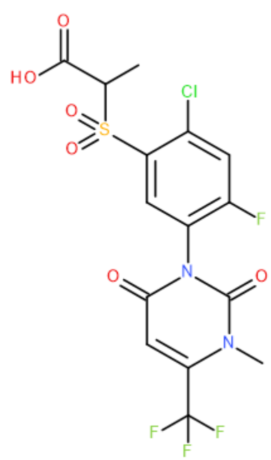
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
			50493842	North Dakota	5.8 (9)	ND (366)
			50493843	North Carolina	ND	ND
DCC-3825-M-13 **IUPAC: 2-((2-Chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)-3,6-dihydropyrimidin-1(2H)-yl)phenyl)thio)propanamide** **Formula: $C_{15}H_{12}ClF_4N_3O_3S$** **MW: 425.78 g/mol** **SMILES:** **O=C(C=C(C(F)(F)F)N1C)N(C2=C(F)C=C(Cl)C(SC(C)C(N)=O)=C2)C1=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	19.7 (0.5)	ND (180)
				CL pH 6.8-7.2	25.3 (0.5)	ND (180)
				C, pH 8.0-8.1	**38.4 (1)**	ND (180)
				LS, pH 6.7-7.1	**35.9 (1)**	ND (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	3.6 (14)	ND (180)
				CL, pH 6.9	3.4 (1,2)	1.7 (180)
				C, pH 7.9	5.3 (1)	ND (180)
				SL, pH 7.1	8.4 (14)	ND (180)
		Aerobic Aquatic	50493820	SL, pH 5.1	**16.8 (10)**	0.6 (100)
				S, pH 7.4	**28.7 (14)**	9.6 (100)
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	5.0 (10)	ND (176)
			50493841	Washington	4.9 (7)	ND (60)
			50493842	North Dakota	4.3 (9)	ND (366)
			50493843	North Carolina	ND	ND
DCC-3825-M-16 **IUPAC: 2-((2-Chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)tetrahydropyrimidin-1(2H)-yl)phenyl)thio)propanoic acid**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND

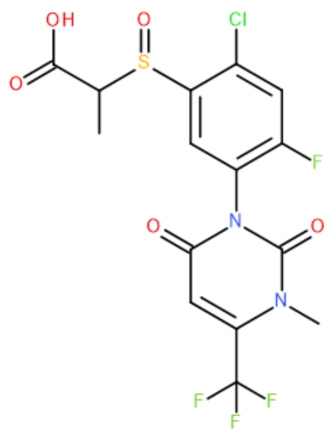
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
Formula: $C_{15}H_{13}ClF_4N_2O_4S$ **MW: 428.78 g/mol** **SMILES:** **O=C(CC(C(F)(F)F)N1C)N(C2=C(F)C=C(Cl)C(SC(C)C(O)=O)=C2)C1=O**				pH 9, 25 °C	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	2.7 (0.5)	ND (180)
				CL pH 6.8-7.2	4.9 (0.5)	ND (180)
				C, pH 8.0-8.1	1.4 (0.5)	ND (180)
				LS, pH 6.7-7.1	1.4 (0.25)	ND (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	**11.9 (60)**	2.4 (180)
				CL, pH 6.9	6.3 (7, 14)	ND (180)
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	1.6 (50)	1.5 (100)
				S, pH 7.4	**14.3 (100)**	**14.3 (100)**
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
DCC-3825-M-20 **IUPAC:** 2-((2-Chloro-4-fluoro-5-(3-methylureido)phenyl)thio)propanoic acid **Formula:** $C_{11}H_{12}ClFN_2O_3S$ **MW:** 306.74 g/mol **SMILES:**		Hydrolysis	50493812	pH 7, 35 °C	ND	ND
				pH 7, 40 °C	ND	ND
				pH 7, 45 °C	ND	ND
				pH 9, 15 °C	ND	ND
				pH 9, 20 °C	ND	ND
				pH 9, 25 °C	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	**21.0 (180)**	**21.0 (180)**
				CL, pH 6.9	**40.4 (180)**	**40.4 (180)**
				C, pH 7.9	**63.7 (180)**	**63.7 (180)**
				SL, pH 7.1	**77.1 (120)**	**64.6 (180)**

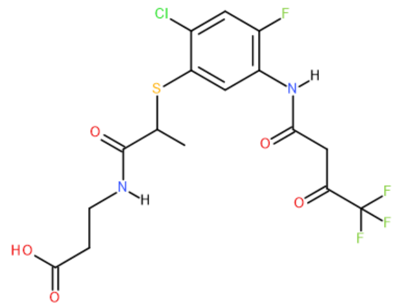
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
		Aerobic Aquatic	50493820	SL, pH 5.1	**47.1 (75)**	**41.9 (100)**
				S, pH 7.4	**11.3 (50)**	5.4 (100)
		Anaerobic Aquatic	50493821	SL, pH 7.5	**32.9 (100)**	**32.9 (100)**
				S, pH 6.6	**24.6 (100)**	**24.6 (100)**
		Field Dissipation[1]	50493840	California	ND	ND
			50493841	Washington	ND	ND
			50493842	North Dakota	ND	ND
			50493843	North Carolina	ND	ND
DCC-3825-M-29 **IUPAC: 3-(3-(5-((1-Carboxyethyl)sulfinyl)-4-chloro-2-fluorophenyl)-1-methylureido)-4,4,4-trifluorobutanoic acid** **Formula: $C_{15}H_{15}ClF_4N_2O_6S$** **MW: 462.8 g/mol** **SMILES:** **[H]N(C1=C(F)C=C(Cl)C(S(C(C)C(O)=O)=O)=C1)C(N(C)C(C(F)(F)F)CC(O)= O)=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	**23.4 (120)**	**17.3 (180)**
				LS, pH 6.7-7.1	3.4 (180)	3.4 (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	ND	ND
			50493841	Washington	ND	ND
			50493842	North Dakota	ND	ND

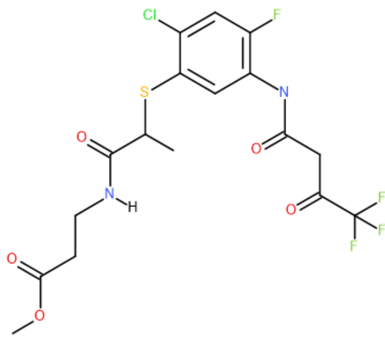
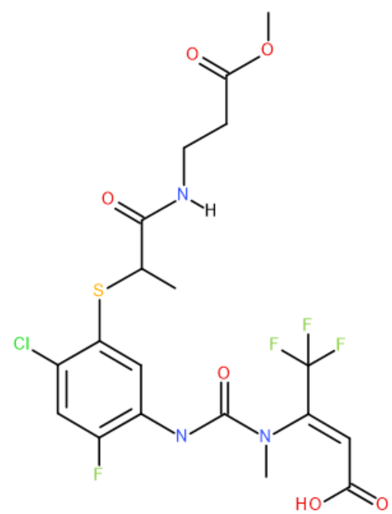
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
			50493843	North Carolina	ND	ND
DCC-3825-M-32 **IUPAC: 2,2,2-Trifluoroacetic acid** **Formula: $C_2HF_3O_2$** **MW: 114.02 g/mol** **SMILES: O=C(C(F)(F)F)O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	DN
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	**27.0 (120)**	**21.2 (180)**
				LS, pH 6.7-7.1	**30.1 (150)**	**15.7 (180)**
		Anaerobic Soil	50493819	SCL, pH 6.1	2.2 (180)	2.2 (180)
				CL, pH 6.9	4.3 (180)	4.3 (180)
				C, pH 7.9	3.2 (180)	3.2 (180)
				SL, pH 7.1	8.1 (120)	1.6 (180)
		Aerobic Aquatic	50493820	SL, pH 5.1	**20.9 (50)**	**16.4 (100)**
				S, pH 7.4	6.7 (100)	6.7 (100)
		Anaerobic Aquatic	50493821	SL, pH 7.5	0.8 (50)	0.5 (100)
				S, pH 6.6	0.7 (75)	0.3 (100)
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
DCC-3825-M-33 (M-33) **IUPAC: 1,1,1-Trifluoropropan-2-one** **Formula: $C_3H_3F_3O$** **MW: 112.05 g/mol** **SMILES:**		Hydrolysis	50493812	pH 7, 35 ℃	**40.5 (30)**	**40.5 (30)**
				pH 7, 40 ℃	**47.1 (30)**	**47.1 (30)**
				pH 7, 45 ℃	**47.7 (30)**	**47.7 (30)**
				pH 9, 15 ℃	**44.3 (14)**	**44.3 (14)**
				pH 9, 20 ℃	**44.3 (6)**	**44.3 (6)**
				pH 9, 25 ℃	**61.6 (5)**	**61.6 (5)**

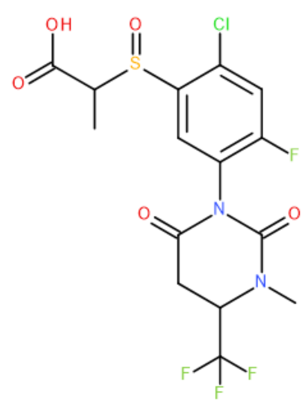
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	6.3 (7)	ND (180)
				C, pH 7.9	**34 (14)**	**11.3 (180)**
				SL, pH 7.1	**30.0 (14)**	ND (180
		Aerobic Aquatic	50493820	SL, pH 5.1	**10.3 (28)**	3.9 (100)
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	**40.6 (14)**	5.3 (100)
				S, pH 6.6	**35.5 (25)**	6.2 (100)
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
DCC-3825-M-34 (M-34) **IUPAC: 1,1,1-trifluoropropan-2-ol** **Formula: $C_3H_5F_3O$** **MW: 114.07 g/mol** **SMILES: CC(O)C(F)(F)F**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	**17.9 (60)**	1.5 (180)

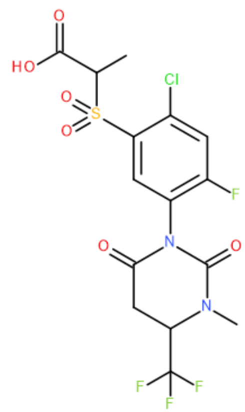
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
				CL, pH 6.9	9.2 (90)	ND
				C, pH 7.9	**25.0 (14)**	4.9 (180)
				SL, pH 7.1	**16.5 (60**	3.5 (180)
		Aerobic Aquatic	50493820	SL, pH 5.1	1.7 (100)	1.7 (100)
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	**17.2 (50)**	6.5 (100)
				S, pH 6.6	8.1 (50)	1.4 (100)
		Field Dissipation[1]	50493840	California	ND	ND
			50493841	Washington	ND	ND
			50493842	North Dakota	ND	ND
			50493843	North Carolina	ND	ND
DCC-3825-M-35 **IUPAC: 2-((2-Chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)-3,6-dihydropyrimidin-1(2H)-yl)phenyl)sulfonyl)propanoic acid** **Formula: $C_{15}H_{11}ClF_4N_2O_6S$** **MW: 458.76 g/mol** **SMILES:** **CN(C(N1C2=C(F)C=C(Cl)C(S(C(C)C(O)=O)(=O)=O)=C2)=O)C(C(F)(F)F)=CC1=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	4.0 (1)	0.3 (180)
				C, pH 8.0-8.1	4.0 (1)	0.3 (180)
				LS, pH 6.7-7.1	**11.4 (120)**	9.3 (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND

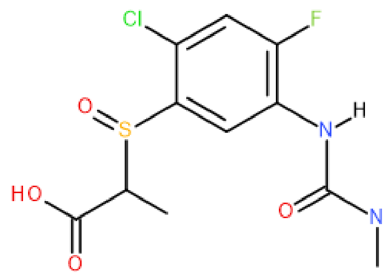
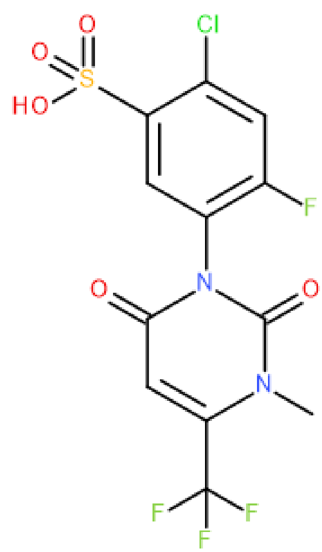
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
		Field Dissipation[1]	50493840	California	ND	ND
			50493841	Washington	ND	ND
			50493842	North Dakota	ND	ND
			50493843	North Carolina	ND	ND
DCC-3825-M-36 **IUPAC: 2-((2-Chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)-3,6-dihydropyrimidin-1(2H)-yl)phenyl)sulfinyl)propanoic acid** **Formula: $C_{15}H_{11}ClF_4N_2O_5S$** **MW: 442.77 g/mol** **SMILES:** C1(=C(C=C(C(=C1)F)N2C(=O)N(C(=CC2=O)C(F)(F)F)C)[S](C(C(=O)O[H])C)=O)Cl		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	**55.0 (3)**	**14.3 (180)**
				CL pH 6.8-7.2	**51.3 (3)**	6.4 (180)
				C, pH 8.0-8.1	**54.7 (30)**	9.8 (180)
				LS, pH 6.7-7.1	**62.9 (30)**	**31.4 (180)**
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	**16.2 (15)**	ND (176)
			50493841	Washington	**14.0 (10)**	ND (60)
			50493842	North Dakota	**15.0 (9)**	ND (366)
			50493843	North Carolina	**11.1 (7)**	ND (90)
DCC-3825-M-39 (M-39) **IUPAC: 3-(2-((2-Chloro-4-fluoro-5-(4,4,4-trifluoro-3-**		Hydrolysis	50493812	pH 7, 35 ℃	0.8 (21)	ND (30)
				pH 7, 40 ℃	4.8 (30)	4.8 (30)
				pH 7, 45 ℃	3.6 (10)	3.6 (10)

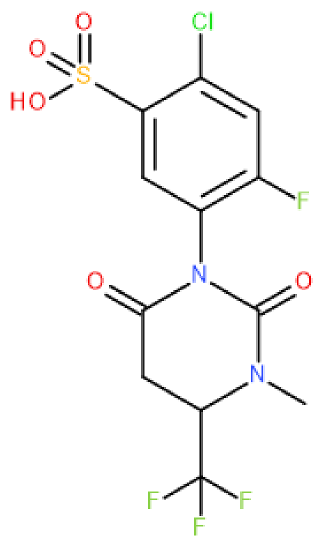
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
oxobutanamido)phenyl)thio)propanamido)propanoic acid **Formula: $C_{16}H_{15}ClF_4N_2O_5S$** **MW: 458.81 g/mol** **SMILES:** **O=C(C(F)(F)F)CC(N(C1=C(F)C=C(Cl)C(SC(C)C(N([H])CCC(O)=O)=O)=C1)[H])=O**				pH 9, 15 ℃	7.7 (14)	7.7 (14)
				pH 9, 20 ℃	6.0 (6)	6.0 (6)
				pH 9, 25 ℃	**16.2 (5)**	**16.2 (5)**
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	**10.5 (180)**	**10.5 (180)**
				CL, pH 6.9	6.1 (90, 150)	3.8 (180)
				C, pH 7.9	**11.7 (60)**	6.7 (180)
				SL, pH 7.1	**17.4 (90)**	**11.8 (180)**
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	**13.5 (50)**	8.1 (100)
				S, pH 6.6	**13.3 (75)**	**10.8 (100)**
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
DCC-3825-M-49 (M-49) **IUPAC: Methyl 3-(2-((2-chloro-4-fluoro-5-(4,4,4-trifluoro-3-oxobutanamido)phenyl)thio)propanamido)propanoate** **Formula: $C_{17}H_{17}ClF_4N_2O_5S$** **MW: 472.84 g/mol** **SMILES:** **O=C(NC1=C(F)C=C(Cl)C(SC(C)C(N([H])CCC(OC)=O)=O)=C1)CC(C(F)(F)F)=O**		Hydrolysis	50493812	pH 7, 35 ℃	9.2 (30)	9.2 (30)
				pH 7, 40 ℃	**10.6 (30)**	**10.6 (30)**
				pH 7, 45 ℃	**10.1 (10)**	**10.1 (10)**
				pH 9, 15 ℃	7.8 (14)	7.8 (14)
				pH 9, 20 ℃	7.6 (6)	7.6 (6)
				pH 9, 25 ℃	8.7 (3)	6.6 (5)
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND

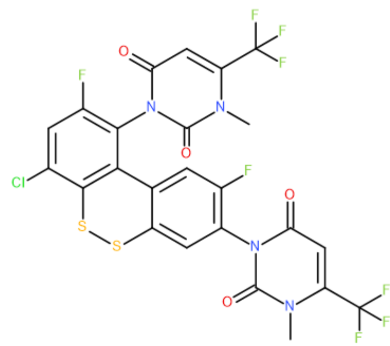
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	5.8 (7)	ND (100)
				S, pH 6.6	**10.0 (7)**	ND (100)
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
DCC-3825-M-50 (M-50) **IUPAC: (Z)-3-(3-(4-chloro-2-fluoro-5-((1-((3-methoxy-3-oxopropyl)amino)-1-oxopropan-2-yl)thio)phenyl)-1-methylureido)-4,4,4-trifluorobut-2-enoic acid** **Formula: $C_{19}H_{20}ClF_4N_3O_6S$** **MW: 529.89 g/mol** **SMILES: O=C(O)/C=C(C(F)(F)F)\N(C)C(NC1=C(F)C=C(Cl)C(SC(C)C(N([H])CCC(OC)=O)=O)=C1)=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	1.4 (1)	ND (10)
				pH 9, 15 ℃	7.3 (7)	4.8 (14)
				pH 9, 20 ℃	**10.6 (3)**	5.9 (6)
				pH 9, 25 ℃	**11.6 (2)**	5.9 (5)
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND

Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	9.3 (3)	ND (100)
				S, pH 6.6	9.3 (3)	ND (100)
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
DCC-3825-M-53 **IUPAC: 2-((2-Chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)tetrahydropyrimidin-1(2H)-yl)phenyl)sulfinyl)propanoic acid** **Formula: $C_{15}H_{13}ClF_4N_2O_5S$** **MW: 444.78 g/mol** **SMILES:** **CN(C(N1C2=C(F)C=C(Cl)C(S(C(C)C(O)=O)=O)=C2)=O)C(C(F)(F)F)CC1=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	**56.3 (90)**	**44.5 (180)**
				CL pH 6.8-7.2	**47.8 (14)**	**28.5 (180)**
				C, pH 8.0-8.1	**21.3 (30)**	3.0 (180)
				LS, pH 6.7-7.1	**14.3 (30)**	9.1 (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	5.4 (30)	ND (176)
			50493841	Washington	ND	ND (60)
			50493842	North Dakota	**11.3 (61)**	ND (366)
			50493843	North Carolina	5.5 (13)	ND (90)

Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
DCC-3825-M-63 **IUPAC: 2-((2-Chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)tetrahydropyrimidin-1(2H)-yl)phenyl)sulfonyl)propanoic acid** **Formula: $C_{15}H_{13}ClF_4N_2O_6S$** **MW: 460.78 g/mol** **SMILES:** **CN(C(N1C2=C(F)C=C(Cl)C(S(C(C)C(O)=O)(=O)=O)=C2)=O)C(C(F)(F)F)CC1=O**		Hydrolysis	50493812	pH 7, 35 °C	ND	ND
				pH 7, 40 °C	ND	ND
				pH 7, 45 °C	ND	ND
				pH 9, 15 °C	ND	ND
				pH 9, 20 °C	ND	ND
				pH 9, 25 °C	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	**21.2 (180)**	**21.2 (180)**
				CL pH 6.8-7.2	**32.9 (30)**	**22.3 (180)**
				C, pH 8.0-8.1	2.1 (60)	1.2 (180)
				LS, pH 6.7-7.1	8.4 (150)	7.7 (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	ND	ND (176)
			50493841	Washington	ND	ND (60)
			50493842	North Dakota	4.8 (119)	ND (366)
			50493843	North Carolina	5.0 (13)	ND (90)
DCC-3825-M-69 **IUPAC: 2-((2-Chloro-4-fluoro-5-(3-methylureido)phenyl)sulfinyl)propanoic acid** **Formula: $C_{11}H_{12}ClFN_2O_4S$** **MW: 322.74 g/mol** **SMILES:** **CNC(N([H])C1=C(F)C=C(Cl)C(S(C(C)C(O)=O)=O)=C1)=O**		Hydrolysis	50493812	pH 7, 35 °C	ND	ND
				pH 7, 40 °C	ND	ND
				pH 7, 45 °C	ND	ND
				pH 9, 15 °C	ND	ND
				pH 9, 20 °C	ND	ND
				pH 9, 25 °C	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND

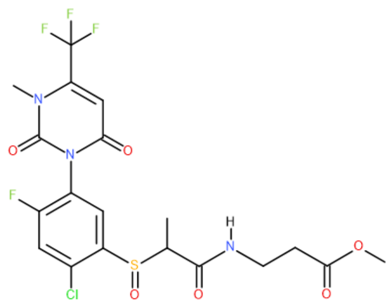
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	**29.2 (120)**	**21.8 (180)**
				LS, pH 6.7-7.1	**13.5 (180)**	**13.5 (180)**
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	ND	ND (176)
			50493841	Washington	ND	ND (60)
			50493842	North Dakota	2.9 (90)	ND (366)
			50493843	North Carolina	ND	ND (90)
DCC-3825-M-72 (M-72) **IUPAC: 2-Chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)-3,6-dihydropyrimidin-1(2H)-yl)benzenesulfonic acid** **Formula:** $C_{12}H_7ClF_4N_2O_5S$ **MW: 402.7 g/mol** **SMILES: CN(C(N1C2=C(F)C=C(Cl)C(S(=O)(O)=O)=C2)=O)C(C(F)(F)F)=CC1=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	**22.9 (15)**	**22.9 (15)**
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	2.4 (90)	1.8 (180)
				CL pH 6.8-7.2	6.1 (30)	1.4 (180)
				C, pH 8.0-8.1	6.2 (60)	1.8 (180)
				LS, pH 6.7-7.1	**19.9 (150)**	**12.4 (180)**
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND

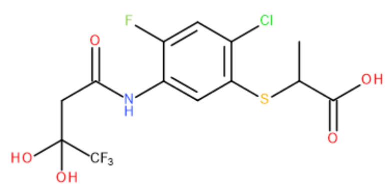
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	**10.2 (15)**	ND (176)
			50493841	Washington	6.8 (10)	ND (60)
			50493842	North Dakota	3.6 (9)	ND (366)
			50493843	North Carolina	**11.0 (7)**	ND (90)
DCC-3825-M-73 **IUPAC: 2-Chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)tetrahydropyrimidin-1(2H)-yl)benzenesulfonic acid** **Formula: $C_{12}H_9ClF_4N_2O_5S$** **MW: 404.72 g/mol** **SMILES:** **CN(C(N1C2=C(F)C=C(Cl)C(S(O)(=O)=O)=C2)=O)C(C(F)(F)F)CC1=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	**14.0 (180)**	**14.0 (180)**
				CL pH 6.8-7.2	**13.8 (150)**	**13.6 (180)**
				C, pH 8.0-8.1	8.1 (120)	2.4 (180)
				LS, pH 6.7-7.1	**10.4 (180)**	**10.4 (180)**
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	ND	ND (176)
			50493841	Washington	ND	ND (60)
			50493842	North Dakota	ND	ND (366)

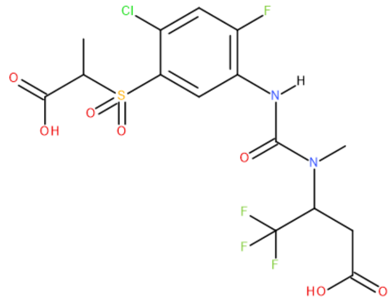
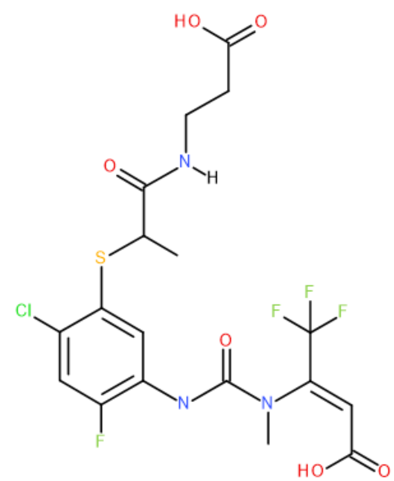
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
			50493843	North Carolina	**15.0 (29)**	6.4 (90)
DCC-3825-M-85 (M-85) **IUPAC: 3,3'-(4-Chloro-2,9-difluorodibenzo[c,e][1,2]dithiine-1,8-diyl)bis(1-methyl-6-(trifluoromethyl)pyrimidine-2,4(1H,3H)-dione)** **Formula: $C_{24}H_{11}ClF_8N_4O_4S_2$** **MW: 670.93 g/mol** **SMILES: O=C(C=C(N1C)C(F)(F)F)N(C1=O)C2=C(F)C=C3C(SSC4=C3C(N5C(N(C)C(C(F)(F)F)=CC5=O)=O)=C(F)C=C4Cl)=C2**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	**11.6 (15)**	**11.6 (15)**
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
Carbon dioxide **IUPAC: Carbon dioxide** **Formula: CO_2** **MW: 44 g/mol** **SMILES: C(=O)=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND

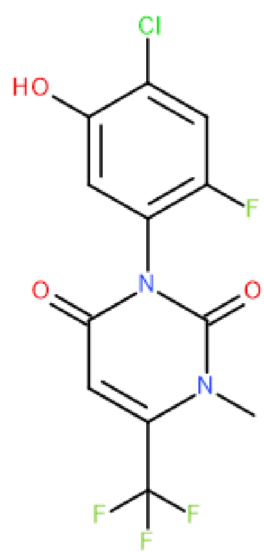
Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	2.30 (30)	2.30 (30)
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	3.7 (180)	3.7 (180)
				CL pH 6.8-7.2	**10.1 (180)**	**10.1 (180)**
				C, pH 8.0-8.1	**10.2 (180)**	**10.2 (180)**
				LS, pH 6.7-7.1	5.4 (180)	5.4 (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	**21.5 (180)**	**21.5 (180)**
				CL, pH 6.9	**15.9 (180)**	**15.9 (180)**
				C, pH 7.9	**19.7 (180)**	**19.7 (180)**
				SL, pH 7.1	**17.8 (180)**	**17.8 (180)**
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
Unextracted Residues	N/A	Hydrolysis	50493812	pH 7, 35 ℃	NA	NA
				pH 7, 40 ℃	NA	NA
				pH 7, 45 ℃	NA	NA
				pH 9, 15 ℃	NA	NA
				pH 9, 20 ℃	NA	NA
				pH 9, 25 ℃	NA	NA
		Aqueous Photolysis	50493813	pH 5	NA	NA
		Soil Photolysis	50493814	SL, pH 6.8	4.0 (30)	4.0 (30)
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	**13.8 (30)**	**11.6 (180)**
				CL pH 6.8-7.2	**25.9 (180)**	**25.9 (180)**
				C, pH 8.0-8.1	**27.1 (180)**	**27.1 (180)**
				LS, pH 6.7-7.1	**15.9 (180)**	**15.9 (180)**
		Anaerobic Soil	50493819	SCL, pH 6.1	**16.2 (150)**	**11.3 (180)**

Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
				CL, pH 6.9	**30.7 (120)**	**25.3 (180)**
				C, pH 7.9	9.7 (1)	4.8 (180)
				SL, pH 7.1	4.8 (180)	4.8 (180)
		Aerobic Aquatic	50493820	SL, pH 5.1	**34.0 (100)**	**34.0 (100)**
				S, pH 7.4	**14.9 (100)**	**14.9 (100)**
		Anaerobic Aquatic	50493821	SL, pH 7.5	**15.8 (100)**	**15.8 (100)**
				S, pH 6.6	**19.5 (75)**	**17.5 (100)**
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
Volatile Compounds (Contains M-32, M-33, and M-34)	N/A	Hydrolysis	50493812	pH 7, 35 ℃	NA	NA
				pH 7, 40 ℃	NA	NA
				pH 7, 45 ℃	NA	NA
				pH 9, 15 ℃	NA	NA
				pH 9, 20 ℃	NA	NA
				pH 9, 25 ℃	NA	NA
		Aqueous Photolysis	50493813	pH 5	NA	NA
		Soil Photolysis	50493814	SL, pH 6.8	4.0 (30)	4.0 (30)
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	0.3 (180)	0.3 (180)
				CL pH 6.8-7.2	0.1 (180	0.1 (180)
				C, pH 8.0-8.1	1.9 (180)	1.9 (180)
				LS, pH 6.7-7.1	0.5 (180)	0.5 (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	**32.0 (180)**	**32.0 (180)**
				CL, pH 6.9	4.2 (180)	4.2 (180)
				C, pH 7.9	8.7 (60)	3.9 (180)
				SL, pH 7.1	**11.3 (60)**	6.2 (180)
		Aerobic Aquatic	50493820	SL, pH 5.1	**12.4[3] (100)**	**12.4[3] (100)**
				S, pH 7.4	**5.1[3] (100)**	**5.1[3] (100)**
		Anaerobic Aquatic	50493821	SL, pH 7.5	**32.0[4] (100)**	**32.0[4] (100)**
				S, pH 6.6	**39.8[4] (100)**	**39.8[4] (100)**

Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
Minor (<10%) TRANSFORMATION PRODUCTS						
DCC-3825-M-10 (M-10) **IUPAC: Methyl 3-(2-((2-chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-(trifluoromethyl)-3,6-dihydropyrimidin-1(2H)-yl)phenyl)sulfinyl)propanamido)propanoate** **Formula: $C_{19}H_{18}ClF_4N_3O_6S$** **MW: 527.87 g/mol** **SMILES: O=C(C=C(C(F)(F)F)N1C)N(C2=C(F)C=C(Cl)C(S(C(C)C(N([H])CCC(OC)=O)=O)=O)=C2)C1=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	7.53 (30)	7.53 (30)
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA
			50493843	North Carolina	NA	NA
DCC-3825-M-26		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND

Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
IUPAC: 2-[2-chloro-4-fluoro-5-[(4,4,4-trifluoro-3,3-dihydroxy-butanoyl)amino]phenyl]sulfanylpropanoic acid **Formula:** $C_{13}H_{12}ClF_4NO_5S$ **MW:** 405.75 **SMILES:** CC(Sc1cc(NC(=O)CC(O)(O)C(F)(F)F)c(F)cc1Cl)C(=O)O				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	9.3 (180)	9.3 (180)
				CL, pH 6.9	5.6 (180)	5.6 (180)
				C, pH 7.9	7.2 (180)	7.2 (180)
				SL, pH 7.1	6.6 (180)	6.6 (180)
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	7.0 (100)	7.0 (100)
				S, pH 6.6	9.1 (100)	9.1 (100)
		Field Dissipation[1]	50493840	California	ND	ND
			50493841	Washington	ND	ND
			50493842	North Dakota	ND	ND
			50493843	North Carolina	ND	ND
DCC-3825-M-30 **IUPAC: 3-(3-(5-((1-Carboxyethyl)sulfonyl)-4-chloro-2-fluorophenyl)-1-methylureido)-4,4,4-trifluorobutanoic acid** **Formula: $C_{15}H_{15}ClF_4N_2O_7S$** **MW: 478.8 g/mol** **SMILES:** **[H]N(C1=C(F)C=C(Cl)C(S(C(C)C(O)=O)(=O)=O)=C1)C(N(C)C(C(F)(F)F)CC(O)=O)=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND

Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	7.9 (120)	7.8 (180)
				LS, pH 6.7-7.1	2.7 (180)	2.7 (180)
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	ND	ND
			50493841	Washington	ND	ND
			50493842	North Dakota	ND	ND
			50493843	North Carolina	ND	ND
DCC-3825-M-40 (M-40) IUPAC: **(Z)-3-(3-(5-((1-((2-carboxyethyl)amino)-1-oxopropan-2-yl)thio)-4-chloro-2-fluorophenyl)-1-methylureido)-4,4,4-trifluorobut-2-enoic acid** Formula: **$C_{18}H_{18}ClF_4N_3O_6S$** MW: **515.86 g/mol** SMILES: **O=C(O)/C=C(C(F)(F)F)\N(C)C(NC1=C(F)C=C(Cl)C(SC(C)C(N([H])CCC(O)=O)=O)=C1)=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	0.9 (30)	0.9 (30)
				pH 7, 45 ℃	1.1 (5)	ND (10)
				pH 9, 15 ℃	3.8 (10)	1.8 (14)
				pH 9, 20 ℃	3.8 (3)	3.3 (6)
				pH 9, 25 ℃	7.9 (5)	7.9 (5)
		Aqueous Photolysis	50493813	pH 5	ND	ND
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND

Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	7.5 (100)	7.5 (100)
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	ND	ND
			50493841	Washington	ND	ND
			50493842	North Dakota	ND	ND
			50493843	North Carolina	ND	ND
DCC-3825-M-71 (M-71) **IUPAC: 3-(4-Chloro-2-fluoro-5-hydroxyphenyl)-1-methyl-6-(trifluoromethyl)pyrimidine-2,4(1H,3H)-dione** **Formula: $C_{12}H_7ClF_4N_2O_3$** **MW: 338.64 g/mol** **SMILES:** **CN(C(N1C2=C(F)C=C(Cl)C(O)=C2)=O)C(C(F)(F)F)=CC1=O**		Hydrolysis	50493812	pH 7, 35 ℃	ND	ND
				pH 7, 40 ℃	ND	ND
				pH 7, 45 ℃	ND	ND
				pH 9, 15 ℃	ND	ND
				pH 9, 20 ℃	ND	ND
				pH 9, 25 ℃	ND	ND
		Aqueous Photolysis	50493813	pH 5	8.5 (15)	8.5 (15)
		Soil Photolysis	50493814	SL, pH 6.8	ND	ND
		Aerobic Soil	50493815	SL/SCL 6.2-6.4	ND	ND
				CL pH 6.8-7.2	ND	ND
				C, pH 8.0-8.1	ND	ND
				LS, pH 6.7-7.1	ND	ND
		Anaerobic Soil	50493819	SCL, pH 6.1	ND	ND
				CL, pH 6.9	ND	ND
				C, pH 7.9	ND	ND
				SL, pH 7.1	ND	ND
		Aerobic Aquatic	50493820	SL, pH 5.1	ND	ND
				S, pH 7.4	ND	ND
		Anaerobic Aquatic	50493821	SL, pH 7.5	ND	ND
				S, pH 6.6	ND	ND
		Field Dissipation[1]	50493840	California	NA	NA
			50493841	Washington	NA	NA
			50493842	North Dakota	NA	NA

Chemical Name/ Synonym and Properties	Chemical Structure	Study Type	MRID	System[2]	Maximum %AR (day)	Final %AR (day)
			50493843	North Carolina	NA	NA

ND=not detected; NA=not analyzed; **Bold** values indicate major (>10%) product.

* Compounds M-01 and M-26 coeluted for an undetermined number of sampling intervals. It could not be determined if M-01 eluted separately at any sampling interval. M-26 appears to have eluted separately only at the later sampling intervals.

[1] Test material in dissipation study was not radiolabeled. The maximum and final values represent the highest and final measured concentrations as a percentage of initial concentration of the parent compound.

[2] Soil Textural Classifications: S=Sand; C = Clay; L=Loam; Si = Silt; LS=Loamy Sand; SL=Sandy Loam; SiL=Silt Loam; SCL=Sandy Clay Loam; CL= Clay Loam; SiCL = Silty Clay Loam; SC = Sandy Clay; SiC = Silty Clay

[3] Total volatiles captured in the NaOH trap. Barium chloride precipitation results were ambiguous. Exact percentages of CO_2 and nature and concentration of individual organic volatiles were not conclusively established.

[4]Total volatiles captured in NaOH and ethandiol trap, consisting of a mixture of M-32, M-33, and M-34 in varying ratios.

Appendix B. PWC Model Input Parameters

Run Name	Use Site	PWC Scenario	Application Date Relative to Emergence[1]	App. Rate in lbs a.i./A (kg a.i./ha)	App. Type[2]	App Method
ILCornSTD_Preplant_Preemerg_2x0.067	Corn	ILCornSTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
INcornSTD_Preplant_Preemerg_2x0.067	Corn	INcornSTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
KScornSTD_Preplant_Preemerg_2x0.067	Corn	KScornSTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
MNcornSTD_Preplant_Preemerg_2x0.067	Corn	MNcornSTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
MScornSTD_Preplant_Preemerg_2x0.067	Corn	MScornSTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
NCcornESTD_Preplant_Preemerg_2x0.067	Corn	NCcornESTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
NEcornSTD_Preplant_Preemerg_2x0.067	Corn	NEcornSTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
OHcornSTD_Preplant_Preemerg_2x0.067	Corn	OHcornSTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
PAcornSTD_Preplant_Preemerg_2x0.067	Corn	PAcornSTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
CAcotton_WirrigSTD_Preplant_Preemerg_3x0.067	Cotton	CAcotton_Wirrig STD	April 10, April 24, Oct 28	3x0.067 (0.075)	Ground	Above Crop
MScottonSTD_Preplant_Preemerg_3x0.067	Cotton	MScottonSTD	April 10, April 24, Sept 8	3x0.067 (0.075)	Ground	Above Crop
NCcottonSTD_Preplant_Preemerg_3x0.067	Cotton	NCcottonSTD	May 11, May 25, Oct 18	3x0.067 (0.075)	Ground	Above Crop
CArightofwaYLF_V2_Postemerg_3x0.067	Non-cropped	CArightofwaYLF_V2	0, 14, 28	3x0.067 (0.075)	Ground	Above Crop
RightOfWayBSS_Postemerg_3x0.067	Non-cropped	RightOfWayBSS	0, 14, 28	3x0.067 (0.075)	Ground	Above Crop
MSsoybeansSTD_Preplant_Preemerg_2x0.067	Soybeans	MSsoybeanSTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
NDwheatSTD_Preplant_Preemerg_2x0.067	Wheat	NDwheatSTD	-21, -7	2x0.067 (0.075)	Ground	Above Crop
Cagrapes_WirrigSTD_Postemerg_3x0.067	Grapes	Cagrapes_Wirrig STD	0, 14, 28	3x0.067 (0.075)	Ground	Below Crop
NYgrapesSTD_Postemerg_3x0.067	Grapes	NYgrapesSTD	0, 14, 28	3x0.067 (0.075)	Ground	Below Crop
NDwheatSTD_Fallow_3x0.067	Fallow	NDwheatSTD	Aug 19, Sept 2, Sept 16	3x0.067 (0.075)	Ground	Above Crop
ILCornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Corn + Fallow	ILCornSTD	-21, -7, 186, 200	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
INcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Corn + Fallow	INcornSTD	-21, -7, 172, 186	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop

Run Name	Use Site	PWC Scenario	Application Date Relative to Emergence[1]	App. Rate in lbs a.i./A (kg a.i./ha)	App. Type[2]	App Method
KScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Corn + Fallow	KScornSTD	-21, -7, 177, 191	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
MNcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Corn + Fallow	MNcornSTD	-21, -7, 172, 186	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
MScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Corn + Fallow	MScornSTD	-21, -7, 159, 173	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
NCcornESTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Corn + Fallow	NCcornESTD	-21, -7, 164, 178	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
NEcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Corn + Fallow	NEcornSTD	-21, -7, 162, 176	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
OHcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Corn + Fallow	OHcornSTD	-21, -7, 191, 205	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
PAcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Corn + Fallow	PAcornSTD	-21, -7, 182, 196	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
CAcotton_WirrigSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Cotton + Fallow	CAcotton_WirrigSTD	April 10, April 24, Oct 28, Nov 25	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Cotton + Fallow	MScottonSTD	April 10, April 24, Sept 8, Oct 6	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
NCcottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Cotton + Fallow	NCcottonSTD	May 11, May 25, Oct 18, Nov 15	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
MSsoybeansSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Soybeans + Fallow	MSsoybeanSTD	-21, -7, 201, 215	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop
NDwheatSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022	Wheat + Fallow	NDwheatSTD	-21, -7, 95, 109	3x0.067, 1x0.022 (0.075, 0.025)	Ground	Above Crop

Appendix C. Example Aquatic Modeling Output and Input Batch Files

All modeling calculations, inputs, and results are available in the attached water modeling Excel files titled Tiafenacil_Parent_Eco_Input_8-8-2019.xlsx and Tiafenacil_ROC_Eco_Input_8-8-2019.xlsx (Attached) Below is an example output summary file from a single PWC modeling simulation.

Tiafenacil_Parent_Eco_Input_8-8-2019.xlsx Tiafenacil_ROC_Eco_Input_8-8-2019.xlsx

Summary of Water Modeling of MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022 and the USEPA Standard Pond

Estimated Environmental Concentrations for MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022 are presented in Table 1 for the USEPA standard pond with the MScottonSTD 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 1.6% of MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022 applied to the field eventually reaches the water body. The main mechanism of transport from the field to the water body is by runoff (89% of the total transport), followed by spray drift (10.8%) and erosion (0.2%).
In the water body, pesticide dissipates with an effective water column half-life of 138.3 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 = 149.8 days) followed by photolysis (1807.8 days) and volatilization (5.104061E+08 days).
In the benthic region, pesticide dissipates (36.9 days). The main source of dissipation in the benthic region is metabolism (effective average half-life = 36.9 days). The pesticide is about evenly distributed in the benthic region between the pore water and sorbed to sediment.

Table 1. Estimated Environmental Concentrations (ppb) for MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022.

Peak (1-in-10 yr)	3.95
4-day Avg (1-in-10 yr)	3.92
21-day Avg (1-in-10 yr)	3.82
60-day Avg (1-in-10 yr)	3.54
365-day Avg (1-in-10 yr)	1.73

Entire Simulation Mean	0.963

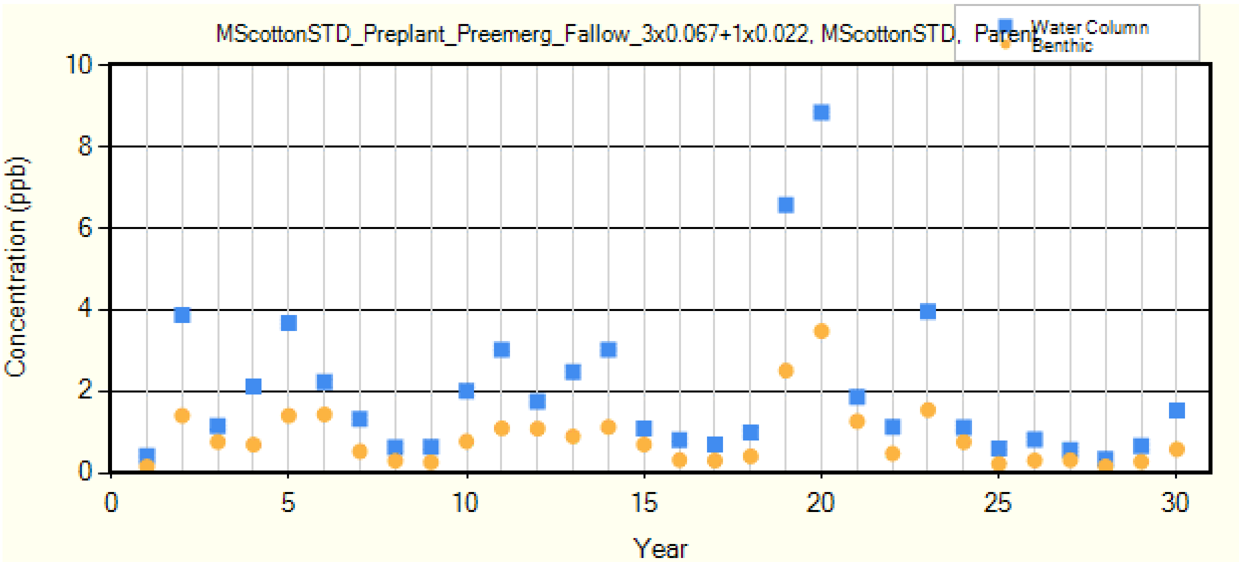
Table 2. Summary of Model Inputs for MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022.

Scenario	MScottonSTD
Cropped Area Fraction	1
Koc (ml/g)	11.8
Water Half-Life (days) @ 20 °C	144
Benthic Half-Life (days) @ 20 °C	35.5
Photolysis Half-Life (days) @ 36 °Lat	18.9
Hydrolysis Half-Life (days)	0
Soil Half-Life (days) @ 20 °C	4.57
Foliar Half-Life (days)	
Molecular Weight	511.88
Vapor Pressure (torr)	1.12E-10
Solubility (mg/l)	110
Henry's Constant	2.8E-11

Table 3. Application Schedule for MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022.

Date (Mon/Day)	Type	Amount (kg/ha)	Eff.	Drift
4/10	Above Crop (Foliar)	0.075	.99	0.017
4/24	Above Crop (Foliar)	0.075	.99	0.017
9/8	Above Crop (Foliar)	0.075	.99	0.017
10/6	Above Crop (Foliar)	0.025	.99	0.017

Figure 1. Yearly Peak Concentrations



Appendix D. PWC Modeling Results

Table D-1. Surface Water EECs for Tiafenacil Parent (Calculated Using PWC version 1.52)

Run Name	Use Site	PWC Scenario	# of Apps, Single App Rate lbs a.i./A (kg/ha)	1-in-10 year mean EEC Water Column (µg/L)		
				1-day	21-day	60-day
ILCornSTD_Preplant_Preemerg_2x0.067_7_ILCornSTD	Corn	ILCornSTD	2x0.067 (0.075)	0.089	0.054	0.033
INcornSTD_Preplant_Preemerg_2x0.067_7_INCornStd	Corn	INcornSTD	2x0.067 (0.075)	0.086	0.051	0.030
KScornSTD_Preplant_Preemerg_2x0.067_7_KSCornStd	Corn	KScornSTD	2x0.067 (0.075)	0.086	0.051	0.030
MNcornSTD_Preplant_Preemerg_2x0.067_7_MNCornStd	Corn	MNcornSTD	2x0.067 (0.075)	0.089	0.053	0.034
MScornSTD_Preplant_Preemerg_2x0.067_7_MScornSTD	Corn	MScornSTD	2x0.067 (0.075)	0.086	0.050	0.029
NCcornESTD_Preplant_Preemerg_2x0.067_7_NCcornESTD	Corn	NCcornESTD	2x0.067 (0.075)	0.087	0.052	0.031
NEcornSTD_Preplant_Preemerg_2x0.067_7_NECornStd	Corn	NEcornSTD	2x0.067 (0.075)	0.085	0.050	0.028
OHcornSTD_Preplant_Preemerg_2x0.067_7_OHCornSTD	Corn	OHcornSTD	2x0.067 (0.075)	0.089	0.053	0.034
PAcornSTD_Preplant_Preemerg_2x0.067_7_PAcornSTD	Corn	PAcornSTD	2x0.067 (0.075)	0.090	0.054	0.036
CAcotton_WirrigSTD_Preplant_Preemerg_3x0.067_7_CAcotton_WirrigSTD	Cotton	CAcotton_WirrigSTD	3x0.067 (0.075)	0.084	0.050	0.030
MScottonSTD_Preplant_Preemerg_3x0.067_7_MScottonSTD	Cotton	MScottonSTD	3x0.067 (0.075)	0.082	0.048	0.026
NCcottonSTD_Preplant_Preemerg_3x0.067_7_NCcottonSTD	Cotton	NCcottonSTD	3x0.067 (0.075)	0.082	0.048	0.025
CArightofwaYLF_V2_Postemerg_3x0.067_7_CArightofwaYLF_V2	Non-cropped	CArightofwaYLF_V2	3x0.067 (0.075)	0.089	0.058	0.039
RightOfWayBSS_Postemerg_3x0.067_7_RightOfWayBSS	Non-cropped	RightOfWayBSS	3x0.067 (0.075)	0.095	0.064	0.043
MSsoybeansSTD_Preplant_Preemerg_2x0.067_7_MSsoybeanSTD	Soybeans	MSsoybeanSTD	2x0.067 (0.075)	0.084	0.050	0.028
NDwheatSTD_Preplant_Preemerg_2x0.067_7_NDwheatSTD	Wheat	NDwheatSTD	2x0.067 (0.075)	0.089	0.054	0.035
Cagrapes_WirrigSTD_Postemerg_3x0.067_7_CAgrapes_WirrigSTD	Grapes	Cagrapes_WirrigSTD	3x0.067 (0.075)	0.065	0.044	0.032
NYgrapesSTD_Postemerg_3x0.067_7_NYGrapesSTD	Grapes	NYgrapesSTD	3x0.067 (0.075)	0.058	0.038	0.025
NDwheatSTD_Fallow_3x0.067_7_NDwheatSTD	Fallow	NDwheatSTD	3x0.067 (0.075)	0.087	0.055	0.039

Run Name	Use Site	PWC Scenario	# of Apps, Single App Rate lbs a.i./A (kg/ha)	1-in-10 year mean EEC Water Column (µg/L)		
				1-day	21-day	60-day
ILCornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_ILCornSTD	Corn + Fallow	ILCornSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.090	0.054	0.034
INcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_INCornStd	Corn + Fallow	INcornSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.086	0.051	0.031
KScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_KSCornStd	Corn + Fallow	KScornSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.086	0.051	0.030
MNcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MNCornStd	Corn + Fallow	MNcornSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.090	0.055	0.034
MScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScornSTD	Corn + Fallow	MScornSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.086	0.050	0.029
NCcornESTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_NCcornESTD	Corn + Fallow	NCcornESTD	3x0.067, 1x0.022 (0.075, 0.025)	0.087	0.052	0.032
NEcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_NECornStd	Corn + Fallow	NEcornSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.085	0.050	0.029
OHcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_OHCornSTD	Corn + Fallow	OHcornSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.089	0.054	0.034
PAcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_PAcornSTD	Corn + Fallow	PAcornSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.090	0.055	0.036
CAcotton_WirrigSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_CAcotton_WirrigSTD	Cotton + Fallow	CAcotton_WirrigSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.084	0.050	0.029
MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScottonSTD	Cotton + Fallow	MScottonSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.082	0.048	0.026
NCcottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_NCcottonSTD	Cotton + Fallow	NCcottonSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.082	0.048	0.025
MSsoybeansSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MSsoybeanSTD	Soybeans + Fallow	MSsoybeanSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.084	0.050	0.028
NDwheatSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_NDwheatSTD	Wheat + Fallow	NDwheatSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.089	0.054	0.035

Table D-2. Surface Water EECs for Tiafenacil ROC (Calculated Using PWC version 1.52)

Run Name	Use Site	PWC Scenario	# of Apps, Single App Rate lbs a.i./A (kg/ha)	1-in-10 year mean EEC Water Column (µg/L)		
				1-day	21-day	60-day
ILCornSTD_Preplant_Preemerg_2x0.067_7_ILCornSTD	Corn	ILCornSTD	2x0.067 (0.075)	1.63	1.58	1.51
INcornSTD_Preplant_Preemerg_2x0.067_7_INCornStd	Corn	INcornSTD	2x0.067 (0.075)	2.51	2.45	2.30
KScornSTD_Preplant_Preemerg_2x0.067_7_KSCornStd	Corn	KScornSTD	2x0.067 (0.075)	3.14	3.03	2.80

Run Name	Use Site	PWC Scenario	# of Apps, Single App Rate lbs a.i./A (kg/ha)	1-in-10 year mean EEC Water Column (µg/L)		
				1-day	21-day	60-day
MNcornSTD_Preplant_Preemerg_2x0.067_7_MNCornStd	Corn	MNcornSTD	2x0.067 (0.075)	1.95	1.92	1.83
MScornSTD_Preplant_Preemerg_2x0.067_7_MScornSTD	Corn	MScornSTD	2x0.067 (0.075)	3.55	3.48	3.24
NCcornESTD_Preplant_Preemerg_2x0.067_7_NCcornESTD	Corn	NCcornESTD	2x0.067 (0.075)	1.15	1.12	1.06
NEcornSTD_Preplant_Preemerg_2x0.067_7_NECornStd	Corn	NEcornSTD	2x0.067 (0.075)	4.07	3.91	3.53
OHcornSTD_Preplant_Preemerg_2x0.067_7_OHCornSTD	Corn	OHcornSTD	2x0.067 (0.075)	2.64	2.58	2.39
PAcornSTD_Preplant_Preemerg_2x0.067_7_PAcornSTD	Corn	PAcornSTD	2x0.067 (0.075)	1.36	1.33	1.26
CAcotton_WirrigSTD_Preplant_Preemerg_3x0.067_7_CAcotton_WirrigSTD	Cotton	CAcotton_WirrigSTD	3x0.067 (0.075)	0.58	0.56	0.53
MScottonSTD_Preplant_Preemerg_3x0.067_7_MScottonSTD	Cotton	MScottonSTD	3x0.067 (0.075)	3.83	3.72	3.48
NCcottonSTD_Preplant_Preemerg_3x0.067_7_NCcottonSTD	Cotton	NCcottonSTD	3x0.067 (0.075)	2.99	2.85	2.70
CArightofwaYLF_V2_Postemerg_3x0.067_7_CArightofwaYLF_V2	Non-cropped	CArightofwaYLF_V2	3x0.067 (0.075)	0.67	0.67	0.63
RightOfWayBSS_Postemerg_3x0.067_7_RightOfWayBSS	Non-cropped	RightOfWayBSS	3x0.067 (0.075)	2.13	2.01	1.79
MSsoybeansSTD_Preplant_Preemerg_2x0.067_7_MSsoybeanSTD	Soybeans	MSsoybeanSTD	2x0.067 (0.075)	3.06	2.94	2.69
NDwheatSTD_Preplant_Preemerg_2x0.067_7_NDwheatSTD	Wheat	NDwheatSTD	2x0.067 (0.075)	1.09	1.05	1.00
Cagrapes_WirrigSTD_Postemerg_3x0.067_7_CAgrapes_WirrigSTD	Grapes	Cagrapes_WirrigSTD	3x0.067 (0.075)	0.22	0.21	0.20
NYgrapesSTD_Postemerg_3x0.067_7_NYGrapesSTD	Grapes	NYgrapesSTD	3x0.067 (0.075)	0.62	0.59	0.56
NDwheatSTD_Fallow_3x0.067_7_NDwheatSTD	Fallow	NDwheatSTD	3x0.067 (0.075)	2.26	2.26	2.15
ILCornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_ILCornSTD	Corn + Fallow	ILCornSTD	3x0.067, 1x0.022 (0.075, 0.025)	2.46	2.42	2.47
INcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_INCornStd	Corn + Fallow	INcornSTD	3x0.067, 1x0.022 (0.075, 0.025)	2.96	2.90	2.71
KScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_KSCornStd	Corn + Fallow	KScornSTD	3x0.067, 1x0.022 (0.075, 0.025)	3.61	3.49	3.22
MNcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MNCornStd	Corn + Fallow	MNcornSTD	3x0.067, 1x0.022 (0.075, 0.025)	2.28	2.26	2.16
MScornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScornSTD	Corn + Fallow	MScornSTD	3x0.067, 1x0.022 (0.075, 0.025)	4.45	4.31	3.97
NCcornESTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_NCcornESTD	Corn + Fallow	NCcornESTD	3x0.067, 1x0.022 (0.075, 0.025)	1.45	1.41	1.32
NEcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_NECornStd	Corn + Fallow	NEcornSTD	3x0.067, 1x0.022 (0.075, 0.025)	4.42	4.24	3.83

Run Name	Use Site	PWC Scenario	# of Apps, Single App Rate lbs a.i./A (kg/ha)	1-in-10 year mean EEC Water Column (µg/L)		
				1-day	21-day	60-day
OHcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_OHCornSTD	Corn + Fallow	OHcornSTD	3x0.067, 1x0.022 (0.075, 0.025)	3.21	3.13	2.93
PAcornSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_PAcornSTD	Corn + Fallow	PAcornSTD	3x0.067, 1x0.022 (0.075, 0.025)	1.58	1.54	1.46
CAcotton_WirrigSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_CAcotton_WirrigSTD	Cotton + Fallow	CAcotton_WirrigSTD	3x0.067, 1x0.022 (0.075, 0.025)	0.59	0.57	0.55
MScottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MScottonSTD	Cotton + Fallow	MScottonSTD	3x0.067, 1x0.022 (0.075, 0.025)	3.94	3.82	3.54
NCcottonSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_NCcottonSTD	Cotton + Fallow	NCcottonSTD	3x0.067, 1x0.022 (0.075, 0.025)	3.08	2.98	2.76
MSsoybeansSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_MSsoybeanSTD	Soybeans + Fallow	MSsoybeanSTD	3x0.067, 1x0.022 (0.075, 0.025)	3.62	3.49	3.16
NDwheatSTD_Preplant_Preemerg_Fallow_3x0.067+1x0.022_7_NDwheatSTD	Wheat + Fallow	NDwheatSTD	3x0.067, 1x0.022 (0.075, 0.025)	1.57	1.50	1.47

Appendix E. **Example Output for Terrestrial Modeling (T-REX)**

Upper Bound Kenaga Residues for RQ Calculation

Chemical Name:	Tiafenacil	
Use	Corn (except sweet corn)	
Formulation	0	
Application Rate	0.067	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 finch	LD50 (mg/kg-bw)	2000.00
	Mallard duck	LC50 (mg/kg-diet)	5455.00
	Bobwhite quail	NOAEL (mg/kg-bw)	0.00
	Bobwhite quail	NOAEC (mg/kg-diet)	56.00
Mammals	LD50 (mg/kg-bw)		2000.00
	LC50 (mg/kg-diet)		0.00
	NOAEL (mg/kg-bw)		8.01
	NOAEC (mg/kg-diet)		150.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	28.27
Tall Grass	12.96
Broadleaf plants	15.90
Fruits/pods/seeds	1.77
Arthropods	11.07

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	2133.50
100	2716.05
1000	3836.53

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams)		
	small	mid	large
	20	100	1000
Short Grass	32.19	18.36	8.22
Tall Grass	14.75	8.41	3.77
Broadleaf plants	18.11	10.33	4.62
Fruits/pods	2.01	1.15	0.51
Arthropods	12.61	7.19	3.22
Seeds	0.45	0.25	0.11

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	0.02	0.01	0.00
Tall Grass	0.01	0.00	0.00
Broadleaf plants	0.01	0.00	0.00
Fruits/pods	0.00	0.00	0.00
Arthropods	0.01	0.00	0.00
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs	
	Acute	Chronic

Short Grass	0.01	0.50
Tall Grass	0.00	0.23
Broadleaf plants	0.00	0.28
Fruits/pods/seeds	0.00	0.03
Arthropods	0.00	0.20

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
Grainivores	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	4395.66	17.60
	35	3556.56	14.24
	1000	1538.32	6.16
Granivores	15	4395.66	17.60
	35	3556.56	14.24
	1000	1538.32	6.16

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams)		
	15	35	1000
Short Grass	26.95	18.63	4.32
Tall Grass	12.35	8.54	1.98
Broadleaf plants	15.16	10.48	2.43
Fruits/pods	1.68	1.16	0.27
Arthropods	10.56	7.30	1.69
Seeds	0.37	0.26	0.06

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	0.01	1.53	0.01	1.31	0.00	0.70
Tall Grass	0.00	0.70	0.00	0.60	0.00	0.32
Broadleaf plants	0.00	0.86	0.00	0.74	0.00	0.39
Fruits/pods	0.00	0.10	0.00	0.08	0.00	0.04
Arthropods	0.00	0.60	0.00	0.51	0.00	0.27
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!	0.19
Tall Grass	#DIV/0!	0.09
Broadleaf plants	#DIV/0!	0.11
Fruits/pods/seeds	#DIV/0!	0.01
Arthropods	#DIV/0!	0.07

Appendix F. Supplemental Tables for Terrestrial Vertebrate Exposure Assessment

Table F-1. Summary of Dietary (mg a.i./kg-diet) and Dose-based Estimated Environmental Concentrations (EECs; mg a.i./kg-bw) as Food Residues for Birds, Reptiles, Terrestrial-Phase Amphibians and Mammals from Proposed Uses of Tiafenacil (T-REX v. 1.5.2, Upper-Bound 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)
Corn only (0.067 lbs ai/A X 2 app, 14-d minimum retreatment interval; ground)							
Short grass	28.27	32.19	18.36	8.22	26.95	18.63	4.32
Tall grass	12.96	14.75	8.41	3.77	12.35	8.54	1.98
Broadleaf plants/small insects	15.90	18.11	10.33	4.62	15.16	10.48	2.43
Fruits/pods/seeds (dietary only)	1.77	2.01	1.15	0.51	1.68	1.16	0.27
Arthropods	11.07	12.61	7.19	3.22	10.56	7.30	1.69
Seeds (granivore)	NA	0.45	0.25	0.11	0.37	0.26	0.06
Corn + Fallow (0.067 lbs ai/A X 3 + 0.022 X 1 app, 14-d minimum retreatment interval; ground)							
Short grass	28.27	32.19	18.36	8.22	26.95	18.63	4.32
Tall grass	12.96	14.75	8.41	3.77	12.35	8.54	1.98
Broadleaf plants/small insects	15.90	18.11	10.33	4.62	15.16	10.48	2.43
Fruits/pods/seeds (dietary only)	1.77	2.01	1.15	0.51	1.68	1.16	0.27
Arthropods	11.07	12.61	7.19	3.22	10.56	7.30	1.69
Seeds (granivore)	NA	0.45	0.25	0.11	0.37	0.26	0.06
Cotton only (0.067 lbs ai/A X 3 app, 14-d minimum retreatment interval; ground)							
Short grass	42.26	48.14	27.45	12.29	40.30	27.85	6.46

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)
Tall grass	19.37	22.06	12.58	5.63	18.47	12.76	2.96
Broadleaf plants/small insects	23.77	27.08	15.44	6.91	22.67	15.67	3.63
Fruits/pods/seeds (dietary only)	2.64	3.01	1.72	0.77	2.52	1.74	0.40
Arthropods	16.55	18.85	10.75	4.81	15.78	10.91	2.53
Seeds (granivore)	NA	0.67	0.38	0.17	0.56	0.39	0.09
Cotton + Fallow (0.067 lbs ai/A X 3 app + 0.022 X 1 app, 14-d minimum retreatment interval; ground)							
Short grass	28.27	32.19	18.36	8.22	26.95	18.63	4.32
Tall grass	12.96	14.75	8.41	3.77	12.35	8.54	1.98
Broadleaf plants/small insects	15.90	18.11	10.33	4.62	15.16	10.48	2.43
Fruits/pods/seeds (dietary only)	1.77	2.01	1.15	0.51	1.68	1.16	0.27
Arthropods	11.07	12.61	7.19	3.22	10.56	7.30	1.69
Seeds (granivore)	NA	0.45	0.25	0.11	0.37	0.26	0.06
Non-crop (0.067 lbs ai/A X 3 app, 14-d minimum retreatment interval; ground)							
Short grass	37.50	42.71	24.36	10.90	35.76	24.71	5.73
Tall grass	17.19	19.58	11.16	5.00	16.39	11.33	2.63
Broadleaf plants/small insects	21.09	24.02	13.70	6.13	20.11	13.90	3.22
Fruits/pods/seeds (dietary only)	2.34	2.67	1.52	0.68	2.23	1.54	0.36
Arthropods	14.69	16.73	9.54	4.27	14.00	9.68	2.24
Seeds (granivore)	NA	0.59	0.34	0.15	0.50	0.34	0.08
Soybeans (0.067 lbs ai/A X 2 app, 14-d minimum retreatment interval; ground)							

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)
Short grass	28.27	32.19	18.36	8.22	26.95	18.63	4.32
Tall grass	12.96	14.75	8.41	3.77	12.35	8.54	1.98
Broadleaf plants/small insects	15.90	18.11	10.33	4.62	15.16	10.48	2.43
Fruits/pods/seeds (dietary only)	1.77	2.01	1.15	0.51	1.68	1.16	0.27
Arthropods	11.07	12.61	7.19	3.22	10.56	7.30	1.69
Seeds (granivore)	NA	0.45	0.25	0.11	0.37	0.26	0.06
Wheat (0.067 lbs ai/A X 2 app, 14-d minimum retreatment interval; ground)							
Short grass	28.27	32.19	18.36	8.22	26.95	18.63	4.32
Tall grass	12.96	14.75	8.41	3.77	12.35	8.54	1.98
Broadleaf plants/small insects	15.90	18.11	10.33	4.62	15.16	10.48	2.43
Fruits/pods/seeds (dietary only)	1.77	2.01	1.15	0.51	1.68	1.16	0.27
Arthropods	11.07	12.61	7.19	3.22	10.56	7.30	1.69
Seeds (granivore)	NA	0.45	0.25	0.11	0.37	0.26	0.06
Grapes (0.067 lbs ai/A X 3 app, 14-d minimum retreatment interval; ground)							
Short grass	37.50	42.71	24.36	10.90	35.76	24.71	5.73
Tall grass	17.19	19.58	11.16	5.00	16.39	11.33	2.63
Broadleaf plants/small insects	21.09	24.02	13.70	6.13	20.11	13.90	3.22
Fruits/pods/seeds (dietary only)	2.34	2.67	1.52	0.68	2.23	1.54	0.36
Arthropods	14.69	16.73	9.54	4.27	14.00	9.68	2.24
Seeds (granivore)	NA	0.59	0.34	0.15	0.50	0.34	0.08

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)
Fallow (0.067 ai/A X 3 app and 0.022 lb/A x 1 app, 14-d minimum retreatment interval; ground)							
Short grass	37.50	42.71	24.36	10.90	35.76	24.71	5.73
Tall grass	17.19	19.58	11.16	5.00	16.39	11.33	2.63
Broadleaf plants/small insects	21.09	24.02	13.70	6.13	20.11	13.90	3.22
Fruits/pods/seeds (dietary only)	2.34	2.67	1.52	0.68	2.23	1.54	0.36
Arthropods	14.69	16.73	9.54	4.27	14.00	9.68	2.24
Seeds (granivore)	NA	0.59	0.34	0.15	0.50	0.34	0.08

Table F-2. Chronic Risk Quotient (RQ) values for Mammals from Labeled Uses of Tiafenacil (T-REX v. 1.5.2, Upper-Bound Kenaga)[1].

Food Type	Chronic Dose-Based RQ NOAEL = 5.6 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 80 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Corn only (0.067 lbs ai/A X 2 app; ground)				
Herbivores/Insectivores				
Short grass	**1.53**	**1.31**	0.70	0.19
Tall grass	0.70	0.60	0.32	0.09
Broadleaf plants	0.86	0.74	0.39	0.11
Fruits/pods/seeds	0.10	0.08	0.04	0.01
Arthropods	0.60	0.51	0.27	0.07
Granivores				
Seeds	0.02	0.02	0.01	N/A
Corn + Fallow (0.067 lbs ai/A X 3 app + 0.022 X 1 app, 14-d minimum retreatment interval; ground)				
Herbivores/Insectivores				
Short grass	0.54	0.46	0.25	0.07
Tall grass	0.23	0.20	0.11	0.03
Broadleaf plants	0.29	0.25	0.13	0.04
Fruits/pods/seeds	0.04	0.04	0.02	0.01
Arthropods	0.41	0.35	0.19	0.05
Granivores				
Seeds	0.01	0.01	<0.01	N/A
Cotton only (0.067 lbs ai/A X 3 app; ground)				
Herbivores/Insectivores				
Short grass	**2.29**	**1.96**	**1.05**	0.28
Tall grass	**1.05**	0.90	0.48	0.13
Broadleaf plants	**1.29**	**1.10**	0.59	0.16
Fruits/pods/seeds	0.14	0.12	0.07	0.02
Arthropods	0.90	0.77	0.41	0.11
Granivores				
Seeds	0.03	0.03	0.01	N/A
Cotton + Fallow (0.067 lbs ai/A X 3 app + 0.022 X 1 app, 14-d minimum retreatment interval; ground)				
Herbivores/Insectivores				
Short grass	**2.88**	**2.46**	**1.32**	0.57
Tall grass	**1.32**	**1.13**	0.60	0.26
Broadleaf plants	**1.62**	**1.38**	0.74	0.32
Fruits/pods/seeds	0.18	0.15	0.08	0.04
Arthropods	**1.13**	0.96	0.52	0.22
Granivores				
Seeds	0.04	0.03	0.02	N/A
Non-crop (0.067 lbs ai/A X 3 app; ground)				
Herbivores/Insectivores				
Short grass	**2.03**	**1.73**	0.93	0.25
Tall grass	0.93	0.80	0.43	0.11
Broadleaf plants	**1.14**	0.98	0.52	0.14
Fruits/pods/seeds	0.13	0.11	0.06	0.02
Arthropods	0.80	0.68	0.36	0.10
Granivores				
Seeds	0.03	0.02	0.01	N/A
Soybeans (0.067 lbs ai/A X 2 app; ground)				

Food Type	Chronic Dose-Based RQ NOAEL = 5.6 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 80 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Herbivores/Insectivores				
Short grass	**1.53**	**1.31**	0.70	0.19
Tall grass	0.70	0.60	0.32	0.09
Broadleaf plants	0.86	0.74	0.39	0.11
Fruits/pods/seeds	0.10	0.08	0.04	0.01
Arthropods	0.60	0.51	0.70	0.07
Granivores				
Seeds	0.02	0.02	0.01	N/A
Wheat (0.067 lbs ai/A X 2 app; ground)				
Herbivores/Insectivores				
Short grass	1.53	**1.31**	0.70	0.19
Tall grass	0.70	0.60	0.32	0.09
Broadleaf plants	0.86	0.74	0.39	0.11
Fruits/pods/seeds	0.10	0.08	0.04	0.01
Arthropods	0.60	0.51	0.70	0.07
Granivores				
Seeds	0.02	0.02	0.01	N/A
Grapes (0.067 lbs ai/A X 3 app; ground)				
Herbivores/Insectivores				
Short grass	**2.03**	**1.73**	0.93	0.25
Tall grass	0.93	0.80	0.43	0.11
Broadleaf plants	**1.14**	0.98	0.52	0.14
Fruits/pods/seeds	0.13	0.11	0.06	0.02
Arthropods	0.80	0.68	0.36	0.10
Granivores				
Seeds	0.03	0.02	0.01	N/A
Fallow (0.067 ai/A X 3 app and 0.022 lb/A x 1 app; ground)				
Herbivores/Insectivores				
Short grass	**2.03**	**1.73**	0.93	0.25
Tall grass	0.93	0.80	0.43	0.11
Broadleaf plants	**1.14**	0.98	0.52	0.14
Fruits/pods/seeds	0.13	0.11	0.06	0.02
Arthropods	0.80	0.68	0.36	0.10
Granivores				
Seeds	0.03	0.02	0.01	N/A

Bolded values exceed the risk level of concern (LOC) of 1.0.

[1]The toxicity endpoints listed in the table are those used to calculate the RQ.

Appendix G. Example Output for Terrestrial Modeling (BeeREX)

Table 1. User inputs (related to exposure)

Description	Value
Application rate	0.067
Units of app rate	lb a.i./A
Application method	foliar spray
Are empirical residue data available?	no

Table 2. Toxicity data

Description	Value (µg a.i./bee)
Adult contact LD50	100.5
Adult oral LD50	100.5
Adult oral NOAEL	22
Larval LD50	4.6
Larval NOAEL	5.63

Table 3. Estimated concentrations in pollen and nectar

Application method	EECs (mg a.i./kg)	EECs (µg a.i./mg)

Table 5. Results (highest RQs)

Exposure	Adults	Larvae
Acute contact	0.0018	NA
Acute dietary	0.02	0.20
Chronic dietary	0.10	0.16

foliar spray	7.37	0.00737
soil application	NA	NA
seed treatment	NA	NA
tree trunk	NA	NA

Table 4. Daily consumption of food, pesticide dose and resulting dietary RQs for all bees

Life stage	Caste or task in hive	Average age (in days)	Jelly (mg/day)	Nectar (mg/day)	Pollen (mg/day)	Total dose (µg a.i./bee)	Acute RQ	Chronic RQ
Larval	Worker	1	1.9	0	0	0.00014003	3.0441E-05	2.49E-05
		2	9.4	0	0	0.00069278	0.0001506	0.000123
		3	19	0	0	0.0014003	0.00030441	0.000249
		4	0	60	1.8	0.455466	0.09901435	0.0809
		5	0	120	3.6	0.910932	0.1980287	0.1618
	Drone	6+	0	130	3.6	0.984632	0.21405043	0.17489
	Queen	1	1.9	0	0	0.00014003	3.0441E-05	2.49E-05
		2	9.4	0	0	0.00069278	0.0001506	0.000123
		3	23	0	0	0.0016951	0.0003685	0.000301
		4+	141	0	0	0.0103917	0.00225907	0.001846
Adult	Worker (cell cleaning and capping)	0-10	0	60	6.65	0.4912105	0.00488767	0.022328
	Worker (brood and queen tending, nurse bees)	6 to 17	0	140	9.6	1.102552	0.01097067	0.050116
	Worker (comb building, cleaning and food handling)	11 to 18	0	60	1.7	0.454729	0.00452467	0.02067

	Worker (foraging for pollen)	>18	0	43.5	0.041	0.32089717	0.00319301	0.014586
	Worker (foraging for nectar)	>18	0	292	0.041	2.15234217	0.02141634	0.097834
	Worker (maintenance of hive in winter)	0-90	0	29	2	0.22847	0.00227333	0.010385
	Drone	>10	0	235	0.0002	1.731951474	0.01723335	0.078725
	Queen (laying 1500 eggs/day)	Entire lifestage	525	0	0	0.0386925	0.000385	0.001759

Appendix H. ECOSAR Toxicity Predictions for Tiafenacil and Degradates

Compound (compound class used by ECOSAR)	Toxicity Endpoint (mg ai/L)					
	Acute Studies			Chronic Studies		
	96-h Freshwater Fish LC_{50}	48-h Daphnid LC_{50}	96-hr Green Algae EC_{50}	Chronic Fish	Chronic Daphnid	Chronic Green Algae
Measured Values from Registrant-submitted Studies						
Parent	>75.6	>75.6	0.00476	0.016	0.605	0.002
Estimated Values from ECOSAR Analysis						
Esters	368.65	876.28	454.78	36.07	858.92	77.63
Amides	1356.94	1595.28	104.35	10.23	166.62	38.31
Carbonyl ureas	390.61	97.14	0.04	2.24	23.91	0.01

Appendix I. Ecological Effects

EPA MRID 50486852 EPA Guideline 850.1075

In a 96-h acute toxicity study with freshwater fish, rainbow trout (*Oncorhynchus mykiss*) were exposed to technical grade tiafenacil (DCC-3825; 97.3% active ingredients; a.i.) at nominal concentrations of 0 (negative control), 10 and 100 mg ai/L under static conditions. Analytical verification was only performed for the nominal 100 mg ai/L test concentration, resulting in a 0 – 96 hr mean-measured concentration of 75.6 mg ai/L (76% of nominal). Observations for mortality and sub-lethal effects were made daily. After 96 hours of exposure, no sublethal effects or mortality were evident in any control or tiafenacil treatment group. Therefore, the reviewer's 96-h LC_{50} value was >75.6 mg ai/L. Based on the results of this study, Tiafenacil would be classified as no more than slightly toxic to *O. mykiss* on an acute exposure basis in accordance with the classification system of the U.S. EPA. This study is scientifically sound and is classified as acceptable.

EPA MRID 50486866 EPA Guideline 850.1400

The 33-day chronic toxicity of technical grade tiafenacil (98.6% active ingredient; a.i.) to the early life-stage of the freshwater Fathead Minnow (*Pimephales promelas*; <24 hours old) was studied under flow-through conditions. Fertilized eggs/embryos (80/level, <24 hours old) were exposed to tiafenacil at nominal concentrations of 0 (negative and solvent [dimethylformamide; DMF; 0.1 mL/L] controls), 2.56, 6.4, 16, 40, and 100 µg ai/L, representing mean-measured concentrations of <2.0 (<LOQ, controls), 2.51, 6.3, 16, 40, and 99 µg ai/L (%CV=2-4%). The test system was maintained at 24.0 to 25.1°C, dissolved oxygen of 6.5 to 8.2 mg/L and a pH of 8.0 to 8.4. No significant treatment-related effects were detected for clinical signs or time to hatch. Although there were statistically significant ($p<0.05$) decreases in the fish total length for the 2.51, 6.3, 16 µg ai/L treatment groups compared to the negative control, the reductions in length were not considered to be biologically significant because they did not follow a concentration-responsive pattern. The 33-day NOAEC and LOAEC values are 16 and 40 µg ai/L, respectively based on statistically significant reductions in growth (*i.e*., 4.9% reduction in total length, 10% reduction in wet weight and a 15% reduction in dry wet) at the LOAEC. This study is scientifically sound and is classified as acceptable.

EPA MRID 50486867 EPA Guideline 850.1400

The 33-day chronic toxicity of technical grade tiafenacil (98.6% active ingredient; a.i.) to the early life-stage of the freshwater Fathead Minnow (*Pimephales promelas*; <24 hours old) was studied under flow-through conditions. Fertilized eggs/embryos (80/level, <24 hours old) were exposed to tiafenacil at nominal concentrations of 0 (negative and solvent [dimethylformamide; DMF; 0.1 mL/L] controls), 2.56, 6.4, 16, 40, and 100 µg ai/L, representing mean-measured concentrations of <2.0 (<LOQ, controls), 2.51, 6.3, 16, 40, and 99 µg ai/L (%CV=2-4%). The test

system was maintained at 24.0 to 25.1°C, dissolved oxygen of 6.5 to 8.2 mg/L and a pH of 8.0 to 8.4. No significant treatment-related effects were detected for clinical signs or time to hatch. Although there were statistically significant ($p<0.05$) decreases in the fish total length for the 2.51, 6.3, 16 µg ai/L treatment groups compared to the negative control, the reductions in length were not considered to be biologically significant because they did not follow a concentration-responsive pattern. The 33-day NOAEC and LOAEC values are 16 and 40 µg ai/L, respectively based on statistically significant reductions in growth (*i.e*., 4.9% reduction in total length, 10% reduction in wet weight and a 15% reduction in dry wet) at the LOAEC. This study is scientifically sound and is classified as acceptable.

EPA MRID 50486857 EPA Guideline 850.1010

The 48-hour acute toxicity of technical grade tiafenacil (DCC-3825**;** 97.3% active ingredients; ai**)** to the freshwater invertebrate Waterflea (*Daphnia magna*) was studied under static conditions in a combined limit and range-finding study. Daphnids were exposed to tiafenacil at nominal concentrations of 0 (negative control) and 0.10, 1.0, 10, and 100 mg/L solution for 48 hr (representing mean-measured concentrations of 0 [negative control], 0.0755, 0.755, 7.55, and 75.5 mg ai/L, respectively based on the analytical recovery at the highest treatment level). Observations for mortality were made daily. After 48 hours of exposure, there was no mortality in the negative control or in the 75.5 mg ai/L mean-measured concentration. The 48-hour EC_{50} was visually estimated to be >75.5 mg ai/L. The study author did not evaluate sublethal effects. Based on the results of this study, technical grade tiafenacil (DCC-3825) would be classified as no more than slightly toxic to *D. magna* on an acute exposure basis in accordance with the classification system of the U.S. EPA. This study is scientifically sound and is classified as acceptable.

EPA MRID 50486864 EPA Guideline 850.1300

The 21-day chronic toxicity of technical grade tiafenacil (DCC-3825; 98.04% active ingredients; a.i.) to freshwater invertebrate daphnids (*Daphnia magna*; <24 hours old) was studied under static-renewal conditions. Daphnids were exposed to tiafenacil at the nominal concentrations of 0 (negative control), 0.307, 0.613, 1.23, 2.45, and 4.90 mg ai/L; representing mean-measured concentrations of <0.05 (<LOD, control), 0.295, 0.605, 1.20, 2.50, and 4.76 mg ai/L, respectively. The following endpoints were statistically ($p<0.05$) different as a result of tiafenacil exposure: (i) parental survival was decreased by 60% at 4.76 mg ai/L relative to the negative control; (ii) time to first brood was significantly delayed at ≥2.50 mg ai/L; and, (iii) the mean number of live offspring per surviving adult and successful birth rate were decreased at ≥1.20 mg ai/L. Based on a treatment-related 9% reduction in offspring production at the ≥1.20 mg ai/L exposure levels, the NOAEC and LOAEC are 0.605 and 1.20 mg ai/L, respectively. No treatment-related effects were observed on growth (length) at any of the exposure concentrations tested. This study is scientifically sound and is classified as acceptable.

EPA MRID 50486862 EPA Guideline 850.1035

In a 96-h acute toxicity study, estuarine/marine invertebrate mysid shrimp (*Americamysis bahia*; <24 hours old) were exposed to technical grade tiafenacil (DCC-3825 98.04% active ingredients; a.i.) at nominal concentrations of 0 (negative and solvent [dimethylformamide; 0.1 mL/L] control), 0.13, 0.25, 0.50, 1.0, and 2.0 mg ai/L (representing mean-measured concentrations of <0.0250 (<LOQ, controls), 0.12, 0.22, 0.47, 0.95, and 1.9 mg ai/L) under flow-through conditions. Mortality at test termination was 5, 5, 35, 55, and 100% in the measured 0.12, 0.22, 0.47, 0.95, and 1.9 mg ai/L treatment concentrations, respectively. No mortalities were observed in either control group. The 96-h LC_{50} value was 0.65 mg ai/L. Sublethal effects (lethargy and erratic swimming) were observed in the groups exposed to 0.47, 0.95, and 1.9 mg ai/L. Based on the results of this study, tiafenacil DCC-3825 would be classified as highly toxic to *A. bahia* on an acute exposure basis in accordance with the classification system of the U.S. EPA. This study is scientifically sound and is classified as acceptable.

EPA MRID 50486865 EPA Guideline 850.1350

The 30-day chronic toxicity of technical grade tiafenacil (DCC-3825; 98.6% active ingredients; a.i.) to the mysid shrimp (*Americamysis bahia*) was studied under flow-through conditions. Mysids (<24-hours old) were exposed to nominal concentrations of 0 (negative and solvent [triethyleneglycol; TEG; 50 µL/L] controls), 47, 94, 188, 375, and 750 µg ai/L, representing mean-measured concentrations of <25.0 (<LOQ, controls), 42, 86, 175, 347, and 658 µg ai/L, respectively. Parental (F_0) growth could not be assessed in the highest treatment level (658 µg ai/L); therefore, the NOAEC for male and female length and weight is 347 µg ai/L. Parental survival pre- and post-pairing had NOAEC values of 175 and 347 µg ai/L, respectively. The number of offspring per female and time to first brood were the most sensitive endpoints measured. The resulting NOAEC and LOAEC values are 86 and 175 µg ai/L, respectively, based on a 79% reduction in the number of offspring per female and 10.6% increase in time to first brood. This study is scientifically sound and is classified as acceptable.

EPA MRID 50486882 EPA Guideline 850.4400

In a 7-day toxicity study, fronds of the freshwater floating aquatic vascular plant duckweed (*Lemna gibba* G3) were exposed to the tiafenacil formulated end-use product DCC-3825 70% WG (71.47% active ingredients; ai) under static renewal conditions at nominal formulation concentrations of 0 (negative control), 1.4, 3.6, 9.0, 23, 56, and 141 mg/L(equivalent to nominal concentrations of active ingredient of 0 (negative control), 1.0, 2.6, 6.4, 16, 40, and 100 µg ai/L, respectively). The test substance was unstable under the test conditions, with coefficients of variation ranging from 26 to 32%. The reviewer calculated time-weighted average (TWA) concentrations were less than the level of quantification of 0.250 (<LOQ; negative control), 0.769, 2.12, 5.22, 13.2, 33.2, and 79.1 µg ai/L (corresponding to 1.08, 2.97, 7.30, 18.4, 46.4, and 111 µg formulation/L). Sub-lethal effects of chlorotic fronds, necrotic fronds, breakup of colonies, root destruction, curled fronds, and/or small fronds were observed in groups exposed to DCC-3825 70 WG at 13.2, 33.2, and 79.1 µg ai/L on Days 3, 5, and 7. By Day 7, the group exposed to 5.22 µg ai/L was affected. The control, 0.769 and 2.12 µg ai/L groups were affected

on Day 7. Frond yield was the most sensitive endpoint, with a NOAEC and IC_{50} of 0.769 and 5.57 µg ai/L, respectively (corresponding to 1.08 and 7.79 µg form/L, respectively). The results of a 7-day post-exposure recovery test indicate that DCC-3825 70 WG is phytocidal at concentrations ≥13.2 µg ai/L. This study is scientifically sound and is classified as acceptable.

EPA MRID 50486888 EPA Guideline 850.4500

In a 96-hour toxicity study, cultures of freshwater green alga *Raphidocelis subcapitata* (formerly *Pseudokirchneriella subcapitata*) were exposed to the tiafenacil formulated end-use product DCC-3825 30 SC (30.7% active ingredients; ai) at nominal formulation concentrations of 0 (control), 2.1, 4.2, 8.1, 16, and 33 µg formulation/L (corresponding to nominal tiafenacil concentrations of 0 (control), 0.63, 1.3, 2.5, 5.0, and 10 µg ai/L) under static conditions. Analytical confirmation demonstrated that tiafenacil declined over the course of the study. Due to a decline in measured concentrations during the exposure period, statistical analysis and endpoints expressed by the reviewers are based on the initial measured tiafenacil concentrations of less than the limit of quantification (LOQ) of 0.550 (control), 0.669, 1.26, 2.57, 5.06, and 10.3 µg ai/L corresponding to formulation concentrations of <LOQ (<0.550, control), 2.18, 4.10, 8.37, 16.5, and 33.6 µg form/L, respectively; which were calculated by the reviewer using the initial measured tiafenacil concentrations along with the percent purity of the active ingredient in the formulation. The study author reported that after 96 hours of exposure, there was no flocculation or aggregation of cells nor adherence of cells to the test chambers in any of the tiafenacil-treated or control groups. Algal cells in all tiafenacil-treated groups appeared normal when compared to cells in the negative control. The percent inhibition of growth in the tiafenacil-treated algal cultures relative to the negative control ranged from 0 to 93%. After 96 hours, the most sensitive endpoints were yield and biomass (area under the curve; AUC), with an IC_{50} value of 4.55 µg ai/L and a NOAEC of 2.57 µg ai/L, respectively, based on the initial measured tiafenacil concentrations. This corresponds to an IC_{50} of 14.8 µg form/L and a NOAEC value 8.37 µg form/L, for both yield and AUC. This study is scientifically sound and is classified as acceptable.

EPA MRID 50486851 EPA Guideline 850.2300

The one-generation reproductive toxicity of technical grade tiafenacil (DCC-3825; 98.04% active ingredient; a.i.) to 27-week old mallard duck (*Anas platyrhynchos*) was assessed over *ca.* 20 weeks. Tiafenacil was administered to the birds (18 pairs per treatment) in the diet at nominal concentrations of 0 (control), 400, 1400, and 5000 mg ai/kg diet, representing mean-measured concentrations of <25.0 (<limit of quantitation [LOQ], control), 398, 1438, and 5099 mg ai/kg diet. The overall NOAEC and LOAEC were 1,438 and 5,099 mg ai/kg diet, respectively. At the LOAEC of 5,099 mg ai/kg diet there was a 21% decrease in the number of viable embryos per eggs set, a 22% decrease in the number of live embryos per eggs set, 27% reduction in the number of hatchlings per eggs set, a 28% reduction in the number of surviving hatchlings, and a 5.4% reduction in 14-day survivor weight. No treatment-related effects were detected for any

other measurement endpoint evaluated. This study is scientifically sound and is classified as acceptable.

EPA MRID 50486832 EPA Guideline 870.3800

A two-generation reproduction toxicity study in rats was conducted to evaluate the potential effects of continuous dietary administration of Tiafenacil TGAI on reproductive performance of male and female rats and on the growth and development of their offspring. Each group consisted of 24 male and 24 female Crl:CD(SD) rats, which were given diets containing Tiafenacil TGAI at concentration of 0, 10, 50, or 150 ppm for two successive generations. No general toxic effect of test substance treatment on P and F1 parental rats was observed in the 10 and 50 ppm groups for any parameters such as clinical findings, body weights, body weight gains, food consumption, hematological observations, or pathological findings. In the 150 ppm group, statistically significant low values were observed in body weight on lactation day 4 as well as body weight gains during treatment weeks 0-1 and lactation days 0-4 for P parental females. As for reproductive performance in P and F1 parental rats, there were no specific treatment-related effects in any of the treated groups in such reproductive parameters as sexual development, incidence of females with normal estrous cycles (cyclicity of estrous cycle), estrous cycle length, mating index, number of days until mating, fertility index, gestation index, duration of gestation, number of implantation sites, testicular sperm head counts, or epididymal sperm number, percent motility and percent normal morphology. No test substance treatment effect on F1 and F2 pups was noted in any of the treated groups for any parameters such as clinical findings, number of pups delivered, sex ratio, viability index during the lactation period, body weights, or pathological observations. Mean liver porphyrin concentrations (total porphyrin content), which were determined in the additional study5), increased significantly in both sexes of parental animals in the P generation and F1 weanlings in the 150 ppm group, yet no such changes were observed in the 10 and 50 ppm groups. These results suggest that the Tiafenacil TGAI-specific toxicity was surely induced at the dose level of 150 ppm in the present study since the symptom, an increase in porphyrin content in the liver, is confirmed to be the test compound-specific in the previous studies6). Based on these results and the reference, it is concluded for Tiafenacil TGAI that the dose level of 50 ppm is the no-observed-adverse-effect level (NOAEL) and dose level of 150 ppm is toxic level for general toxicity in parental rats. It is also concluded that the dose level of 150 ppm is the no-observed-adverse-effect level (NOAEL) for reproductive performance of parental rats. As for rat pups, the dose level of 50 ppm is the no-observed-adverse-effect level (NOAEL).

EPA MRID 50486873 OECD Test Guidelines 213 & 214

Adult honey bees, *Apis mellifera carnica* L., were exposed to technical grade tiafenacil DCC-3825 (97.3% active ingredients; a.i) for 48 hours in both oral and the contact toxicity limit tests at nominal doses of 0 (negative and solvent [acetone; 5%] controls) and 100.5 µg ai/bee; measured doses of tiafenacil in the oral toxicity limit test were 0 (negative and solvent controls) and 109.5 µg/bee. After 48 hours of exposure in the oral toxicity test, mortality averaged 2 and

0% in the negative and solvent controls, respectively, and there was no mortality in the single tiafenacil exposure group. No abnormal behaviors were observed in two control groups or in the limit dose group throughout the oral toxicity limit test. After 48 hours of exposure, mortality averaged 2% in both controls, but there was no mortality in the tiafenacil single exposure group, in the contact toxicity test. No abnormal behaviors were observed in either control groups or in the limit dose group throughout the contact toxicity limit test. The LD_{50} value for the oral toxicity test was >109.5 µg ai/bee. The LD_{50} value for the contact toxicity test was >100.5 µg ai/bee. Based on the results of this study, technical grade tiafenacil is categorized as practically non-toxic to adult honey bees on both an acute contact and oral exposure basis.

EPA MRID 50486876 OECD Test Guidelines 237

Individual synchronized honey bee (*Apis mellifera* L.) larvae (first instar, 4 days old) were exposed *in vitro* to a single dose exposure to technical grade tiafenacil (DCC-3825; 98.6% active ingredient; a.i; TGAI) at nominal doses of 0.40, 0.80, 1.6, 3.2, and 6.4 µg ai/larva. Analytical determination of tiafenacil recovery was performed in the lowest and highest doses only. The reviewer used those recoveries to calculate measured doses for the low and high treatment groups and applied the average of those recoveries to calculate the measured doses of the remaining three treatment groups. Measured doses used for reviewer analysis and reporting were 0.37, 0.66, 1.3, 2.6, and 4.6 µg ai/larva. Larvae used in the study were from in-house stock bee hives maintained at the test facility. A negative and a solvent (i.e., untreated diet containing 0.5 % acetone) control were run; dimethoate was used as a reference toxicant at 8.8 µg ai/larva. All groups consisted of 3 replicates with 12 larvae/replicate for a total of 36 larvae; each larva was contained within a single grafting cell that was within a 48-well cell culture plate. On Day 4, the larvae were provided with treated diet or untreated control diet. On Days 5 and 6, larvae were provided untreated artificial diet. Survival was assessed daily during the treatment phase, and uneaten diet remaining was observed at test termination, Day 7 (72-hrs post tiafenacil treatment). On Day 7 (D7), cumulative larval mortality was 0 and 6% in the negative and solvent controls, respectively, and ranged from 0 to 3% mortality in the tiafenacil treatment groups. On D7, uneaten food was observed for 17, 26, 20, 17, and 8% of the living larvae of the measured 0.37, 0.66, 1.3, 2.6, and 4.6 µg ai/larva treatment groups as compared to 31 and 24% of the living larvae of the negative and solvent controls, respectively. Since these observations were recorded on Day 7 of the study; there is uncertainty as to the extent to which the larvae consumed the treated diet on Day 4. The NOAEL and 72-hr LD_{50} are 4.6 and >4.6 µg ai/larva, respectively and based on the results of this study, technical grade tiafenacil is classified as no more than moderately toxic to honey bee larvae on an acute oral exposure basis in accordance with the adult honey bee acute toxicity classification system of the U.S. EPA. The positive control (dimethoate), at a nominal dose of 8.8 µg ai/larva, caused mortality of 97.2% by Day 7. The study is scientifically sound is classified as acceptable.

EPA MRID 50486878 OECD Test Guidelines 239

Three-day old individual synchronized larval honey bees (*Apis mellifera*) were repeatedly exposed *in vitro* to technical grade tiafenacil (DCC-3825; 98.6% active ingredient; a.i.) at nominal concentrations of 0.813, 2,44, 7.33, 22,0, 66.1 and 198 mg a.i./kg diet.) for 4 consecutive days representing nominal cumulative doses of 0.12, 0.37, 1.11, 3.33, 10.0, and 30.0 µg a.i./larva. Mean measured concentrations were 0.72, 2.1, 6.31, 18.5, 54.4, and 149 mg a.i./kg diet, representing measured cumulative doses of 0.11, 0.31, 0.96, 2.80, 8.24, and 22.5 µg a.i./larva, respectively. Measured daily dose were 0.026, 0.078, 0.239, 0.701, 2.06, and 5.63 µg a.i./larva, respectively. Percent recoveries were applied to nominal cumulative doses to determine measured cumulative dose, and these values were then divided by the number of exposure days to the test material, 4, to get measured daily doses in µg ai/larva/day. Dimethoate was used as a reference toxicant at a nominal dose of 7.39 µg ai/bee. All treatment groups consisted of 3 replicates with 16 larvae/replicate for a total of 48 larvae per group, placed within 48-well cell culture plates. From Day 3, the larvae were observed daily until either mortality or adult emergence occurred. The adult emergence rate was assessed on Day 19, as all bees had emerged or were dead by Day 19; however, the reviewer refers to test termination as Day 22. Observations of sublethal effects, including the presence of uneaten diet and larvae with reduced body size, were recorded on Days 7 and 8.

On Day 8, larval mortality was 2% in both the negative and solvent (0.5% acetone) controls, as compared to mortality ranging from 0 to 6% in the treatment groups. On Day 22 (all bees had emerged or died by Day 19 in this study), the adult emergence rate was 94 and 90% in the negative and solvent controls, respectively, as compared to emergence ranging from 83 to 96% in the treatment groups. According to the study report, all living larvae had consumed their entire allotted diets by D8 with the exception of two bees in the measured daily dose of 0.078 µg ai/bee/day treatment group. Mortality in the reference toxicant (dimethoate), at the nominal dose of 7.39 µg ai/bee was 66.7% by Day 8. The NOAEC and EC_{50} for emergence are 149 and >149 mg ai/kg diet, respectively, corresponding to 5.63 and >5.63 µg ai/larva/day. Mortality and weight at emergence were also not significantly affected. The study is scientifically sound and is classified as acceptable.

EPA MRID 50486875 OECD draft (2016) guideline

Two-day old adult honey bees, *Apis mellifera* L., were exposed to technical grade tiafenacil (DCC-3825; 97.82% active ingredients; a.i) for 10 days in a feeding study at the measured concentrations of 311, 586, 1172, 2344 and 4400 mg ai/kg-diet. After 10 days of exposure, mortality was 0% in both the negative and solvent (4.5% acetone /0.5% Tween 80) controls as compared to mortality ranging from 0 to 20% in the treated groups. No behavioral abnormalities were observed in the control groups or in any of the tiafenacil treatment groups. The reference toxicant, dimethoate resulted in 100% mortality after 10 days. Based on measured concentrations, the 10-day NOAEC is 1,172 mg ai/kg diet and the NOAEL is 22 µg ai/bee/day.

EPA MRID 50486880 EPA Guideline 850. 4150

The effect of the tiafenacil formulated end-use product DCC-3825 70 WG (70% active ingredients; a.i.) on the vegetative vigor of monocotyledonous crops (monocot: corn, *Zea mays*; onion, *Allium cepa*; oat, *Avena sativa;* and ryegrass, *Lolium perenne*) and dicotyledonous crops (dicot: cabbage, *Brassica oleracea*; carrot, *Daucus carota*; cucumber, *Cucumis sativus*; lettuce, *Lactuca sativa*; soybean, *Glycine max*; and tomato, *Lycopersicon esculentum*) crops was studied at nominal concentrations of 0 (negative and adjuvant [Phase-II®; methylated seed oil] controls), 0.000021, 0.000062, 0.00018, 0.00054, 0.0017, 0.0050, 0.015, and 0.045 lb ai/A. Tiafenacil treatment rates were analytically confirmed at all treatment levels and measured rates were <0.0000049 (<LOD, negative and adjuvant controls), 0.000059, 0.00017, 0.00064, 0.0017, 0.0049, and 0.014 lb ai/A for cabbage; <0.0000049 (<LOD, negative and adjuvant controls), 0.000045, 0.00012, 0.00036, 0.0011, 0.0031, 0.0051, 0.015, and 0.044 lb ai/A for cucumber, onion and ryegrass; <0.0000049 (<LOD, negative and adjuvant controls), 0.000020, 0.000063, 0.00021, 0.00060, 0.0017, 0.0055, and 0.016 lb ai/A for tomato; <0.0000049 (<LOD, negative and adjuvant controls), 0.000022, 0.000063, 0.00019, 0.00053, 0.0016, 0.0049, and 0.015 lb ai/A for carrot and oat; <0.0000049 (<LOD, negative and adjuvant controls), 0.000075, 0.00019, 0.00049, 0.0014, 0.0039, and 0.013 lb ai/A for soybean; and <0.0000049 (<LOD, negative and adjuvant controls), 0.000075, 0.00021, 0.00056, 0.0016, 0.0048, and 0.014 lb ai/A for corn and lettuce.

Survival in both the negative and adjuvant control was 100%. The reviewer detected significant (p<0.05) inhibitions in survival in all species tested. Significant reductions in carrot survival were 19, 50, and 64% at 0.0016, 0.0049, and 0.015 lb ai/A, respectively; in lettuce survival were 25, 64, and 97% at 0.00056, 0.0016, and 0.0048 lb ai/A, respectively; and in onion survival was reduced by 6, 8, 8, and 28% at 0.0031, 0.0051, 0.015, and 0.044 lb ai/A, respectively, compared to the negative control (Jonckheere-Terpstra Step-Down test, p<0.05). There was a significant reduction in cabbage survival of 47% at 0.014 lb ai/A; in oat, survival was reduced by 19% at 0.015 lb ai/A; and in ryegrass survival was reduced by 31 and 72% at 0.0031 and 0.0051 lb ai/A, respectively, compared to the negative control (Whitney U Two-Sample test, p<0.05). There was a significant reduction in corn survival of 47% at 0.014 lb ai/A; in cucumber survival was reduced by 37, 62, and 83% at 0.0011, 0.0031, and 0.0051 lb ai/A, respectively; in soybean survival was reduced by 43 and 87% at 0.0039 and 0.013 lb ai/A, respectively; and in tomato survival was reduced by 60 and 80% at 0.0055 and 0.016 lb ai/A, respectively, compared to the negative control (Fisher Exact/Bonferroni-Holm test, p<0.05).

The reviewer detected significant (p<0.05) reductions in plant height for all species tested except cabbage. There were significant reductions in corn height of 12, 15, 29, 35, 47, and 64% at 0.000075, 0.00021, 0.00056, 0.0016, 0.0048, and 0.014 lb ai/A, respectively; in ryegrass, height was reduced by 6 and 11% at 0.0031 and 0.0051 lb ai/A, respectively; and in lettuce, height was reduced by 23 and 55% at 0.0016 and 0.0048 lb ai/A, respectively, compared to the negative control (William's Multiple Comparison test, p<0.05). Only one lettuce plant survived to test termination at 0.0048 lb ai/A. There were significant reductions in cucumber height of 31 and 43% at 0.0031 and 0.0051 lb ai/A, respectively; in onion there were significant reductions in height of 7, 27, 17, and 29% at 0.0031, 0.0051, 0.015, and 0.044 lb ai/A, respectively; in soybean height was reduced by 12, 23, 45, 58, 82, and 90% at 0.000075, 0.00019, 0.00049, 0.0014, 0.0039, and 0.013 lb ai/A, respectively; and in tomato height was reduced by 23 and 42% at 0.0055 and 0.016 lb ai/A, respectively, compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$). There was a significant reduction in oat height of 35% at 0.015 lb ai/A; and there was a significant reduction in carrot height of 16% at 0.015 lb ai/A compared to the negative control (Mann-Whitney U Two-Sample test, $p<0.05$). Carrot negative control height was significantly lower than adjuvant control height ($p=0.0131$).

The reviewer detected significant ($p<0.05$) reductions in plant dry weight for all species tested. There were significant reductions in cabbage dry weight of 25 and 35% at 0.0049 and 0.014 lb ai/A, respectively; there were significant reductions in cucumber dry weight of 14, 34, 43, 50, and 46% at 0.00012, 0.00036, 0.0011, 0.0031, and 0.0051 lb ai/A, respectively; in lettuce, dry weight was reduced by 23, 30, and 62% at 0.00056, 0.0016, and 0.0048 lb ai/A, respectively, compared to the negative control (William's Multiple Comparison test, $p<0.05$). Only one lettuce plant survived to test termination at 0.0048 lb ai/A. There were significant reductions in ryegrass dry weight of 28 and 37% at 0.0031 and 0.0051 lb ai/A, respectively, compared to the negative control (William's Multiple Comparison test, $p<0.05$). Ryegrass negative control dry weight was significantly lower than adjuvant control dry weight ($p=0.0063$). There were significant reductions in corn dry weight of 29, 59, 51, 72, and 79% at 0.00021, 0.00056, 0.0016, 0.0048, and 0.014 lb ai/A, respectively; in soybean, dry weight was reduced by 22, 44, 67, 72, and 69% at 0.00019, 0.00049, 0.0014, 0.0039, and 0.013 lb ai/A, respectively; in tomato, dry weight was reduced by 20, 21, 35, 44, 45, and 56% at 0.000063, 0.00021, 0.00060, 0.0017, 0.0055, and 0.016 lb ai/A, respectively; and in oat, dry weight was reduced by 22, 31, 18, and 47% at 0.00053, 0.0016, 0.0049, and 0.015 lb ai/A, respectively, compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$). Oat negative control dry weight was significantly lower than adjuvant control dry weight ($p=0.0060$). There were significant inhibitions in onion dry weight of 26, 48, 22, and 44% at 0.0031, 0.0051, 0.015, and 0.044 lb ai/A, respectively, compared to the negative control (Dunnett's Multiple Comparison test, $p<0.05$). Onion adjuvant control dry weight was significantly lower than negative control dry weight ($p=0.0362$). There were significant inhibitions in carrot dry weight of 16, 25, 26, and 22% at 0.00019, 0.00053, 0.0016, and 0.015 lb ai/A, respectively, compared to the negative control (Mann-Whitney U Two-Sample test, $p<0.05$). This however does not appear to be biologically significant.

The most sensitive monocot was corn based on reductions in plant dry weight, with NOAEC and IC_{25} values of 0.000075 and 0.0000815 lb ai/A, respectively. Significant mortality at the highest treatment level for corn may have impacted the validity of growth endpoints; therefore, these results should be interpreted with caution. The most sensitive dicot was soybean based on reductions in plant height, with NOAEC and IC_{25} values of <0.000075 and 0.000197 lb ai/A, respectively. Significant mortality at the highest treatment level for soybean may have impacted the validity of growth endpoints. Additionally, significant inhibitions in soybean height were detected at all treatment levels and the NOAEC and IC_{05} were not bracketed by the range of test concentrations. Therefore, these results should be interpreted with caution. Based on the phytotoxicity rating system used by the study author, no phytotoxicity was observed in the negative and adjuvant control groups for any species tested. In the treatment groups, oat displayed “moderate” phytotoxicity; cabbage, carrot, corn, onion, ryegrass, soybean, and tomato displayed “severe” phytotoxicity; cucumber displayed “severe” phytotoxicity and slightly deformed new growth; and lettuce displayed near complete phytotoxicity. Phytotoxic effects displayed a concentration-response in all species tested.

EPA MRID 50486879 EPA Guideline 850. 4100

The effect of the tiafenacil formulated end-use product DCC-3825 70 WG **(**70% active ingredient) on the seedling emergence of monocotyledonous crops (monocot: corn, *Zea mays*; onion, *Allium cepa*; oat, *Avena sativa;* and ryegrass, *Lolium perenne*) and dicotyledonous crops (dicot: cabbage, *Brassica oleracea*; carrot, *Daucus carota*; cucumber, *Cucumis sativus*; lettuce, *Lactuca sativa*; soybean, *Glycine max*; and tomato, *Lycopersicon esculentum*) crops was studied at nominal treatment rates of 0 (negative and adjuvant [esterified rapeseed oil; 1% v/v] controls), 0.0019, 0.0055, 0.017, 0.050, 0.15, and 0.45 lbs ai/A. Tiafenacil treatment rates were analytically confirmed at all treatment levels and measured rates were <0.0000050 (<LOD, negative and adjuvant controls), 0.0019 (cucumber only), 0.0058, 0.017, 0.052, 0.15, and 0.47 lb ai/A for cabbage, cucumber, and onion; <0.0000048 (<LOD, negative and adjuvant controls), 0.0018 (carrot and tomato only), 0.0054, 0.016, 0.049, 0.15, and 0.44 lb ai/A for carrot, corn, ryegrass, tomato; <0.0000048 (<LOD, negative and adjuvant controls), 0.0018 (lettuce only), 0.0056, 0.017, 0.049, 0.14, and 0.42 lb ai/A for lettuce and oat; and <0.0000050 (<LOD, negative and adjuvant controls), 0.0018, 0.0054, 0.016, 0.050, 0.15, and 0.45 lb ai/A for soybean.

Emergence ranged from 96 to 100% in the negative control and from 94 to 100% in the adjuvant control. The reviewer detected significant reductions in emergence for all species except oat, onion, and soybean. Significant reductions in cabbage emergence were 15, 26, 30, and 50% at 0.017, 0.052, 0.15, and 0.47 lb ai/A, respectively; in carrot emergence were 40 and 100% at 0.15 and 0.44 lb ai/A, respectively; in corn emergence were 13, 15, and 21% at 0.049, 0.15, and 0.44 lb ai/A, respectively; and in tomato emergence were 5, 78, 100, and 100% at 0.016, 0.049, 0.15, and 0.44 lb ai/A, respectively, compared to the negative control ($p<0.05$, Jonckheere-Terpstra Step-Down test). Significant reductions in lettuce emergence were 52, 90, and 88% at 0.049, 0.14, and 0.42 lb ai/A, respectively; and in ryegrass, emergence was 42% at 0.44 lb ai/A compared to the negative control ($p<0.05$, Mann-Whitney U Two-Sample test). Significant reductions in cucumber emergence were 18 and 23% at 0.15 and 0.47 lb ai/A, respectively, compared to the negative control ($p<0.05$, Fisher Exact/Bonferroni-Holm test).

The reviewer determined survival based on the number of seedlings planted. Survival ranged from 96 to 100% in the negative control and ranged from 90 to 100% in the adjuvant control. There were significant (p<0.05) inhibitions in survival for every species tested. Significant reductions in cabbage survival were 24, 39, 100, 100, and 100% at 0.0058, 0.017, 0.052, 0.15, and 0.47 lb ai/A, respectively; in carrot survival were 96 and 100% at 0.15 and 0.44 lb ai/A; no carrot plants emerged at 0.44 lb ai/A; in corn survival were 15, 31, and 87% at 0.049, 0.15, and 0.44 lb ai/A, respectively; in lettuce survival were 81, 98, and 100% at 0.049, 0.14, and 0.42 lb ai/A, respectively; in onion survival were 67 and 96% at 0.15 and 0.47 lb ai/A, respectively; in ryegrass survival were 8, 98, and 100% at 0.049, 0.15, and 0.44 lb ai/A, respectively; in soybean survival were 8, 30, and 88% at 0.050, 0.15, and 0.45 lb ai/A, respectively; and in tomato survival were 5, 85, 100, and 100% at 0.016, 0.049, 0.15, and 0.44 lb ai/A, respectively, compared to the negative control (p<0.05, Jonckheere-Terpstra Step-Down test). The significant inhibition in oat survival was 49% at 0.42 lb ai/A compared to the negative control (p<0.05, Mann-Whitney U Two-Sample test). Significant inhibitions in cucumber survival were 100 and 100% at 0.15 and 0.47 lb ai/A, respectively, compared to the negative control (p<0.05, Fisher Exact/Bonferroni-Holm test).

There were significant (p<0.05) inhibitions in height for all species tested. Significant reductions in carrot height were 12 and 20% at 0.049 and 0.15 lb ai/A, respectively, compared to the negative control (p<0.05, Williams' Multiple Comparison test); there were no emerged carrot plants at 0.44 lb ai/A. Significant reductions in corn height were 12, 22, and 73% at 0.049, 0.15, and 0.44 lb ai/A, respectively; and in oat height were 9, 37, and 70% at 0.049, 0.14, and 0.42 lb ai/A, respectively, compared to the negative control (p<0.05, Williams' Multiple Comparison test). Significant reductions in onion height were 13, 40, and 35% at 0.052, 0.15, and 0.47 lb ai/A treatments, respectively, compared to the negative control (p<0.05, Williams' Multiple Comparison test); there were only two surviving onion plants at 0.47 lb ai/A. Significant reductions in ryegrass height were 18, 50, and 78% at 0.016, 0.049, and 0.15 lb ai/A, respectively, compared to the negative control (p<0.05, Williams' Multiple Comparison test); there was only one surviving ryegrass plant at 0.15 lb ai/A and mortality was 100% at 0.44 lb ai/A. Significant reductions in tomato height were 23 and 65% at 0.016 and 0.049 lb ai/A, respectively, compared to the negative control (p<0.05, Williams' Multiple Comparison test); tomato mortality was 100% at 0.15 and 0.44 lb ai/A. Significant inhibitions in soybean height were 17, 36, and 67% at 0.050, 0.15, and 0.45 lb ai/A, respectively, compared to the negative control (p<0.05, Jonckheere-Terpstra Step-Down test). The significant reductions in cabbage height was 22% at 0.017 lb ai/A compared to the negative control (p<0.05, Dunnett's Multiple Comparison test); cabbage mortality was 100% at 0.052, 0.15, and 0.47 lb ai/A. The significant inhibition in cucumber height was 11% at 0.052 lb ai/A compared to the negative control (p<0.05, Dunnett's Multiple Comparison test); cucumber mortality was 100% at 0.15 and 0.47 lb ai/A. The significant inhibition in lettuce height was 38% at 0.049 lb ai/A compared to the negative control (p<0.05, Dunnett's Multiple Comparison test); there was only one surviving lettuce plant at 0.14 lb ai/A and mortality was 100% at 0.42 lb ai/A.

There was significant inhibitions in dry weight for corn, oat, ryegrass, soybean, and tomato. Significant inhibitions in oat dry weight were 46 and 71% at 0.14 and 0.42 lb ai/A, respectively; and in soybean dry weight were 18, 38, and 72% at 0.050, 0.15, and 0.45 lb ai/A, respectively, compared to the negative control ($p<0.05$, Jonckheere-Terpstra Step-Down test). Significant reductions in ryegrass dry weight were 60 and 90% at 0.049 and 0.15 lb ai/A, respectively, compared to the negative control ($p<0.05$, Jonckheere-Terpstra Step-Down test); there was only one surviving ryegrass plant at 0.15 lb ai/A and mortality was 100% at 0.44 lb ai/A. Significant reductions in tomato dry weight were 33 and 78% at 0.016 and 0.049 lb ai/A, respectively, compared to the negative control ($p<0.05$, Jonckheere-Terpstra Step-Down test); tomato mortality was 100% at 0.15 and 0.44 lb ai/A. The significant reduction in corn dry weight was 88% at 0.44 lb ai/A compared to the negative control ($p<0.05$, Dunnett's Multiple Comparison test). There were no significant differences between the negative control and the adjuvant control for any endpoint ($p>0.05$). The most sensitive monocot was ryegrass based on reductions in dry weight with NOAEC and IC_{25} values of 0.016 and 0.0206 lb ai/A, respectively. Significant mortality in ryegrass was observed at the 0.15 and 0.44 lb ai/A treatment levels which may have impacted the validity of other endpoints; therefore, these results should be interpreted with caution. The most sensitive dicot was cabbage based on decreased survival with NOAEC and EC_{25} values of 0.00301 (EC_{05} value) and 0.00722 lb ai/A, respectively. There were significant ($p<0.05$) inhibitions in cabbage survival at all application rates. Low cabbage survival may impact the validity of the other endpoints; therefore, the results for cabbage should be interpreted with caution.

Based on the phytotoxicity rating system used by the study author, minor phytotoxicity was observed in the adjuvant control group for cabbage. Effects in the adjuvant control were attributed to random plant death. In the treatment groups, oat displayed near total chlorosis; soybean displayed wilting plants and complete chlorosis; carrot, corn, onion, and tomato displayed wilting plants, complete chlorosis, and no seedling germination; and cabbage, cucumber, lettuce, and ryegrass experienced complete plant death of replicates. Phytotoxic effects displayed a concentration-response in all species tested.