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WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

August 15, 2019

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MEMORANDUM

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

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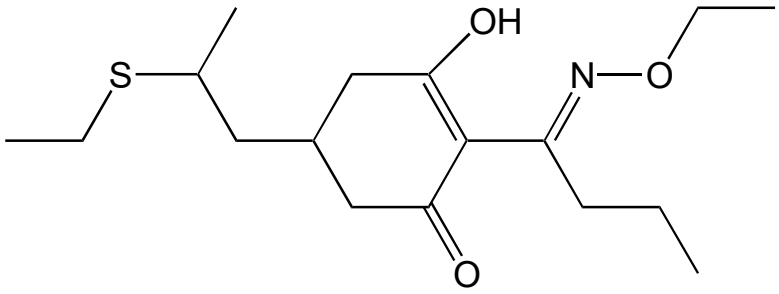
The Environmental Fate and Effects Division (EFED) has completed the draft environmental fate and ecological risk assessment in support of the Registration Review of the herbicide sethoxydim.

Draft Ecological Risk Assessment for the Registration Review of Sethoxydim



Sethoxydim; CAS No. 74051-80-2
USEPA PC Code: 121001

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August 15, 2019

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1 Executive Summary

1.1 Overview

Sethoxydim is a member of the cyclohexanedione class of chemicals. The mode of action for this herbicide is lipid biosynthesis inhibition. Selectivity to monocots is due to the greater susceptibility at acetyl-coenzyme A carboxylase (ACCase) of grassy species. Sethoxydim is used post-emergence for selective control of annual and perennial grass weeds in broadleaf crops. Use sites include Agricultural (Indoor and Outdoor), Occupational/ Manufacturing/ Processing/ Industrial Area (Indoor and Outdoor), Residential/ Recreational/ Institutional/ Retail (Indoor and Outdoor), and Woodland/ Nature Areas/ Animal Habitat (Outdoor).

This Draft Risk Assessment (DRA) examines the potential ecological risks associated with labeled uses of sethoxydim on non-listed non-target organisms. The risk assessment took a streamlined approach to focus on the taxa of primary risk concern based on previously completed risk assessments (USEPA, 2005a), taxa for which additional data have become available, and uses that had previously not been assessed. Taxa of focus in this assessment include pollinators, birds, terrestrial-phase amphibians, reptiles, mammals, and terrestrial plants. Risk to aquatic taxa, including to aquatic plants based on a previously unassessed aquatic use, was also assessed. The residues of concern (ROCs) include sethoxydim and eight degradates. A total toxic residue (TTR) approach was used for the exposure assessment and estimated environmental concentrations (EECs) were compared to the toxicity endpoint of parent sethoxydim. For more information on the ROCs, see **Section 4**.

1.2 Risk Conclusions Summary

Risk to aquatic animals and plants from sethoxydim is expected to be low for terrestrial applications. However, a recently registered use on wetlands (for invasive species control in wetlands) does result in risk to vascular aquatic plants. Terrestrial application risks exceeding the level of concern (LOC) were identified for mammals, bees, and terrestrial monocot plants. There are chronic dose-based LOC exceedances for multiple size classes of mammals consuming a variety of dietary items. There are chronic adult bee LOC exceedances based on food consumption, but risk to terrestrial invertebrates is otherwise expected to be low based on the new suite of honey bee data made available for this assessment. Risk to birds is expected to be low, based on the lack of effects noted in a new passerine bird study, which is consistent with the lack of effects observed in bird studies addressed in previous assessments. Risk conclusions are summarized in **Table 1-1**.

1.3 Environmental Fate and Exposure Summary

Sethoxydim is not expected to be volatile under field conditions or from water since it is a highly soluble compound with a low vapor pressure. Bioconcentration potential is limited since it has a low octanol/water partition coefficient and displays only limited bioaccumulation followed by rapid depuration. Sethoxydim and its degradates are considered mobile to very mobile based on soil partition coefficients, but in the terrestrial and aquatic field dissipation studies sethoxydim residues were not detected below the 4 to 8-inch soil core depth.

Sethoxydim degradation is rapid (< 1 day) under aerobic conditions, but its degradates of concern are more persistent resulting in prolonged exposure to its total residues of concern. While sethoxydim does undergo abiotic hydrolysis under acidic conditions, the degradate produced is a residue of concern resulting in no net degradation loss to the total residues of concern. Sethoxydim and its ROCs are susceptible to aqueous photolysis.

In this streamlined assessment, the Pesticide in Water Calculator (PWC) was not used since all the terrestrial agricultural applications have been previously assessed and were found to produce low aquatic risks. However, a direct application to wetland areas use has been added to Special Local Needs (SLN) registrations in Florida and South Carolina. Since these applications are specified in terms of mass per unit area (lbs/A) rather than a target concentration, the modified Tier 1 rice model was used to estimate aquatic exposure for these previously unassessed SLN uses only.

1.4 Ecological Effects Summary

Sethoxydim is slightly to practically non-toxic to fish and aquatic invertebrates on an acute exposure basis. Effects on survival and growth were observed in a chronic toxicity study on freshwater fish. A chronic waterflea (*Daphnia magna*) study submitted for this assessment was classified as supplemental and suitable only for qualitative use in risk assessment because of uncertainty in the results and little confidence in the data presented. Sethoxydim displays toxicity to aquatic vascular plants but not to tested aquatic non-vascular plants.

Sethoxydim is classified as practically non-toxic to birds on an acute oral and dietary basis. In available acute studies, no effects were noted through the highest concentrations tested, though instability of the compound at three treatment levels in the new passerine study lends to uncertainty in the data. The most sensitive endpoint for chronic bird effects was the proportion of hatchlings to 3-week (21-d) viable embryos (12% reduction from the control group) in the Mallard duck study.

On an acute oral basis, both technical grade active ingredient (TGAI) sethoxydim and the formulated products are classified as "practically non-toxic" to mammals. A 2-generation reproduction study with rats using sethoxydim TGAI displayed significant weight decreases in second generation pups at the highest dose (13% reduction from the control group). No reproductive effects were observed in the 2-generation study.

A suite of new terrestrial invertebrate data generally indicated low toxicity of sethoxydim to honey bees. There was little to no mortality noted in acute adult contact and oral studies and a chronic larval study. The chronic adult bee study resulted in reduced food consumption up to 13% at doses of 7.29 µg a.i./bee/day and above and a 17% increase in mortality at the highest dose of 59.3 µg a.i./bee/day. An acute larval study was not submitted.

Available data for terrestrial plants exposed to the formulated product displayed higher monocot sensitivity to sethoxydim than dicot sensitivity. For seedling emergence, the most sensitive monocot species was ryegrass, based on survival. The most sensitive dicot species was sugarbeet, based on emergence. For vegetative vigor, the most sensitive monocot species was ryegrass based on dry weight. The most sensitive dicot species was cabbage, based on dry weight. Terrestrial plants are more sensitive to the formulated product of sethoxydim than the TGAI.

1.5 Identification of Data Needs

Although new studies have been submitted and incorporated into this risk assessment, the risk conclusions in this assessment are the same as past assessments (except for the risk conclusions for bees). Data is available for only two soils in the aerobic and anaerobic soil metabolism studies. Data for four soils is typically required for both study types. The missing metabolism studies do not impact the risk conclusions in this assessment.

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

Taxa	Exposure Duration	Risk Quotient (RQ) Range[2]	RQ Exceeding the LOC for Non-listed Species	Additional Information/ Lines of Evidence
Freshwater fish*	Acute	<0.01 – 0.01	No	--
	Chronic	0.05 – 0.15	No	--
Estuarine/ marine fish*	Acute	Not calculated	No	RQ was not calculated because the study resulted in a non-definitive endpoint.
	Chronic	Not calculated	No	Freshwater chronic RQ value was used as a surrogate for estuarine/marine fish chronic risk assessment.

Taxa	Exposure Duration	Risk Quotient (RQ) Range[2]	RQ Exceeding the LOC for Non-listed Species	Additional Information/ Lines of Evidence
Freshwater invertebrates*	Acute	<0.01—0.01	No	--
Estuarine/ marine invertebrates*	Acute	Not calculated	No	No effects observed in the study.
Mammals	Acute	0.02-0.05	No	No effects observed in the study.
	Chronic	<0.01-4.8	Yes	LOC exceedances occur in chronic dose-based exposure based on a 13% reduction in pup weight.
Birds	Acute	Not calculated	No	RQ was not calculated because the study resulted in a non-definitive endpoint.
	Chronic	0.28-0.71	No	----
Terrestrial invertebrates	Acute Adult	Not calculated	No	LOC exceedances occur in chronic dietary exposure, based on food consumption. RQs only exceed the LOC for adult honey bees on a chronic basis. No acute larval toxicity study is available.
	Chronic Adult	0.73 – 3.67	Yes	
	Acute Larval	Not calculated	No	
	Chronic Larval	Not calculated	No	
Aquatic plants*	N/A	1.4-4.8	Yes	Sethoxydim is an herbicide applied to wetlands specifically to kill wetland and aquatic plants. RQs exceed the LOC for vascular aquatic plants only.
Terrestrial plants	N/A	**Dicot** Dry Areas <0.10 Semi-aquatic areas 0.10-0.14 Spray Drift Only <0.10 **Monocot** Dry Areas 0.22-1.09 Semi-Aquatic Areas 1.20-5.98 Spray Drift Only 0.58-2.91	Yes	No dicot LOC exceedances. Monocot exceedances occur for all uses except spray drift only and dry areas at the lowest application rate (0.1 lb a.i./A). Six aggregate plant incidents reported.

Level of Concern (LOC) Definitions:
Terrestrial Animals: Acute=0.5; Chronic=1.0; Terrestrial invertebrates=0.4
Aquatic Animals: Acute=0.5; Chronic=1.0

Plants: 1.0
[1] Based on water-column toxicity data compared to pore-water concentration.
[2] RQs reflect exposure estimates for sethoxydim and its degradates of concern at the maximum application rates allowed on labels.
* RQs for aquatic taxa represent the direct application to wetlands only. RQs for aquatic taxa exposed to sethoxydim via terrestrial uses were found in previous assessments to be below the LOCs.

2 Introduction

This Draft Risk Assessment (DRA) examines the potential ecological risks associated with labeled uses of sethoxydim on non-listed non-target organisms. This risk assessment incorporates the available exposure and effects data and most current modeling and methodologies. The DRA uses the best available scientific information on the use, environmental fate and transport, and ecological effects of sethoxydim. 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. Federally listed threatened/endangered species ("listed") are not evaluated in this document. For additional information on listed species see **Appendix E**.

This document assesses risk to terrestrial taxa for terrestrial uses and to all taxa for wetland uses. Risk to aquatic taxa for terrestrial uses has been previously assessed and the risk conclusions have not changed (USEPA, 2005a).

3 Problem Formulation Update

In the risk assessment process, the purpose of the problem formulation step is to provide the foundation for the environmental fate and ecological risk assessment being conducted for the labeled uses of sethoxydim. The problem formulation identifies the objectives for the risk assessment and provides a plan for analyzing the data and characterizing the risk. As part of the Registration Review (RR) process, a detailed problem formulation for this DRA was published to the docket in March 2015 (DP Barcode 424581). The following sections summarize the key points of the problem formulation and discusses key differences between the analysis outlined there and the analysis conducted in this DRA.

The problem formulation described conclusions from previous ecological risk assessments of sethoxydim. In previous assessments, RQs did not exceed the LOCs for aquatic animals or aquatic plants. Risks exceeding levels of concern were identified for mammals on a chronic basis, adult honey bees on a chronic basis, and for terrestrial monocot plants. The problem formulation recommended the request of studies to assess the effects of sethoxydim on a

passerine bird species, to comprehensively assess effects to honey bees, and to assess chronic risk to freshwater aquatic invertebrates, estuarine/marine fish, and estuarine/marine aquatic invertebrates. The problem formulation further recommended requesting studies to assess the effects of the sethoxydim degradate, M2-SO_2 on aquatic vascular plants and the effects of a formulated product of sethoxydim on seedling emergence and vegetative vigor of terrestrial plants.

The agency subsequently granted a request to waive chronic testing with sethoxydim on estuarine/marine fish and aquatic invertebrates (OCSPP 850.1400 and 850.1350; USEPA, 2016). EFED concluded that, because freshwater fish appear to be more sensitive than estuarine/marine fish, the chronic freshwater fish endpoint can be used for all fish (DP 434834, USEPA 2016). The agency also granted the request to waive the aquatic vascular plant study of the sethoxydim degradate, metabolite M2-SO_2 (non-guideline). EFED concluded that there is currently no evidence to show that the metabolite M2-SO_2 is more toxic than the parent sethoxydim, and since it is present at less than 4% in combined sediment and water extraction, the additional data on the degradate M2-SO_2 would not likely change the risk conclusions (DP 434834, USEPA 2016).

The new data submitted for all terrestrial taxa are described in more detail in the effects characterization section (**Section 6**)**.** The new data for other taxa are described in more detail in **Appendix C.**

As summarized in the problem formulation based on previous risk assessments, potential risks associated with the use of sethoxydim include risks to mammals and terrestrial plants. Risks from direct aquatic applications had not been assessed at the time of the problem formulation. No new environmental fate studies have been submitted since the problem formulation was written. The following ecotoxicity studies have been submitted since the problem formulation was written:

- OCSPP 850.1300: Freshwater invertebrate life-cycle toxicity study using TGAI (MRID 50420001), Supplemental (QUAL)
- OCSPP 850.2100: Acute oral toxicity study with passerine species with TGAI (MRID 50542501), Acceptable
- OCSPP 850.3020: Honey bee acute contact toxicity test with TGAI (MRID 50420004), Acceptable
- OECD Test Guideline 213: OECD Guideline for the testing of chemicals on honey bee, acute oral toxicity test (MRID 50420004), Acceptable
- OECD Test Guideline 239: Honey bee larval chronic oral toxicity study (MRID 50420005), Acceptable
- OECD Test Guideline 245: Honey bee chronic oral toxicity test (MRID 50420006), Acceptable

- OCSPP 850.4100: Terrestrial plant seedling emergence toxicity study with current market TEP (typical end-use product) (MRID 50420002), Supplemental (QUANT)
- OCSPP 850.4150: Terrestrial plant vegetative vigor Tier II toxicity study with (dicots and one additional species of monocots), (MRID 50420003), Acceptable

3.1 Mode of Action for Target Pests

Sethoxydim is a member of the cyclohexanedione class of chemicals. The mode of action for this herbicide is lipid biosynthesis inhibition. Selectivity to monocots is shown to be due to the greater susceptibility at acetyl-coenzyme A carboxylase (ACCase) of grassy species. Susceptible grassy species are killed by inhibition of the ACCase which is a key enzyme in the lipid biosynthetic pathway. The cyclohexanedione chemical class also includes clethodim (PC code 121011), tepraloxydim (121005), and tralkoxydim (121000), which are registered in the U.S., and alloxydim, butroxydim, cloproxydim, cycloxydim, and profoxydim, which are not currently registered in the U.S.

3.2 Label and Use Characterization

Sethoxydim is used post-emergence for selective control of annual and perennial grass weeds in broadleaf crops. Use sites include Agricultural (Indoor and Outdoor), Occupational/ Manufacturing/ Processing/ Industrial Area (Indoor and Outdoor), Residential/ Recreational/ Institutional/ Retail (Indoor and Outdoor), and Woodland/ Nature Areas/ Animal Habitat (Outdoor). (The pesticide use index is available at https://www.epa.gov/pesticide-registration/pesticide-use-site-index.) Two end-use formulations containing sethoxydim are currently registered for use in the United States. Sethoxydim was previously assessed at the time of the Reregistration Eligibility Decision (RED) in 2005 (USEPA, 2005a), and a new use assessment was completed in December 2014 (USEPA, 2014c).

3.2.1 Label Summary

The Biological and Economic Assessment Division (BEAD) prepared a Label Use Information Summary (LUIS) report in September of 2014 and a Pesticide Label Use Summary (PLUS) Report in March 2019. Both reports summarized all registered uses of sethoxydim based on the actively registered labels at the time each report was generated. Because work on this assessment began prior to the completion of the PLUS report, the LUIS report was used as the source to summarize representative uses for the problem formulation (PF) (USEPA 2015) and this DRA. Since new use sites were registered since the publication of the PF, those additional use sites were added into this Label Use Summary Section.

Once the PLUS report became available, this summary section was checked against the LUIS derived information. There appears to be a rounding error discrepancy between the application rates calculated for the LUIS and PLUS reports. It is considered insignificant in terms of exposure and risk estimates but is noted here since the application rates used in this assessment are from the LUIS report and differ slightly from the rates listed in the PLUS report. A full summary of the PLUS report use sites and application characteristics for each of those use sites can be found in **Appendix A.**

Label directions specify that sethoxydim cannot be applied through irrigation equipment. Due to concerns that direct applications to water in wetlands might contaminate irrigation water, these wetland uses may only occur 500 or more feet from an irrigation water well. Additionally, water from a treated wetland may not be used as irrigation water for 30 days after the last sethoxydim application.

Table 3-1 groups uses by similar single application rates, number of applications, and retreatment intervals. For larger groups of uses, the preharvest interval (PHI) and 'comments' fields became too complicated to present with proper specificity for the individual uses. In these cases, the entry in these fields is "various". The reader is directed to **Appendix A**, which provides this information on a use site specific basis.

Table 3-2. Summary of the Maximum Labeled Use Patterns for Sethoxydim

Use Site/ Location	Form[1]	pp Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Terrestrial Applications											
Celery	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.276	2	0.553	14	30	Only hose-end sprayer allowed in FL
Citrus, Pistachio, Tree Nuts	EC	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.461	4	1.84	14	15	NA
Agricultural Fallow/Idleland/ Conservation Reserve, Alfalfa, Avocado, Clover, Cotton (Unspecified), Date, Fig, Nonagricultural Uncultivated Areas/Soils, Olive, Plum, Pome Fruits, Pomegranate, Prune, Sainfoin, Trefoil	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.461	3	1.38	14	Various[1]	Various
1C. Tuberous and corm vegetables subgroup, 20A. Rapeseed subgroup, Apricot, Artichoke, Asparagus, Beans, Dried-Type, Beans, Succulent (Snap), Beets (Unspecified), Blueberry, Borage, Buckwheat, Caneberries, Canola/Rape, Carrot (Including Tops), Cherry, Crambe, Cranberry, Dill, Grapes, Grasses Grown For Seed, Horseradish, Lentils, Mint, Nectarine, Ornamental Lawns and Turf, Peach, Peas, Dried Type, Potato, White/ Irish (or Unspecified), Safflower, Small Fruits, Soybeans (Unspecified), Sugar Beet, Sweet Potato	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.461	2	0.921	14	Various	Various

Use Site/ Location	Form[1]	pp Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Ornamental Lawns and Turf	EC, SC/L	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.461	2	0.921	NS	NA	NA
Beans, Dried-Type	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.393	1	0.393	NA	30	NA
1B. Root vegetables (except sugar beet) subgroup, Corn, Field, Corn, Sweet, Mint/ Peppermint/ Spearmint, Peas, Dried Type, Soybeans (Unspecified), Strawberry, Sunflower	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.461	1	0.461	14	Various	Various
Forest Plantings (Reforestation Programs) (Tree Farms, Tree Plantation, ETC.)	SC/L	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	A, G, BP, HS	All	0.461	NS	NS	14	NA	Various
Endive (Escarole), Forest Plantings (Reforestation Programs) (Tree Farms, Tree Plantation, ETC.), Lettuce, Head, Rye	EC, SC/L	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.504	NS	NS	NS	Various	NA
Okra	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.263	4	0.964	14	14	Disallowed hose-end sprayer in CA
Bulb Vegetables, Flax, Fruiting Vegetables, Peas, Succulent, Pepper, Tobacco	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.276	3	0.829	14	Various	Various
Brassica (Head and Stem) Vegetables, Corn, Field, Cucumber, Cucurbit Vegetables, Leafy Vegetables, Melons, Cantaloupe, Mustard, Peanuts (Unspecified), Rhubarb	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.276	2	0.553	14	Various	Various
Corn, Sweet	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.276	2	0.553	10	35 (Forage) 45 (Fodder) 30 (Food)	Disallowed in CA

Use Site/ Location	Form[1]	pp Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Nonagricultural Rights-Of-Way/ Fencerows/ Hedgerows	EC, SC/L	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	A, G, BP, HS	All	0.184	1	0.184	NS	NA	NA
Orchards (Unspecified)	EC	Foliage/ Plant	Ban/Bro/ Spot	G, BP, HS	All	0.0921	1	0.0921	14	NA	Disallowed in CA
Aquatic Applications											
Non- or Slow-Flowing/Lentic Water Areas	EC	Foliage/ Plant	Bro/Dir	A (helicopter), G, BP, HS, BM	All	0.469	NS	1.88 lbs ai/A/yr	NS	NA	Allowed in FL, SC

App=application; equip=equipment--=not specified; EC=emulsifiable concentrate; SC=soluble concentrate; L=liquid; G=granular; MRI = Minimum retreatment interval; PHI=preharvest interval; Ban= Banded; Bro=broadcast, Dir=directed; Spot=spot treatment A=aerial; G=ground; BP=back pack; HS=hand sprayer; H-ES=hose-end sprayer; BM=boat mounter sprayer; ai=active ingredient; CC=crop cycle; d=day; All=indicates that the product may be applied during any crop status. Typically, this occurs when the product is applied based on pest pressure; () Values in parenthesis were calculated based on other information provided on the label. These values are not on the label.

* Information is provided on a crop cycle (CC) basis, unless otherwise specified.

[1] "Various" indicates that more specific information on individual use sites is available in **Appendix A.**

3.2.2 Usage Summary

Based on market usage data from 1998-2017, usage of sethoxydim declined from approximately 900,000 lbs ai applied on 4,500,000 acres treated to <100,000 lbs ai applied on <500,000 acres treated (USEPA, 2019). The screening-level use assessment (SLUA) estimate, which only considers agricultural use, indicates that, on average, 80,000 lbs of sethoxydim was applied to dry beans/peas per year between 2007 and 2017. On average over the same time period, 5,000 to 10,000 lbs of sethoxydim was applied to alfalfa, almonds, oranges, peanuts, soybeans, each year.

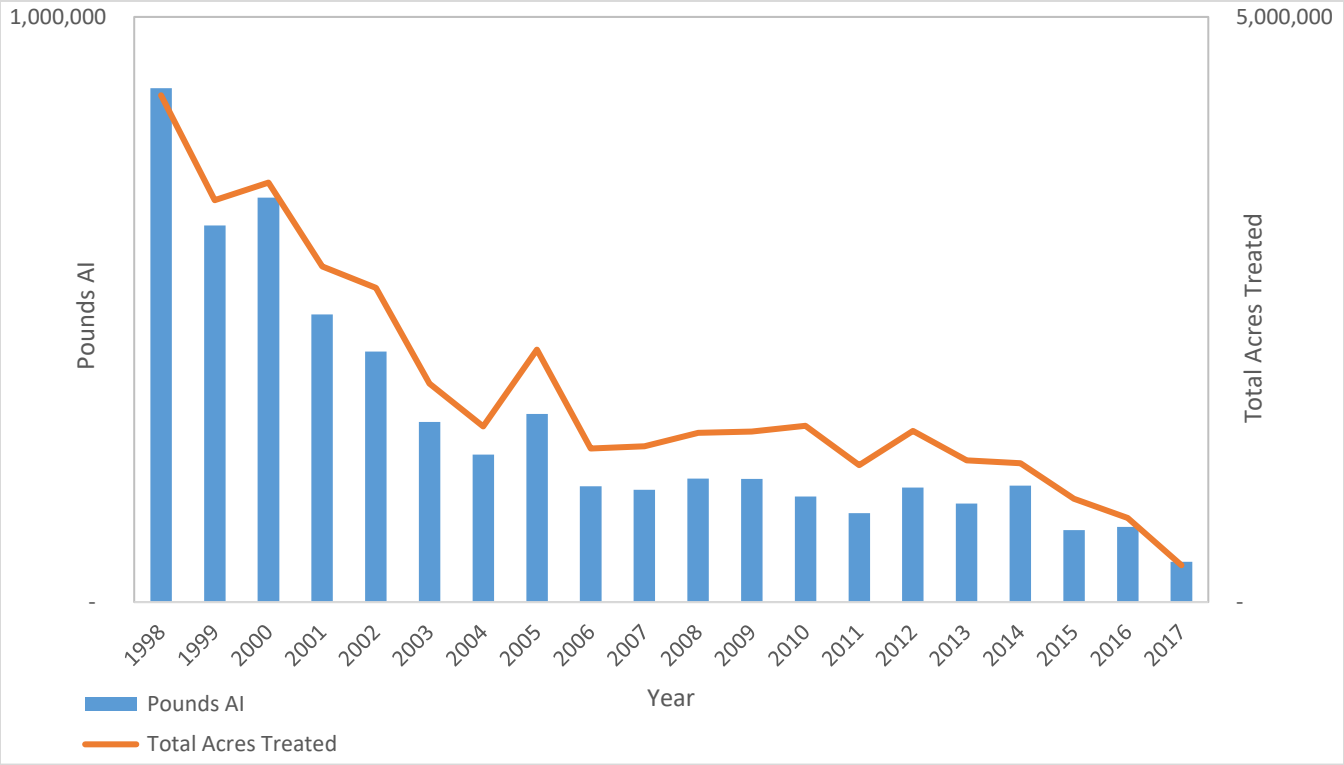

Figure 3-1. Sethoxydim Total Acres Treated and Total Pounds A.I. Applied (1998-2017)
Source: Agricultural *Market Research Data (MRD).* 1998-2017

4 Residues of Concern

The Metabolism Assessment and Review Committee (MARC) of the Health Effects Division indicated that all sethoxydim degradates are to be included for drinking water assessment (Loranger 1998; DP 246356). The eight degradates identified in the sethoxydim fate data are: M-SO, M-SO_2, M1-S, M1-SO, M1-SO_2, M2-S, M2-SO, and M2-SO_2. Historically, EFED has included the same degradates as degradates of concern for ecological risk assessment. The fate studies provide a proposed degradation scheme for the transformation of sethoxydim and the eight metabolites (replicated in **Figure 4-1**). This registrant-proposed degradation scheme differs somewhat from those discussed in earlier EFED assessments (USEPA 2005b; DP 312559).

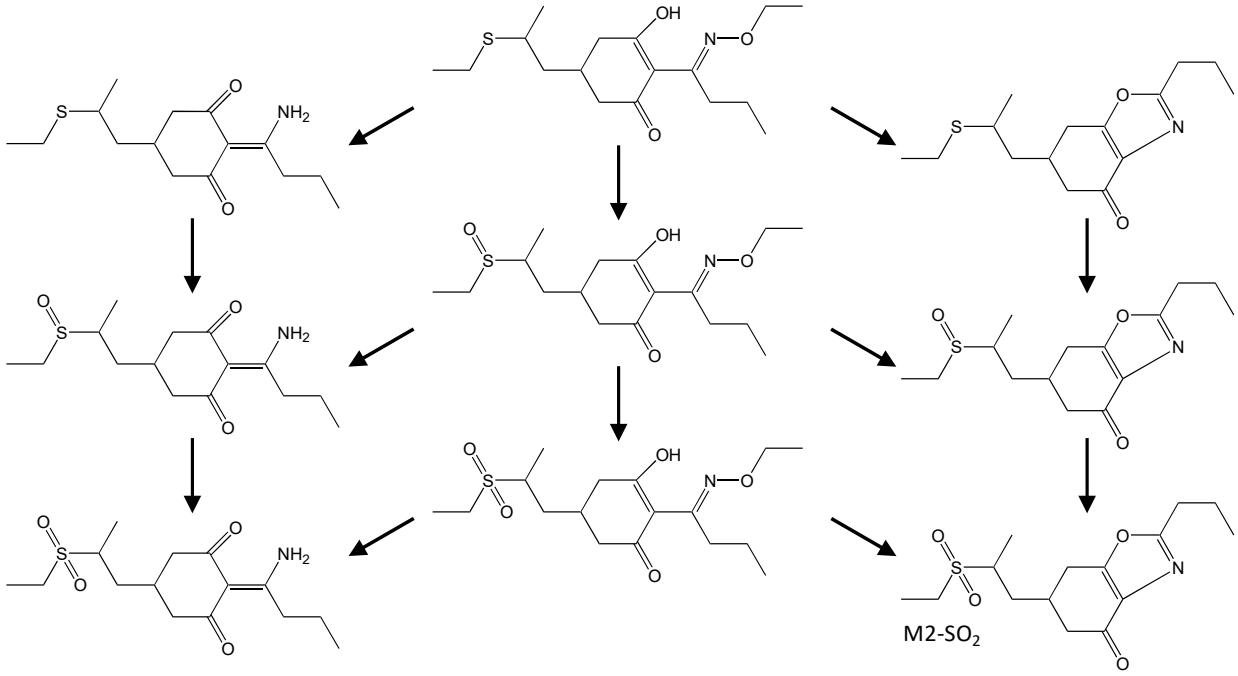

Figure 4-1. Sethoxydim Degradation Pathway

5 Environmental Fate Summary

Sethoxydim is a highly soluble compound (4700 mg/L in pH 7 water) with a low octanol/water partition coefficient (log Kow is 1.65). The calculated bioconcentration factors (BCF) for sethoxydim's total radioactive residues were 7×, 25×, and 21× for edible, nonedible, and whole fish, respectively. Depuration was fast, with a half-life of 3.6 days. For these reasons, bioaccumulation is not likely to be significant. Also, due to its low vapor pressure (1.6×10^{-7} mm Hg) and Henry's Law Constant (1.47×10^{-11} atm-m^3/mol), sethoxydim is not expected to be volatile under field conditions or from water.

Based on batch equilibrium experiments, sethoxydim and its transformation products, M2-SO_2, M-SO, M-SO_2, and M2-SO, were determined to be mobile to very mobile (FAO, 2000) in sterile (autoclaved) sand, sandy loam, sandy clay loam, silt loam, and clay loam soils (i.e., sterility was deemed necessary to prevent sethoxydim's rapid degradation). Freundlich Kd values were <1.00 for sethoxydim and its transformation products M-SO and M-SO_2. The Freundlich Kd values for M2-SO and M2-SO_2 ranged from 0.06 to 9.12. Unsterilized soils (in addition to matching data for sterilized soils) were only used for M2-SO_2 because M2-SO_2 is thought to be the most stable of the compounds in the degradation pathway. The Freundlich Kd values of M2-SO_2 with non-sterilized soil are 0.12, 2.89, 0.78, 5.64, and 9.42, respectively for sand, sandy loam, sandy clay loam, silt loam, and clay loam, but were similar for the same unsterilized soils. **Table 5-1** summarizes the physical chemical properties of sethoxydim.

Table 5-2. Summary of Physical-Chemical, Sorption, and Bioconcentration Properties of Sethoxydim

Parameter	Value[1]			Source/ Study Classification/ Comment
Molecular Weight (g/mole)	327			--
Water Solubility at 25°C mg/L	257, pH 5			MRID 41475201
Vapor Pressure (torr)	1.6×10^{-7} torr			Non-volatile under field conditions
Henry's Law constant at 20°C (atm-m^3/mole)	1.47×10^{-11}			Estimated[1] from vapor pressure and water solubility at 20°C.
Log Dissociation Constant (pKa)	4.61 – 4.62			MRID 00047650. Ionized under neutral and basic in natural waters
Octanol-water partition coefficient (K_{ow}) at 25°C (unitless)	44.7 (log K_{OW}=1.65)			Not likely to bioconcentrate significantly.
Air-water partition coefficient (K_{AW}) (unitless)	2.72×10^{-13} (log K_{AW} = -13.434)			Estimated[1] from EpiWeb 4.1. Nonvolatile from water.
Soil-Water Distribution Coefficients (Kd in L/kg-soil or sediment) Organic carbon normalized distribution coefficients (Koc in L/kg-organic carbon)	**Soil/Sediment**	**K_d**	**K_{OC}**	MRID 41475212. Acceptable. Mobile to very mobile (FAO classification system); K_{OC} is a better predictor of sorption based on lower CV.
	Sand, pH 6.1	0.09	75	
	Sandy loam, pH 6.9	0.04	13.8	
	Sandy Clay loam, pH 5.6	0.94	72.9	
	Silt loam, pH 5.8	0.68	46.3	
	Clay loam, pH 6.6	0.03	2.7	
	Mean	0.356	42.14	
	CV	119%	79%	
Steady State Bioconcentration Factor (BCF) L/kg-wet weight fish or L/kg wet weight lipid	**Species**	**BCF**	**Depuration**	MRID 42118001. Acceptable. Does not appear to significantly bioaccumulate.
	Bluegill sunfish	21× (whole fish)	3.6 days	

CV=Coefficient of Variation

[1]All estimated values were calculated 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, 2010a).

Sethoxydim hydrolyzes at moderately rapid rates at low pH values but is more stable at high pH values. The calculated half-lives are 8.7, 155, and 284 days in pH 5, 7, and 8.7 solutions, respectively. The major observed hydrolysis transformation product is M2-S or 6-(2-

(ethylthio)propyl)-4-oxo-2-propyl-4,5,6,7-tetrahydrobenzoxazole. However, since M2-S is a degradate of concern, the total toxic residues of sethoxydim are considered stable.

Sethoxydim and sethoxydim total residues degrade photolytically in both water and soil. In pH 8.7 buffered water, the calculated photolysis half-life of sethoxydim is 5.23 days, and the major transformation product is M1-S or 2-(1-aminobutylidene)-5-(2-(ethylthio)-propyl)-cyclohex-1,3-dione. In sandy loam soil irradiated with a xenon light source, the half-life of sethoxydim is approximately 1 hour, and the major transformation product is M-SO or 2-(1-ethoxyiminobutyl)-5-(2-(ethylsulfinyl)propyl)-3-hydroxycyclohex-2-enone. The total residues of sethoxydim photodegrade at a slower rate than parent sethoxydim in soil and water. Using the total residues method, EFED calculated a half-life of 19.8 days for the photolysis in water, but only 20 hours in soil.

Under aerobic conditions, parent sethoxydim transformed with short half-lives (<1 day) both in soil and aquatic environments. It degraded with a half-life of less than one day in sandy loam and sandy clay loam soils. The major transformation product at 2 months was M-SO, and after 12 months the major product was CO_2. Using aerobic clay loam soil:water and aerobic clay soil:water systems, it was determined that, under aerobic aquatic conditions, sethoxydim transformed with a half-life of <1 day. After 28 days, the major transformation products were CO_2, M-SO, M2-S, and M-SO_2. In contrast to parent sethoxydim, sethoxydim total residues were more persistent. The observed half-life was 1 month for sethoxydim total residues in the aerobic sandy loam study, and 7 days in the aerobic sandy clay loam study. In an aerobic clay loam soil:water system, the calculated half-life for sethoxydim total residues was 38.1 days, while in an aerobic clay soil:water system the half-life was 32.9 days.

Under anaerobic conditions, parent sethoxydim is more persistent than under aerobic conditions. It transformed with half-lives of 11 to >60 days under anaerobic soil conditions and 25-39 days in anaerobic aquatic metabolism studies. M-SO was the major transformation product in both studies. It was observed that M2-S, which was a major transformation product in the hydrolysis study, was only a minor transformation product in the anaerobic aquatic metabolism study. Sethoxydim total residues were more persistent than parent sethoxydim in the anaerobic studies. A half-life of 91.6 days was observed in the anaerobic soil metabolism study, while half-lives of 132-187 days were observed in the anaerobic aquatic metabolism study.

Table 5-3 summarizes representative degradation half-life values from laboratory degradation data for sethoxydim and sethoxydim plus its degradates of concern. A table summarizing the maximum amounts of degradates formed in different studies and depicting the degradate structures is available in **Appendix B.**

Table 5-4. Summary of Environmental Degradation Data for Sethoxydim and Residues of Concern

Study	System Details	Representative Half-life (days)[1,2]		Source/ Study Classification/Comment
		Parent	TTR/Degradate	
Abiotic Hydrolysis (25°C)	pH 5 pH 7 pH 8.6	8.7 155 284	Stable	MRID 41475207. Acceptable
Atmospheric Degradation	Hydroxyl Radical	0.074 (SFO)	--	Estimated value EPIWeb Version 4.1
Aqueous Photolysis	pH 8.7, 25°C assumed 40°N sunlight	5.23 (SFO)	19.8	MRID 41475208. Acceptable
Soil Photolysis	Sandy loam, 25°C, PH 7.7, assumed 40°N sunlight	0.15 (SFO)	NA	MRID 41475209. Acceptable
Aerobic Soil Metabolism	Sandy loam, 25°C	< 1	30	MRID 41475210. Acceptable. 54 d (upper 90th percentile on 2 values)
	Sandy clay loam, 25°C	<1	7	
Anaerobic Soil Metabolism	Sandy loam, 25°C	11.2	NA	MRID 41475211. Acceptable.
	Sandy clay loam, 25°C	> 60	NA	
Aerobic Aquatic Metabolism	Clay loam, 25°C	< 1	38.1	MRID 42165604. Acceptable. 44 d (upper 90th percentile on 2 values)
	Clay, 25°C	<1	32.9	
Anaerobic Aquatic Metabolism	Sandy loam, 25°C	25.4 (SFO)	132	MRID 41475211. Acceptable. 244 d (upper 90th percentile on 2 values)
	Sandy clay loam, 25°C	39.9 (SFO)	187	

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, --=not available or applicable; SFO-LN=SFO calculated using natural log transformed data

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

[1] 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). Some values were calculated using natural log transformed data to estimate the SFO half-life (designated with SFO-LN).

A summary of aquatic and terrestrial field dissipation data is provided in **Table 5-5**. Rather than measure individual chemical concentrations, both the aquatic and terrestrial studies converted all sethoxydim and degradate residues into a common chemical prior to measurement. Therefore, sethoxydim and degradate concentrations were only measured collectively (*i.e.*, only total residue data back-calculated as sethoxydim-equivalent concentrations are available). Dissipation half-lives in reviewed terrestrial field dissipation studies ranged from 3 to 181 days at 6 sites in the United States. Aquatic field dissipation half-lives studies ranged from 0.5 to 9 days at 4 sites in the United States. Overall, these results indicate that the persistence is highly dependent on the environmental conditions. Detected residues in both the terrestrial and aquatic field dissipation studies were confined to the top 8 inches of soil or sediment. Mobility

data for sethoxydim and its degradates suggest a propensity to leach to groundwater in some environments, but the field dissipation studies suggest otherwise.

Table 5-6. Summary of Field Dissipation Data for Sethoxydim and Residues of Concern

System Details	Half-life (days)		Max Leaching Interval (in)	Source/ Classification/ Comment
	Sethoxydim	TTR		
Terrestrial Field Dissipation				
Dinuba, CA; Sandy loam; pH 6.9; 0.8% OM	NA	Range: 3-181 Average: ~70	4-8	MRID 41510608, 41510609, 41510610, 41510611, 44311001, 44352401. Supplemental. Total sethoxydim residues were analyzed, rather than the parent compound and its eight degradates.
Hollandale, MN; Sandy loam; pH 7.6; 5.3% OM				
Geneseo, IL; Silt loam; pH 6.4; 3.4% OM				
Greenville, MS; Silt loam; pH 6.9; 0.5% OM				
Madera, CA; variable texture; pH 6.4-7.5; 0.1-0.4% OM				
Madera, CA; loamy sand/sand; pH 4.8-7.2; 0.1-0.3% OM				
Aquatic Field Dissipation				
Madera, CA	NA	0.53	0-6	MRID 42165605. Acceptable.
Chico, CA	NA	8.1	0-6	
Rosa, LA	NA	8.96	0-6	
Leland, MS	NA	1.98	0-6	

While field dissipation studies are designed to capture a range of loss processes, laboratory studies are designed to capture loss from one specific 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 compares to the loss rates in the field dissipation studies. For example, the aquatic field dissipation studies, which can be thought of as a combination of the degradation pathways of aerobic aquatic metabolism and aqueous photolysis, have a total residue half-life range of 0.5 to 9 days, which is shorter than either of the individual laboratory total residue half-lives for aerobic aquatic metabolism (33-38 days) and aqueous photolysis (20 days). This provides some context for interpretation of the tier 1 rice model results presented in **Section 8** which only considers degradation via aerobic aquatic metabolism (*i.e.*, will produce more conservative exposure estimates than those that would be produced from the aquatic field dissipation study half-lives). However, the aquatic field dissipation studies occurred in rice paddies where direct exposure to sunlight is greater, which promotes aqueous photolysis, compared to the reduced sunlight penetration found some wetlands with greater plant and tree canopy shading the water's surface, darker stained waters, and thick mats of pond scum during those months when the sun would be most intense.

6 Ecotoxicity Summary

Ecological effects data are used to estimate the toxicity of sethoxydim to surrogate species. Ecotoxicity data for sethoxydim and its associated products have been reviewed in previous ecological risk assessments (USEPA 2005a), and in a Registration Review Problem Formulation (USEPA, 2015). This section provides a summary of these studies, in addition to summaries of newly submitted studies.

Table 6-1 and **Table 6-2** summarize the most sensitive measured toxicity endpoints available across aquatic and terrestrial taxa. 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 this table are classified as acceptable or supplemental. Non-definitive endpoints are designated with a greater than or less than value. Values that are based on newly submitted data are designated with an N footnote associated with the MRID number in tables.

6.1 Aquatic Toxicity

6.1.1 Fish

Sethoxydim TGAI is practically non-toxic to freshwater fish on an acute exposure basis. A study that tested rainbow trout (*Oncorhynchus mykiss*) resulted in a 96-h median lethal dose (LC_{50}) of 170 mg a.i./L (MRID 00042815). A chronic study that tested the TGAI on the fathead minnow resulted in a no observed adverse effect concentration (NOAEC) of 4.86 mg a.i./L, and a lowest observed adverse effect concentration (LOAEC) of 9.59 mg a.i./L (MRID 47691702). Post-hatch survival was reduced by 28% and standard length was reduced by 5% in the highest test concentration compared to the negative control.

Sethoxydim TGAI is practically non-toxic to estuarine/marine fish on an acute exposure basis. A study that tested the sheepshead minnow (*Cyprinodon variegatus*) resulted in a 96-h LC_{50} of >145.8 mg a.i./L, the highest concentration tested (MRID 42315101). A memo issued by the agency granted a request to waive chronic testing with sethoxydim on estuarine/marine fish and aquatic invertebrates (OCSPP 850.1400 and 850.1350; USEPA, 2016). Based on the finding by the agency that freshwater fish appear to be more sensitive than estuarine/marine fish, EFED is using the chronic freshwater fish TGAI endpoints for all fish because they are likely protective for both freshwater and estuarine/marine fish.

6.1.2 Aquatic Invertebrates

Sethoxydim TGAI is slightly to practically non-toxic to aquatic invertebrates on an acute exposure basis. A waterflea (*Daphnia magna*) study resulted in a 48-h LC_{50} value of 78.1 mg a.i./L (MRID 00042816). For estuarine/marine invertebrates, an acute mysid (*Americamysis bahia*) study resulted in a 96-h LC_{50} of >141.8 mg a.i./L (MRID 42315102). A chronic *Daphnia magna* study submitted for Registration Review (MRID 50420001) was classified as

supplemental and suitable for qualitative use only because of uncertainty in the results and little confidence in the data presented. The study showed no significant effects on growth, reproduction, or mortality in most tested treatment groups in the study. **Appendix C** contains more information on the submitted study.

6.1.3 Aquatic Plants

For aquatic plants, a vascular plant study is available that tested a formulated product of sethoxydim (19.3% a.i.) on reed mannagrass (*Glyceria maxima*). The study resulted in a 21-d NOAEC at 0.093 mg a.i./L, and the EC_{50} value at 0.21 mg a.i./L (MRID 48000902). These endpoints were based on the growth rate of total leaf length. The percent growth inhibition of total leaf length in treated culture as compared to the control ranged from 10 to 95%. No effects were observed in non-vascular plant toxicity studies with sethoxydim (MRID 43626101).

Table 6-3. Aquatic Toxicity Endpoints Selected for Risk Quotient Calculations for Sethoxydim

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)[1]	MRID or ECOTOX No./ Classification	Comments
Freshwater Fish (surrogates for vertebrates)					
Acute	TGAI (97.3%)	Rainbow trout (*Oncorhynchus mykiss*)	96-h LC_{50} = 170,000 (practically non-toxic)	00042815 Acceptable	Sublethal effects noted included being irritated, erratic swimming, dark discolored pigment, and labored respiration.
Chronic	TGAI (94.8%)	Fathead minnow *(Pimephales promelas)*	NOAEC = 4860 LOAEC = 9590	47691702 Acceptable	Post hatch survival exhibited 28% reduction and standard length exhibited a 5% reduction in the highest test concentration compared to the negative control.
Estuarine/marine Fish (Surrogates for vertebrates)					
Acute	TGAI (98%)	Sheepshead Minnow (*Cyprinodon variegatus*)	96-h LC_{50} = >145,800 (practically non-toxic)	42315101 Acceptable	No effects noted in the study.
Freshwater Invertebrates					
Acute	TGAI (97.3%)	Waterflea (*Daphnia magna*)	48-h LC_{50} = 78,100 (slightly toxic)	00042816 Acceptable	No sub-lethal effects noted in the study.
Estuarine/ marine invertebrates					
Acute	TGAI (97.8%)	Mysid (*Americamysis bahia*)	96-h LC_{50} = >141,800 (practically non-toxic)	42315102 Acceptable	No effects noted in the study.

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)[1]	MRID or ECOTOX No./ Classification	Comments
Aquatic plants and algae					
Vascular	TEP (19.3%)	Reed Mannagrass (*Glyceria maxima*)	21-d NOAEC = 93 EC_{50} = 210	48000902 Acceptable	Endpoints based on growth rate of total leaf length. Percent growth inhibition of total leaf length in treated culture as compared to the control ranged from 10 to 95%.
Non-vascular	TGAI (99.8%)	Marine diatom (*Skeletonema costatum*)	NOAEC = 250 120-h EC_{50} = >250	43626101 Acceptable	No effects noted in the study.

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

6.2.1 Birds

The available data indicate that sethoxydim TGAI is practically non-toxic to birds on an acute oral and subacute dietary basis. A new acute dietary canary (*Serinus canaria*) study (MRID 50542501) resulted in an LC_{50} of >4341 mg a.i./kg-diet. A chronic mallard duck (*Anas platyrhynchos*) study (MRID 48000901) resulted in a NOAEC and LOAEC of 466 and 953 mg a.i./kg-diet, respectively. The most sensitive endpoint in the chronic study was the proportion of hatchlings to 3-week (21-d) viable embryos (there was a 12% reduction from the control group).

6.2.2 Mammals

On an acute oral basis, both sethoxydim TGAI and the formulated product are classified as "practically non-toxic" to mammals. An acute study (MRID 00045847) that assessed the TGAI (94-99%) determined the LD_{50} value was 2,676 mg a.i./bw for females, and 3,125 mg a.i./bw for males.

A 2-generation reproduction study with rats (MRIDs 41510606 & 43366401) that assessed sethoxydim TGAI indicated that the NOAEC and LOAEC for mammals are 600 and 3,000 mg a.i./kg-diet, respectively. Significant weight decreases in second generation pups were observed in the highest dose (13% reduction from the control group). No reproductive effects were observed.

6.2.3 Terrestrial Invertebrates

New data are available for an adult honey bee (*Apis mellifera*) acute oral and contact study (48-h, MRID 50420004). No mortality was observed in the negative or solvent control group. Mortality was only observed in the highest treatment group, at 3%. The test LD_{50} for both the acute and the contact test were >200.2 µg a.i./bee (the highest concentration tested).

New data are available from a chronic larval honey bee study (22-d dietary; MRID 50420005); the NOAEC and EC_{50} are 536 and >536 mg ai/kg diet, respectively. No treatment-related effects were observed in the study. The study was submitted to fulfill the requirement for an acute larval honey bee study as well, but this is not typically an acceptable approach for assessing the acute larval exposure, since the acute larval study guidelines (OECD 237) require assessment of a single dose, which is not a concentration that is easy to extrapolate from the repeated exposure doses in the chronic larval study.

New data are available for an adult honey bee chronic oral study (10-d dietary, MRID 50420006). The NOAEC and LOAEC based on food consumption were calculated as 0.163 and 0.327 g a.i./kg, respectively (corresponding to NOAEL and LOAEL values of 4.38 and 7.29 µg a.i./bee/day, respectively) based on 13% reduced consumption at the LOAEC. The NOAEC and LOAEC for mortality were 1.307 and 2.614 g a.i./kg, respectively (30.8 and 59.3 µg a.i./bee/day) based on 17% mortality at the LOAEC. During the test, one bee out of 30 remaining bees was described as affected in terms of uncoordinated movements in the highest test dose on day 2. On day 10, one bee out of 25 remaining bees was described as affected in the highest test dose. No other treatment-related behavioral abnormalities were observed in the test groups.

6.2.4 Terrestrial Plants

Data are available for the seedling emergence of terrestrial plants exposed to the formulated product (BAS 562 05 H; a.i. 18%) (MRID 50420002). The most sensitive monocot species was ryegrass, based on survival, with a NOAEC of 0.020 lb a.i./A and an EC_{25} value of 0.046 lb a.i./A. The most sensitive dicot species was sugarbeet, based on emergence, with NOAEC and EC_{25} values of 0.0073 lb ai/A and >1.8 lb a.i./A, respectively; the EC_{25} was not calculable due to a lack of a dose-dependent response. Other sublethal effects detected included inhibition in both height and dry weight for corn, ryegrass, and wheat. The tomato control group did not meet the validity requirement for survival. There is uncertainty with the data since the most sensitive endpoint overall was survival (ryegrass), although the study is designed to capture sub-lethal effects.

Data are also available for the vegetative vigor of terrestrial plants exposed to the formulated product (BAS 562 05 H; a.i. 19.6%) (MRID 47691704). The most sensitive monocot species was ryegrass, based on dry weight, with a NOAEC of 0.00276 lb a.i./A and an IC_{25} of 0.0086 lb a.i./A. In a following vegetative vigor study (a.i. 18%) (MRID 50420003) the most sensitive dicot species was cabbage, based on dry weight. The NOAEC was 0.68 lb a.i./A, and the IC_{25} was 2.44

lb a.i./A. Sublethal effects detected included inhibition in height (soybean) and dry weight (cabbage).

Table 6-4. Terrestrial Toxicity Endpoints Selected for Risk Estimation for Sethoxydim

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value[1]	MRID or ECOTOX No./ Classification	Comments
Birds (surrogates for terrestrial amphibians and reptiles)					
Sub-acute (dietary)	TGAI (97.1%)	Canary (*Serinus canaria*)	LC_{50} >4341 mg a.i./kg-diet (Practically non-toxic)	50542501[N] (Acceptable)	No effects observed in the study.
Acute	TGAI (97.3 % a.i.)	Mallard Duck (*Anas platyrhynchos*)	LD_{50} = >2510 mg a.i./kg-bw (Practically non-toxic)	00042813 (Acceptable)	No effects observed in the study.
Chronic (dietary)	TGAI (96.8% a.i.)	Mallard duck (*Anas platyrhynchos*)	NOAEC = 466 mg LOAEC = 953 mg a.i./kg-diet	48000901 (Acceptable)	Endpoint affected: proportion of hatchlings to 3-week (21-d) viable embryos (12% reduction from control)
Mammals					
Acute Oral	TGAI 94-99% a.i.	Laboratory Rat (*Rattus norvegicus*)	LD_{50} (females) = 2676 mg a.i./kg-bw LD_{50} (males) = 3125 mg a.i./kg-bw (practically non-toxic)	00045847 (Acceptable)	No effects observed in the study.
Chronic	TGAI 94-99% a.i.	Laboratory Rat (*Rattus norvegicus*)	NOAEC = 600 mg a.i./kg-diet LOAEC = 3000 mg a.i./kg-diet	41510606 & 43366401 (Acceptable)	No reproductive effects were observed. Significant weight decrease in second generation pups in highest dose (13% reduction from control).
Terrestrial invertebrates					
Acute contact (adult)	TGAI 97.2% a.i.	Honey bee (*Apis mellifera* L.)	LC_{50} = >200.2 µg a.i./bee	50420004[N] (Acceptable)	No effects noted in the study
Acute oral (adult)	TGAI 97.2% a.i.	Honey bee (*Apis mellifera* L.)	LD_{50} = >200.2 µg a.i./bee	50420004[N] (Acceptable)	No effects noted in the study
Chronic oral (adult)	TGAI 97.2% a.i.	Honey bee (*Apis mellifera* L.)	NOAEL = 4.38 µg a.i./bee/day LOAEL = 7.29 µg a.i./bee/day	50420006[N] (Acceptable)	Most sensitive endpoint: food consumption

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value[1]	MRID or ECOTOX No./ Classification	Comments
Chronic oral (larval)	TGAI 97.2% a.i.	Honey bee (*Apis mellifera L.*)	NOAEC = 21 LOAEC = >21 µg a.i./larvae/day	50420005[N] (Acceptable)	One bee displayed uncoordinated movements. On day 10 one bee out of 25 remaining bees was described as affected in the highest test item dose.
Terrestrial and wetland plants					
Vegetative Vigor	TEP 18.55% a.i.	Various species	Dicots (cabbage): IC_{25} = 2.4 lb a.i./acre Monocot (ryegrass): IC_{25} = 0.0086 lb a.i./A	47691704 & 50420003[N] (Acceptable)	The most sensitive dicot was cabbage, based on the dry weight endpoint. The most sensitive monocot was ryegrass, based on the dry weight endpoint. Phytotoxicity effects were observed.
Seedling Emergence	TEP 18.55% a.i.	Various species	Dicots (sugarbeet): IC_{25} = >1.8 lb a.i./acre Monocots (ryegrass): EC_{25} = 0.046 lb a.i./acre	50420002[N] (Supplemental quantitative)	The most sensitive monocot was ryegrass, based on survival. This study is designed to capture sub-lethal effects; therefore, survival is not expected to be the most sensitive endpoint and low survival may impact the validity of the other endpoints. The EC_{25} could not be calculated for dicots. Phytotoxic effects were displayed in corn, ryegrass, and wheat.

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

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

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

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

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

6.3 Incident Data

The Incident Data System (IDS) provides information on the available ecological pesticide incidents, including those that have been aggregately reported to the EPA. The incident data reported here are from a search of IDS conducted on April 8, 2019.

There have been five reported non-aggregate incidents involving sethoxydim reported to the EPA. Four of the incidents, involving freshwater fish and two crop species, were discussed in the PF. An additional incident has been received since the PF was conducted (see **Table 6-5**). This

incident from July 2014 involved a commercial beekeeper that reported sethoxydim as one of three pesticides to which affected bee colonies were exposed. The colonies were being used to pollinate low-bush blueberry crops in Cherryfield, Maine. The certainty for sethoxydim's effect was classified as "possible" (**Table 6-6**). There have been seven reported aggregate incidents (only reported as a count-based measure) involving sethoxydim reported to the EPA – one incident involving vertebrate wildlife, and six involving plants (**Table 6-7**).

EPA's changes in the registrant reporting requirements for incidents in 1998 may account for a reduced number of non-aggregated reported incidents. Registrants are now only required to submit detailed information on "major" fish, wildlife, and plant incidents. Minor fish, wildlife, and plant incidents, as well as all other non-target incidents, are generally reported rarely.

Table 6-8. Sethoxydim Incidents from the Incident Data System (IDS)

Incident Number	Year	State	Product and Additional Active Ingredients	Legality	Certainty Index	Use Site	Species	Magnitude/Other Notes
Aquatic								
I000232-001	1992	USA	POAST PLUS	Registered Use	Possible	Cotton, peanuts	Bluegill, crappie	According to the report a pond collected water from a large watershed that drained 104 acres of farmland where cotton (40 yards away) and peanuts (60 yards away) were being grown. The cotton had been treated with Pix (growth regulator) and the peanuts had been treated with Poast-Plus Herbicide and Lorsban 15G Granular Insecticide 8-10 days prior to an alleged fish kill (Bluegill and Crappie). Two inches of rain fell one hour after the Lorsban application. It was believed that chlorpyrifos was responsible for the observed incident. Four pond water samples were collected and analyzed for chlorpyrifos one week after the fish kill was reported. Presence of chlorpyrifos was revealed. The product label states that drift or runoff from treatment areas may be hazardous to aquatic organisms in neighboring aquatic sites. While chlorpyrifos is probably the primary cause of this fish kill, it is also possible that mepiquat chloride and sethoxydim contributed to the toxicity observed in this incident.
I011716-002	2001	AZ	CHECKMATE	Misuse (Accidental)	Possible	Cotton	Grass carp	A crop-dusting plane, misdirected spray suffocated dozens of White Amur grass carp (*Ctenpharyngondon idella*). The pilot was to spray Thiodan and Checkmate over a cotton field to kill the common whitefly. Endosulfan is much more toxic to fish than is sethoxydim and was likely the primary cause of the fish mortality. It is possible, however, that sethoxydim also contributed to the toxicity to the fish.
Terrestrial								

I018428-016	2006	CA	POAST	Misuse (Intentional)	Possible	Watermelon	Watermelon	An aerial application of the product (Poast) resulted in damage to watermelon fruits and foliage. The application was made at twice the label rate. Application rate was listed as 51.2 oz/A.
I021485-016	2009	ID	HI YIELD	Registered Use	Possible	Winter wheat	Winter wheat	An application of the products Huskie (a.i. pyrasulfotole, bromoxynil octanoate and bromoxynil heptanoate) and Hi Yield (a.i. sethoxydim) onto 193 acres of winter wheat in Cassia County, ID allegedly stunted the crop.
I028065-001	2014	ME	POAST	Undeter-mined	Possible	Blueberries	Honey bees	The state of Maine did not investigate this bee kill, where the affected beekeeper alleged 3,500 of 3,800 colonies were possibly affected by exposure to pesticides. Commercial products Bravo (chlorothalonil) and Tilt (propiconazole) were classified as "possible" reasons for the incident.

Table 6-9. Sethoxydim Aggregate Incidents from the Incident Data System (IDS)[1]

Taxa	Number of Incidents
Vertebrate Wildlife (W-B)	1
Plant (P-B)	6
Non-vertebrate (ONT)	0

[1] Aggregate incidents are only reported as a count based measure.

7 Analysis Plan

7.1 Overall Process

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

This assessment evaluated the use patterns with the highest application rate – citrus, pistachio, and tree nuts, and included assessment of the use patterns of lower application rates when there were LOC exceedances, to provide a comprehensive evaluation of sethoxydim's potential risk to non-target organisms. This document assesses risk to terrestrial taxa for terrestrial uses and to all taxa for wetland uses. Risk to aquatic taxa for terrestrial uses has been previously assessed and the risk conclusions have not changed (USEPA, 2005a).

7.2 Modeling

Various models are used to calculate aquatic and terrestrial EECs (see **Table 7-1**)**.** The specific models used in this assessment are discussed further below.

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

Environment	Taxa of Concern	Exposure Media	Exposure Pathway	Model(s) or Pathway
Aquatic	Vertebrates/ Invertebrates (including sediment-dwelling)	Surface water	Direct application to water in wetland areas	Provisional Tier 1 Rice Model version 2.0
	Aquatic Plants (vascular and nonvascular)			
Terrestrial	Vertebrate	Dietary items	Ingestion of residues in/on dietary items as a result of direct foliar application	T-REX version 1.5.2[1]
	Plants	Spray drift/runoff	Runoff and spray drift to plants	TERRPLANT version 1.2.2

Environment	Taxa of Concern	Exposure Media	Exposure Pathway	Model(s) or Pathway
	Bees and other terrestrial invertebrates	Contact Dietary items	Spray contact and ingestion of residues in/on dietary items as a result of direct application	BeeREX version 1.0
All Environments	All	Movement through air to aquatic and terrestrial media	Spray drift	AgDRIFT version 2.1.1 (Spray drift)

[1] The 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

The aquatic exposure and risk of sethoxydim applications to all of the terrestrial use sites described in **Appendix A** have been considered in previous risk assessments (USEPA, 2005a) and risk is not expected to exceed levels of concern for any aquatic taxa from those uses. In this streamlined aquatic assessment, only the wetland use site applications included in special local needs (SLN) registrations (FL160001 and SC170001 for Florida and South Carolina, respectively) are assessed, as they were not included in any previous assessment.

8.1.1 Modeling

The SLN labels provide application rates on a mass per unit area basis (lbs/A) basis similar to applications to rice paddies, rather than as a target water concentration as is given for many direct water applications. Therefore, surface water aquatic modeling was simulated using the Tier 1 Rice Model version 2.0 for applications to wetland areas, since it models shallow waterbodies and accepts mass per unit area application rates. Chemical-specific input parameters used in this rice model are the average Kd (3.688 L/Kg) and the total toxic residue (TTR) aerobic aquatic metabolism half-life (44 days)[1]. The Kd value of 3.688 L/Kg is the average Kd for the M2-SO_2 degradate. The Kd for this degradate is thought to be most representative of the Kd for the sethoxydim total residues since M2-SO_2 appears to be the most persistent sethoxydim degradate. The 44-day aerobic aquatic metabolism half-life input represents the

[1] The only other parameters used in this model were left at there default values: water column depth = 0.10m; sediment depth = 0.01m; organic fraction of sediment = 0.01 (unitless); sediment bulk density = 1300 kg/m^3; and sediment porosity = 0.509 (unitless).

upper 90th percentile of the two aquatic system TTR half-life values. Input parameters were selected in accordance with EFED's guidance documents (USEPA, 2009b; USEPA, 2010b; USEPA, 2012b; USEPA, 2013a; USEPA, 2013b; USEPA, 2014a; USEPA, 2014b; USEPA and Health Canada, 2013).

Wetlands vary in terms of water flow from relatively static waterbodies that "flow" only through slow exchanges with groundwater to riverine systems with obvious flow. Up to four reapplications are allowed on labels at a minimum of 14-day intervals. In more static wetlands, the reapplications would fall on the same water that had been previously treated with the undegraded remainder of previous applications accumulating with the latest application. However, in flowing waterbodies, the undegraded remainder of previous applications is far downstream of the reapplication. Therefore, in waterbodies with higher flow, there is no or limited accumulation with reapplications. **Figure 8-1** depicts these two extremes of static and accumulating (a) and flowing without accumulation (b) exposure estimates.

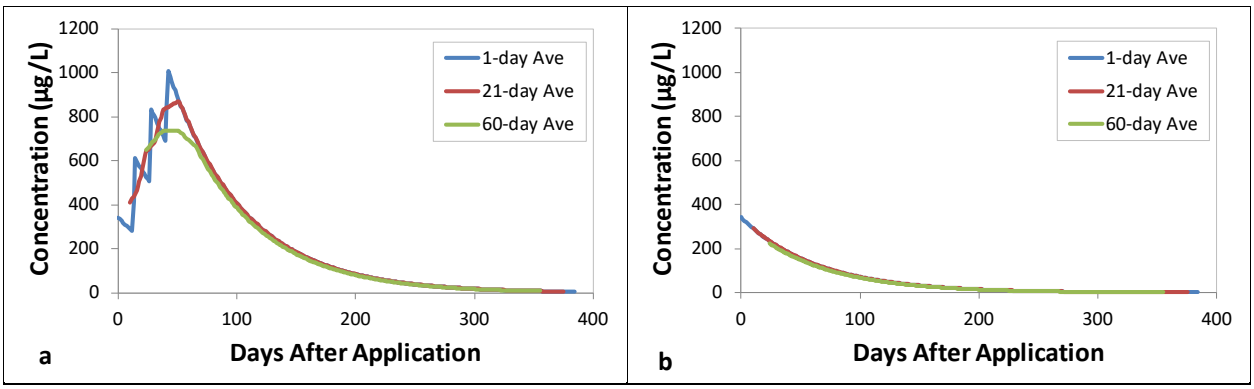

Figure 8-1. Comparison of Predicted Sethoxydim Exposure in Static (a) and Flowing (b) wetlands

Table 8-1 presents exposure estimates as specific concentrations that can be compared to endpoint estimates. The chronic flowing wetland exposure estimates are likely conservative (high) estimates of this low exposure scenario since 1) contaminant plumes tend to spread out and become diluted, which is not factored into the flowing water estimate; and 2) the exposed organism would have to be traveling with the flow to receive the longer-term chronic exposures. However, the high exposure static scenario would not be affected by either of the aforementioned flowing water issues. As previously noted in **Section 5**, aqueous photolysis may decrease chronic exposures in clear, shallow waterbodies below these exposure estimates that are based aerobic aquatic metabolism alone (no photodegradation), but many wetlands are shaded by trees and plants, have dark stained waters, and thick mats of pond scum which limits light penetration and therefore photolysis in water.

Table 8-2. Surface Water EECs for the Total Residues of Sethoxydim (Estimated Using the Tier 1 Rice Model Version 2.0)

Use	Annual App Rate lbs a.i./A, App type	Water Column µg/L		
		1-day	21-day	60-day
Flowing Wetlands	0.47, aerial or ground	341	292	222
Static Wetlands	0.47, aerial or ground	1009	870	736

Maximum EECs are shown in bold.

8.1.2 Monitoring

As discussed in the PF, sethoxydim is not an analyte in California Environmental Data Exchange Network (CEDEN) (State Water Resources Control Board, 2015)[2] and California Department of Pesticide Regulation Surface Water Database[3] (CADPR, 2004). In the Water Quality Portal (USEPA and USGS)[4], the only data available is from the Arizona Department of Environmental Quality, but it consists solely of 738 vapor phase samples and shows no detections at a reporting limit of 10 µg/L.

8.2 Aquatic Organism Risk Characterization

8.2.1 Aquatic Vertebrates

The risk quotients for fish[5] calculated for sethoxydim were based on comparing the EECs to the toxicity endpoints reported in the fish studies. The acute endpoint for estuarine/marine fish was non-definitive; therefore, acute risk could not be determined through derivation of a risk quotient for this taxa. A qualitative comparison of the non-definitive endpoint (i.e., highest concentration tested in the study) and the EECs indicates that acute risks to estuarine/marine fish would not be of concern. The remaining RQs for fish were calculated using EECs of sethoxydim in both flowing and static wetlands. The acute RQs determined for freshwater fish ranged from <0.01 to 0.01, which all fall below the acute LOC of 0.5. The freshwater fish chronic RQs ranged from 0.05 to 0.15, which all fall below the chronic LOC of 1.0. Chronic toxicity data are not available for estuarine/marine fish; however, because freshwater fish are generally more sensitive than estuarine/marine fish, the chronic freshwater fish endpoints are acceptable surrogate data to use to draw risk conclusions for estuarine/marine fish (per USEPA 2016). Thus, the calculated chronic RQs for freshwater fish also indicate that the chronic RQs fall below the LOC of 1.0.

[2] http://www.ceden.org/
[3] http://www.cdpr.ca.gov/docs/emon/surfwtr/surfdata.htm
[4] https://www.waterqualitydata.us/
[5] Fish are also used as a proxy for aquatic-phase amphibians.

Table 8-3. Acute and Chronic Vertebrate Risk Quotients for Non-listed Species

Use Sites	1-in-10 Yr EEC µg/L		Risk Quotient		
			Freshwater		Estuarine/Marine
	Daily Ave	60-day Ave	Acute[1]	Chronic[2]	Chronic[3]
			LC_{50} = 170,000 µg a.i./L	NOAEC = 4860 µg a.i./L	NOAEC = 4860 µg a.i./L
Flowing Wetlands	341	222	<0.01	0.05	0.05
Static Wetlands	1009	736	0.01	0.15	0.15

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

[1] The EECs used to calculate these RQs are based on the 1-in-10-year peak 1-day average value from **Table 8-1.**

[2] The EECs used to calculate these RQs are based on the 1-in-10-year 60-day average value from **Table 8-1**.

[3]The freshwater fish chronic endpoint values are used as surrogate data for estuarine and marine fish

For the two reported sethoxydim incidents that involved fish, other active ingredients were the probable cause of fish mortality, though sethoxydim potentially contributed to the observed toxicity (I000232-001, 1992; I011716-002, 2001). Therefore, based on the available data, the risk to freshwater and estuarine/marine fish from the use of sethoxydim is expected to be low on both an acute and chronic basis.

8.2.2 Aquatic Invertebrates

The risk quotients of aquatic invertebrates calculated for sethoxydim were based on comparing the EECs to the toxicity endpoints reported in the aquatic invertebrate studies. The endpoint for estuarine/marine invertebrates was non-definitive. A qualitative comparison of the non-definitive endpoint (i.e., highest concentration tested in the study) and the EECs indicates that acute risks to estuarine/marine invertebrates would not be of concern. The remaining RQs were calculated using sethoxydim EECs for both flowing and static wetlands. The acute RQs determined for freshwater invertebrates ranged from <0.01 to 0.01, which all fall below the acute LOC of 0.5. The chronic RQ values were not calculated because of the lack of chronic endpoints for aquatic invertebrates.

Table 8-4. Acute Aquatic Invertebrate Risk Quotients

Use Sites	1-in-10 Yr EEC µg/L		Risk Quotient
			Freshwater
	Daily Ave	21-day Ave	Acute[1]
			LC_{50} = 78,100 µg a.i./L
Flowing Wetlands	341	292	<0.01
Static Wetlands	1009	870	0.01

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

[1] The EECs used to calculate this RQ are based on the 1-in-10-year peak 1-day average value from **Table 8-1**.

Based on available information, the risk to aquatic invertebrates is expected to be low. The chronic freshwater invertebrate study (MRID 50420001) showed no statistically significant effects on growth, reproduction, or mortality in most tested treatment groups in the study. More information about the chronic study is available in **Appendix C**. More information would

be needed to quantitatively assess risk to freshwater invertebrates on a chronic basis, since the study submitted since the PF was deemed supplemental on a qualitative basis. Based on the RQs calculated of the acute studies, and the information derived from the chronic study, risk to aquatic invertebrates is expected to be low.

8.2.3 Aquatic Plants

The risk quotients of aquatic plants calculated for sethoxydim were based on comparing the EECs to the toxicity endpoints reported in the aquatic plant studies. The endpoint used to estimate the RQ of non-vascular plants was non-definitive, which means the risk quotient could not be calculated. A qualitative comparison of the non-definitive endpoint (i.e., highest concentration tested in the study) and the EECs indicates that acute risks to non-vascular plants would not be of concern. The vascular plant RQs were calculated for EECs of sethoxydim in both flowing and static wetlands. The vascular plant RQs ranged from 1.60 to 4.80, exceeding the LOC of 1.

The non-definitive endpoint used for the non-vascular plant study (IC_{50} = >250 µg a.i./L) is lower than the EECs calculated in both wetland scenarios. This indicates that the sethoxydim concentrations found in aquatic environments may match or be greater than the concentrations that inhibit at least 50% of the plant populations affected. The highest concentrations of both plant studies were below the EECs calculated. As a result, plant studies with higher test concentrations would be needed to more accurately characterize risk to aquatic plants.

Table 8-5. Aquatic Plant Risk Quotients for Non-listed Species

Use Sites	1-in-10 Year Daily Average EEC µg/L	Risk Quotients
		Vascular
		IC_{50} = 210 µg a.i./L
Flowing Wetlands	341	**1.60**
Static Wetlands	1009	**4.80**

Bolded values exceed the LOC for non-listed plants of 1. The endpoints listed in the table are the endpoint used to calculate the RQ.

Based on the available data, exceedances of the aquatic plant level of concern from the use of sethoxydim is expected in both flowing and static wetland scenarios. Because sethoxydim is an herbicide, risk to non-target plants is expected as a result of the application of sethoxydim.

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. Sethoxydim is applied through aerial and ground application methods, which includes broadcast sprays, band treatments, and spot treatments.

Therefore, potential dietary exposure for terrestrial wildlife in this assessment is based on consumption of sethoxydim residues on food items following spray foliar applications. EECs for birds[6] and mammals from consumption of dietary items on the treated field were calculated using T-REX v.1.5.2. Detailed T-REX inputs and outputs are in **Appendix D**.

9.1.1 Dietary Items on the Treated Field

Potential dietary exposure for terrestrial wildlife in this assessment is based on consumption of sethoxydim residues on food items following spray foliar applications. EECs for birds and mammals from consumption of dietary items on the treated field were calculated using T-REX v.1.5.2. For the foliar uses, EECs are based on application rates, number of applications, and intervals presented in **Table 3-1**. The foliar dissipation half-life used was 35 days, the default half-life value in T-Rex. Only one foliar dissipation study for sethoxydim was available, a tobacco study that included several magnitude of residue trials that calculated the foliar dissipation half-life (MRID 44021206) but it did not include a day zero time measurement in calculating the half-life of each of its trials, nor did it fully meet the criterion of strictly foliar applications (the trials applied sethoxydim to the seed for the first treatment). Thus, the default foliar dissipation half-life was deemed more appropriate to use for calculations of the RQs.

Kenaga nomogram values are used to derive EECs for sethoxydim's exposures to terrestrial mammals and birds on the field of application based on a 1-year period. Consideration is given to different types of feeding strategies for mammals, including herbivores, insectivores and granivores. Dose-based exposures are estimated for three weight classes of birds (20 g, 100 g, and 1,000 g) and three weight classes of mammals (15 g, 35 g, and 1,000 g). Dietary-based EECs on terrestrial food items range from 1.50 to 332.10 mg/kg-diet. . Dose-based EECs, adjusted for body weight, range from 0.05 to 378.23 mg/kg-body weight for birds and 3.17 to 316.63 mg/kg-body weight for mammals. A summary of upper bound EECs are found in **Table 9-1**.

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

Table 9-1. Summary of Dietary (mg a.i./kg-diet) and Dose-based EECs (mg a.i./kg-bw) as Food Residues for Birds, Reptiles, Terrestrial-Phase Amphibians and Mammals from Labeled Uses of Sethoxydim (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)
Citrus, Pistachio, Tree Nuts (0.5 lb a.i./acre, 4x, 14-day interval)							
Short grass	332.10	378.23	215.68	96.56	316.63	218.83	50.74
Tall grass	152.21	173.35	98.85	44.26	145.12	100.30	23.25
Broadleaf plants/small insects	186.81	212.75	121.32	54.32	178.10	123.09	28.54
Fruits/pods/(seeds, dietary only)	20.76	23.64	13.48	6.04	19.79	13.68	3.17
Arthropods	130.07	148.14	84.47	37.82	124.01	85.71	19.87
Seeds (granivore)	NA	5.25	3.00	1.34	4.40	3.04	0.70
Agricultural Fallow/Idleland/Conservation Reserve & Other Crops[1] (0.5 lb a.i./acre, 3x, 14-day interval)							
Short grass	279.86	318.74	181.76	81.38	266.83	184.42	42.76
Tall grass	128.27	146.09	83.31	37.30	122.30	84.52	19.60
Broadleaf plants/small insects	157.42	179.29	102.24	45.77	150.09	103.73	24.05
Fruits/pods/(seeds, dietary only)	17.49	19.92	11.36	5.09	16.68	11.53	2.67
Arthropods	109.61	124.84	71.19	31.87	104.51	72.23	16.75
Seeds (granivore)	NA	4.43	2.52	1.13	3.71	2.56	0.59
Tuberous and corm vegetables & Other Crops[2] (0.5 lb a.i./acre, 2x, 14-day interval)							
Short grass	210.94	240.24	137.00	61.34	201.12	139.00	32.23
Tall grass	96.68	110.11	62.79	28.11	92.18	63.71	14.77
Broadleaf plants/small insects	118.66	135.14	77.06	34.50	113.13	78.19	18.13
Fruits/pods/(seeds, dietary only)	13.18	15.02	8.56	3.83	12.57	8.69	2.01
Arthropods	82.62	94.10	53.66	24.02	78.77	54.44	12.62
Seeds (granivore)	NA	3.34	1.90	0.85	2.79	1.93	0.45
Beans, Dried-Type & Other Crops[3] (0.5 lb a.i./acre, 1x)							
Short grass	120.00	136.67	77.93	34.89	114.41	79.07	18.33
Tall grass	55.00	62.64	35.72	15.99	52.44	36.24	8.40
Broadleaf plants/small insects	67.50	76.88	43.84	19.63	64.36	44.48	10.31
Fruits/pods/(seeds, dietary only)	7.50	8.54	4.87	2.18	7.15	4.94	1.15
Arthropods	47.00	53.53	30.52	13.67	44.81	30.97	7.18
Seeds (granivore)	NA	1.90	1.08	0.48	1.59	1.10	0.25
Okra (0.25 lb a.i./acre, 4x, 14-day interval)							
Short grass	166.05	189.11	107.84	48.28	158.31	109.42	25.37

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	76.11	86.68	49.43	22.13	72.56	50.15	11.63
Broadleaf plants/small insects	93.40	106.38	60.66	27.16	89.05	61.55	14.27
Fruits/pods/(seeds, dietary only)	10.38	11.82	6.74	3.02	9.89	6.84	1.59
Arthropods	65.04	74.07	42.24	18.91	62.01	42.85	9.94
Seeds (granivore)	NA	2.63	1.50	0.67	2.20	1.52	0.35
Bulb vegetables, Flax, Fruiting Vegetables, Succulent Peas, Pepper, & Tobacco (0.25 lb a.i./acre, 3x, 14-day interval)							
Short grass	139.93	159.37	90.88	40.69	133.41	92.21	21.38
Tall grass	64.14	73.04	41.65	18.65	61.15	42.26	9.80
Broadleaf plants/small insects	78.71	89.65	51.12	22.89	75.05	51.87	12.03
Fruits/pods/(seeds, dietary only)	8.75	9.96	5.68	2.54	8.34	5.76	1.34
Arthropods	54.81	62.42	35.59	15.94	52.25	36.11	8.37
Seeds (granivore)	NA	2.21	1.26	0.57	1.85	1.28	0.30
Brassica (head and stem), field corn, cucumber, cucurbits, leafy vegetables, cantaloupe melons, mustard, peanuts, rhubarb (0.25 lb a.i./acre, 2x, 14-day interval)							
Short grass	105.47	120.12	68.50	30.67	100.56	69.50	16.11
Tall grass	48.34	55.06	31.40	14.06	46.09	31.85	7.39
Broadleaf plants/small insects	59.33	67.57	38.53	17.25	56.56	39.09	9.06
Fruits/pods/(seeds, dietary only)	6.59	7.51	4.28	1.92	6.28	4.34	1.01
Arthropods	41.31	47.05	26.83	12.01	39.39	27.22	6.31
Seeds (granivore)	NA	1.67	0.95	0.43	1.40	0.97	0.22
Sweet corn (0.25 lb a.i./acre, 2x, 10-day interval)							
Short grass	109.22	124.39	70.93	31.76	104.13	71.97	16.69
Tall grass	50.06	57.01	32.51	14.56	47.73	32.99	7.65
Broadleaf plants/small insects	61.44	69.97	39.90	17.86	58.57	40.48	9.39
Fruits/pods/(seeds, dietary only)	6.83	7.77	4.43	1.98	6.51	4.50	1.04
Arthropods	42.78	48.72	27.78	12.44	40.79	28.19	6.54
Seeds (granivore)	NA	1.73	0.99	0.44	1.45	1.00	0.23
Non-agricultural Rights-of-Way (0.25 lb a.i./acre, 1x)							
Short grass	60.00	68.33	38.97	17.45	57.21	39.54	9.17
Tall grass	27.50	31.32	17.86	8.00	26.22	18.12	4.20
Broadleaf plants/small insects	33.75	38.44	21.92	9.81	32.18	22.24	5.16
Fruits/pods/(seeds, dietary only)	3.75	4.27	2.44	1.09	3.58	2.47	0.57

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)
Arthropods	23.50	26.76	15.26	6.83	22.41	15.49	3.59
Seeds (granivore)	NA	0.95	0.54	0.24	0.79	0.55	0.13
Orchards, Unspecified (0.1 lb a.i./acre, 1x)							
Short grass	24.00	27.33	15.59	6.98	22.88	15.81	3.67
Tall grass	11.00	12.53	7.14	3.20	10.49	7.25	1.68
Broadleaf plants/small insects	13.50	15.38	8.77	3.93	12.87	8.90	2.06
Fruits/pods/(seeds, dietary only)	1.50	1.71	0.97	0.44	1.43	0.99	0.23
Arthropods	9.40	10.71	6.10	2.73	8.96	6.19	1.44
Seeds (granivore)	NA	0.38	0.22	0.10	0.32	0.22	0.05

1. Agricultural Fallow/Idleland/ Conservation Reserve, Alfalfa, Avocado, Clover, Cotton (Unspecified), Date, Fig, Nonagricultural Uncultivated Areas/Soils, Olive, Plum, Pome Fruits, Pomegranate, Prune, Sainfoin, Trefoil
2. Tuberous and corm vegetables subgroup, Rapeseed subgroup, Apricot, Artichoke, Asparagus, Beans, Dried-Type, Beans, Succulent (Snap), Beets (Unspecified), Blueberry, Borage, Buckwheat, Caneberries, Canola/Rape, Carrot (Including Tops), Cherry, Crambe, Cranberry, Dill, Grapes, Grasses Grown For Seed, Horseradish, Lentils, Mint, Nectarine, Ornamental Lawns and Turf, Peach, Peas, Dried Type, Potato, White/ Irish (or Unspecified), Safflower, Small Fruits, Soybeans (Unspecified), Sugar Beet, Sweet Potato
3. Endive (Escarole), Forest Plantings (Reforestation Programs) (Tree Farms, Tree Plantation, ETC.), Lettuce, Head, Rye, Root vegetables (except sugar beet) subgroup Field Corn, Sweet Corn, Mint/ Peppermint/ Spearmint, Peas, Dried Type, Soybeans (Unspecified), Strawberry, Sunflower

9.2 Terrestrial Vertebrate Risk Characterization

RQ values are generated based on the upper bound EECs discussed both above and in **Appendix D**, and toxicity values contained in **Table 6-2**.

In the sub-acute dietary passerine study (MRID 50542501), the LC_{50} value is non-definitive; because the highest tested concentration (4341 mg/kg-diet) is considerably higher than the EECs at the maximum application rate (20.76 to 332.10 mg/kg-diet), it can be assumed that the concentrations of sethoxydim in the environment present a low risk to birds on an acute dietary basis for all registered uses. The LD_{50} from the acute mallard duck study (MRID 00042813) is also non-definitive, but the highest test concentration (2510 mg a.i./kg-bw) is also considerably higher than the EECs at the maximum application rate. Thus, it can be assumed sethoxydim presents a low risk to birds on an acute oral and dietary basis for all registered uses.

For chronic risk to birds, the dietary-based RQ values range from 0.28 to 0.71, based on upper bound values for the maximum use pattern on citrus, pistachio, and tree nuts. RQs are provided in **Table 9-2**.

The mammalian acute dose-based RQ values of sethoxydim range from <0.01 to 0.05, based on upper bound values for the maximum application rate, which is below the LOC for mammals. These RQs are provided in **Table 9-3**. Because of the lack of an exceedance at the highest application rate, risk to mammals on an acute basis is expected to be low. For chronic risk for mammals, the dietary-based RQ values range from 0.03 to 0.55, based on the upper bound values at the maximum application rate. At the highest application rate, the mammalian chronic dose-based RQ values range from 0.03 to 4.80. The RQ values exceed the LOC of 1.0 for all weight class sizes (15, 35, and 1000 g), and for the following dietary items: short grass, tall grass, broadleaf plants, and arthropods. There are no LOC exceedances for fruits/pods or seeds. Evaluation of all 11 use patterns determined that LOC exceedances occur at all but the lowest two application rates. **Table 9-4** displays the chronic RQ values for all the application rates.

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

Food Type	Chronic Dietary RQ NOAEC = 466 mg a.i./kg-diet
Citrus, Pistachio, Tree Nuts (0.5 lb a.i./acre, 4x, 14-day interval)	
Short grass	0.71
Tall grass	0.33
Broadleaf plants	0.40
Fruits/pods/seeds	0.04
Arthropods	0.28

The endpoints listed in the table are the endpoint used to calculate the RQ.

Table 9-3. Acute RQ values for Mammals from Labeled Uses of Sethoxydim (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Acute Dose-Based RQ LD_{50} = 2676 mg a.i./kg-bw		
	Small (15 g)	Medium (35 g)	Large (1000 g)
Citrus, Pistachio, Tree Nuts (0.5 lb a.i./acre, 4x, 14-day interval)			
Short grass	0.05	0.05	0.02
Tall grass	0.02	0.02	0.01
Broadleaf plants	0.03	0.03	0.01
Fruits/pods	<0.01	<0.01	<0.01
Arthropods	0.02	0.02	0.01
Seeds	<0.01	<0.01	<0.01

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

Table 9-4. Chronic RQ values for Mammals from Labeled Uses of Sethoxydim (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Chronic Dose-Based RQ NOAEL = 30 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 600 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Citrus, Pistachio, Tree Nuts (0.5 lb a.i./acre, 4x, 14-day interval)				
Short grass	**4.8**	**4.1**	**2.2**	0.55
Tall grass	**2.2**	**1.88**	**1.01**	0.25
Broadleaf plants	**2.7**	**2.31**	**1.24**	0.31
Fruits/pods/seeds	0.3	0.26	0.14	0.03
Arthropods	**1.88**	**1.61**	0.86	0.22
Seeds	0.07	0.06	0.03	N/A
Agricultural Fallow/Idleland/Conservation Reserve & Other Crops[1] (0.5 lb a.i./acre, 3x, 14-day interval)				
Short grass	**4.05**	**3.46**	**1.85**	0.47
Tall grass	**1.85**	**1.58**	0.85	0.21
Broadleaf plants	**2.28**	**1.94**	**1.04**	0.26
Fruits/pods/seeds	0.25	0.22	0.12	0.03
Arthropods	**1.59**	**1.35**	0.73	0.18
Seeds	0.06	0.05	0.03	N/A
Tuberous and corm vegetables & Other Crops[2] (0.5 lb a.i./acre, 2x, 14-day interval)				
Short grass	**3.05**	**2.61**	**1.40**	0.35
Tall grass	**1.40**	**1.19**	0.64	0.16
Broadleaf plants	**1.72**	**1.47**	0.79	0.20
Fruits/pods/seeds	0.19	0.16	0.09	0.02
Arthropods	**1.19**	**1.02**	0.55	0.14
Seeds	0.04	0.04	0.02	N/A
Beans, Dried-Type & Other Crops[3] (0.5 lb a.i./acre, 1x)				
Short grass	**1.74**	**1.48**	0.79	0.20
Tall grass	0.80	0.68	0.36	0.09
Broadleaf plants	0.98	0.83	0.45	0.11
Fruits/pods/seeds	0.11	0.09	0.05	0.01

Food Type	Chronic Dose-Based RQ NOAEL = 30 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 600 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Arthropods	0.68	0.58	0.31	0.08
Seeds	0.02	0.02	0.01	N/A
Okra (0.25 lb a.i./acre, 4x, 14-day interval)				
Short grass	**2.40**	**2.05**	**1.10**	0.28
Tall grass	**1.10**	0.94	0.50	0.13
Broadleaf plants	**1.35**	**1.15**	0.62	0.16
Fruits/pods/seeds	0.15	0.13	0.07	0.02
Arthropods	0.94	0.80	0.43	0.11
Seeds	0.03	0.03	0.02	N/A
Bulb vegetables, Flax, Fruiting Vegetables, Succulent Peas, Pepper, & Tobacco (0.25 lb a.i./acre, 3x, 14-day interval)				
Short grass	**2.02**	**1.73**	0.93	0.23
Tall grass	0.93	0.79	0.42	0.11
Broadleaf plants	**1.14**	0.97	0.52	0.13
Fruits/pods/seeds	0.13	0.11	0.06	0.01
Arthropods	0.79	0.68	0.36	0.09
Seeds	0.03	0.02	0.01	N/A
Brassica (head and stem), field corn, cucumber, cucurbits, leafy vegetables, cantaloupe melons, mustard, peanuts, rhubarb (0.25 lb a.i./acre, 2x, 14-day interval)				
Short grass	**1.53**	**1.30**	0.70	0.18
Tall grass	0.70	0.60	0.32	0.08
Broadleaf plants	0.86	0.73	0.39	0.10
Fruits/pods/seeds	0.10	0.08	0.04	0.01
Arthropods	0.60	0.51	0.27	0.07
Seeds	0.02	0.02	0.01	N/A
Sweet corn (0.25 lb a.i./acre, 2x, 10-day interval)				
Short grass	**1.58**	**1.35**	0.72	0.18
Tall grass	0.72	0.62	0.33	0.08
Broadleaf plants	0.89	0.76	0.41	0.10
Fruits/pods/seeds	0.10	0.08	0.05	0.01
Arthropods	0.62	0.53	0.28	0.07
Seeds	0.02	0.02	0.01	N/A
Non-agricultural Rights-of-Way (0.25 lb a.i./acre, 1x)				
Short grass	0.87	0.74	0.40	0.10
Tall grass	0.40	0.34	0.18	0.05
Broadleaf plants	0.49	0.42	0.22	0.06
Fruits/pods/seeds	0.05	0.05	0.02	0.01
Arthropods	0.34	0.29	0.16	0.04
Seeds	0.01	0.01	0.01	N/A
Orchards, Unspecified (0.1 lb a.i./acre, 1x)				
Short grass	0.35	0.30	0.16	0.04
Tall grass	0.16	0.14	0.07	0.02
Broadleaf plants	0.20	0.17	0.09	0.02
Fruits/pods/seeds	0.02	0.02	0.01	<0.01

Food Type	Chronic Dose-Based RQ NOAEL = 30 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 600 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Arthropods	0.14	0.12	0.06	0.02
Seeds	<0.01	<0.01	<0.01	N/A

Bolded values exceed the LOC for chronic risk of 1.0. The endpoints listed in the table are the endpoint used to calculate the RQ.

1. Agricultural Fallow/Idleland/ Conservation Reserve, Alfalfa, Avocado, Clover, Cotton (Unspecified), Date, Fig, Nonagricultural Uncultivated Areas/Soils, Olive, Plum, Pome Fruits, Pomegranate, Prune, Sainfoin, Trefoil
2. Tuberous and corm vegetables subgroup, Rapeseed subgroup, Apricot, Artichoke, Asparagus, Beans, Dried-Type, Beans, Succulent (Snap), Beets (Unspecified), Blueberry, Borage, Buckwheat, Caneberries, Canola/Rape, Carrot (Including Tops), Cherry, Crambe, Cranberry, Dill, Grapes, Grasses Grown For Seed, Horseradish, Lentils, Mint, Nectarine, Ornamental Lawns and Turf, Peach, Peas, Dried Type, Potato, White/ Irish (or Unspecified), Safflower, Small Fruits, Soybeans (Unspecified), Sugar Beet, Sweet Potato
3. Endive (Escarole), Forest Plantings (Reforestation Programs) (Tree Farms, Tree Plantation, ETC.), Lettuce, Head, Rye, Root vegetables (except sugar beet) subgroup Field Corn, Sweet Corn, Mint/ Peppermint/ Spearmint, Peas, Dried Type, Soybeans (Unspecified), Strawberry, Sunflower

Based on the available data, risk to birds from the use of sethoxydim from acute and chronic exposure is expected to be low. The risk to mammals from acute exposure is low. However, risks to mammals from chronic dose-based exposure exceed levels of concern. Actual exposure in the environment will vary depending on the mix of dietary items eaten, but at the maximum EEC a small mammal would need to eat only 20% of its diet (1/4.8) in contaminated food items to reach the NOAEC. Also, this assessment does not account for other routes of exposure such as drinking water, inhalation, or dermal exposure. However, the EECs do not exceed the LOAEC, and when T-REX is run with the LOAEC the max RQ is 0.96, so there is uncertainty as to whether exposures would be high enough to cause effects in the environment.

Terrestrial vertebrate spray drift analyses were conducted with AgDRIFT (version 2.1.1). The highest and lowest single application rates with LOC exceedances (0.25 and 0.5 lbs ai/A) were used in combination with the highest chronic mammalian LOC exceedances at those rates (2.4 and 4.8, respectively). The analyses resulted in distances to 29 ft from the treated field for aerial applications with fine to medium droplet size distribution, and up to 13 ft for ground applications at which chronic RQs exceed the LOC for mammals feeding on contaminated dietary items (see **Appendix D**).

10 Terrestrial Invertebrate Risk Assessment

10.1 Terrestrial Invertebrate Exposure Assessment

Contact and dietary exposure are estimated separately using different approaches specific for different application methods. The BeeREX model (Version 1.0) calculates default (*i.e.*, high end, yet reasonably conservative) EECs for contact and dietary routes of exposure for foliar, soil, and seed treatment applications. Further information about the BeeREX model, including a summary of the methods used for deriving the default Tier I EECs can be found in the User Guide : https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#terrestrial

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

Sethoxydim is applied to bee-attractive crops, as identified in the pollinator attractiveness report (USDA, 2017), including alfalfa, corn, dates, lettuce, and mustard. Therefore, exposure on and off the field of application is anticipated.

10.2 Terrestrial Invertebrate Risk Characterization (Tier I)

The chronic study that evaluated the effects of sethoxydim TGAI on larval honey bees, and the acute studies that evaluated the effects on adult honey bees both yielded little to no mortality of the test organisms. For these studies, the NOAECs were recorded as the highest dosage tested, and the EC_{50} values were all non-definitive endpoints. There were no adverse effects noted in the available acute honey bee studies conducted at the highest test concentration of 200.2 µg a.i./bee.

For assessment of risk exposure to bees, BeeREX was used to calculate the EEC of sethoxydim at the maximum single application rate, 0.5 lb a.i./A. Because the highest tested contact and oral dose (200.2 µg a.i./bee) is considerably higher than the EECs (16 µg a.i./bee oral dose, 1.35 µg a.i./bee contact exposure) at the maximum application rate, it can be assumed that the concentrations of sethoxydim in the environment present a low risk to honey bees on an acute basis for all registered uses. Therefore, all the RQs on these bases of exposure would be below the LOC for risk to bees. Thus, only the RQ values for the chronic honey bee studies are evaluated in this assessment. The sethoxydim BeeREX calculations are included in **Appendix D**.

On-Field Risk – Contact Exposure
Since an exposure potential of bees is identified for several use patterns 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 high end estimates of exposure via contact and oral routes. For contact exposure, only the adult forager and drones life stage is considered since this is the relevant life stage for honey bees. Furthermore, toxicity protocols have only been developed for acute exposures. Effects are defined by laboratory exposures to groups of individual bees. The calculated EEC (1.35 µg a.i./bee) for adult honey bees based on acute contact exposure is lower than the highest tested concentration (200.2 µg a.i./bee) in those studies. Therefore, risk to adult forager and drone honey bees via acute contact is expected to be low.

On-Field Risk – Oral Exposure

For oral exposure, the Tier 1 assessment considers just the caste of bees with the greatest oral exposure (foraging adults). If risks are identified, then other factors are considered for refining the Tier 1 risk estimates. These factors include other castes of bees and available information on residues in pollen and nectar which is deemed applicable to the crops of interest. For the chronic risk to adult honey bees, the RQ values range from 0.73 to 3.67, based on the maximum single application rate for several use patterns. Evaluation of all three single application rates (0.1, 0.25, and 0.5 lb a.i./A) determined that LOC exceedances occur at all but the lowest application rate (0.1 lb a.i./A). **Table 10-1** displays the chronic dietary RQ values for all the application rates for adult bees. For the chronic risk to larval honey bees, the RQs do not exceed the LOC of 1.0 for any of the modeled application rates (RQs 0.06-0.32)

Table 10-1. Tier 1 (Default) Oral Risk Quotients for Adult Nectar Forager Honey Bees

Use Pattern	Max. Single Appl. Rate	Bee Caste/Task	Unit Dose (µg a.i./bee per 1 lb a.i./A)[1]	Oral Dose (µg a.i./bee)	Adult Chronic Oral RQ[2]
Citrus, Pistachio, Tree Nuts, and Other Crops[4]	0.50 lb a.i./A	Adult nectar forager	32	16.06	**3.67**[3]
Okra, Bulb Vegetables, Flax, and Other Crops[5]	0.25 lb a.i./A		32	8.03	**1.83**
Orchards, unspecified	0.10 lb a.i./A		32	3.21	0.73

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

[2] Based on a 10-d chronic NOAEL of 4.38 µg a.i./bee/d for adults (MRID 50420006)

[3] **Bolded** RQ value exceeds (or potentially exceeds) the chronic LOC of 1.0

[4] Citrus, Pistachio, Tree Nuts, Agricultural Fallow/Idleland/ Conservation Reserve, Alfalfa, Avocado, Clover, Cotton (Unspecified), Date, Fig, Nonagricultural Uncultivated Areas/Soils, Olive, Plum, Pome Fruits, Pomegranate, Prune, Sainfoin, Trefoil, Tuberous and corm vegetables subgroup, Rapeseed subgroup, Apricot, Artichoke, Asparagus, Beans, Dried-Type, Beans, Succulent (Snap), Beets (Unspecified), Blueberry, Borage, Buckwheat, Caneberries, Canola/Rape, Carrot (Including Tops), Cherry, Crambe, Cranberry, Dill, Grapes, Grasses Grown For Seed, Horseradish, Lentils, Mint, Nectarine, Ornamental Lawns and Turf, Peach, Peas, Dried Type, Potato, White/ Irish (or Unspecified), Safflower, Small Fruits, Soybeans (Unspecified), Sugar Beet, Sweet Potato, Endive (Escarole), Forest Plantings (Reforestation Programs) (Tree Farms, Tree Plantation, ETC.), Lettuce, Head, Rye, Root vegetables (except sugar beet) subgroup Field Corn, Sweet Corn, Mint/ Peppermint/ Spearmint, Peas, Dried Type, Soybeans (Unspecified), Strawberry, Sunflower

[5] Okra, Bulb Vegetables, Flax, Fruiting Vegetables, Succulent Peas, Pepper, & Tobacco, Brassica (Head And Stem), Field Corn, Cucumber, Cucurbits, Leafy Vegetables, Cantaloupe Melons, Mustard, Peanuts, Rhubarb, Sweet Corn, Non-Agricultural Rights-Of-Way

Off-Field Risk

In addition to bees foraging on the treated field, bees may also be foraging in fields adjacent to the treated fields. Spray drift analyses were conducted with AgDRIFT (version 2.1.1.) to determine the distance from the treated field at which RQs exceed the LOC for terrestrial invertebrates. The two highest single application rates (0.25 and 0.5 lbs a.i./A) were used in combination with the highest chronic adult honey bee LOC exceedances at those rates (3.67 and 1.83, respectively). The analyses resulted in distances to 69 ft from the treated field for aerial applications with fine to medium droplet size distribution, and up to 10 ft for ground

applications at which chronic RQs exceed the LOC for adult honey bees feeding on contaminated dietary items (see **Appendix D**).

10.3 Terrestrial Invertebrate Risk Characterization – Additional Lines of Evidence

Potential risk to adult bees based on dietary exposure on a chronic basis is possible. The adult chronic honey bee study yielded the only statistically significant effects for the bee studies on food consumption and mortality (MRID 50420006). Food consumption is decreased between 6 and 13% (not in a dose-response pattern) at doses of 7.29 µg a.i./bee/day and above. These decreases in food consumption are assumed to result in a decrease in bee growth, which was not measured in the study. It is unknown whether this effect in the laboratory study would result in a colony-level effect in the field. Mortality in the study was significantly decreased by 17% at only the highest dose of 59.3 µg a.i./bee/day. Using the mortality NOAEL of 30.8 µg a.i./bee/day, the RQ is 0.52 and does not exceed the LOC of 1.0.

For the one sethoxydim incident that involved honey bees (I028065-001), the state of Maine did not investigate this bee kill, where the affected beekeeper alleged 3,500 of 3,800 of his colonies were possibly affected by exposure to pesticides. Commercial products Bravo (chlorothalonil) and Tilt (propiconazole) which are both fungicide active ingredients were also classified as “possible” reasons for the incident.

11 A separate acute larval honey bee study could add confidence to the risk conclusions. However, it is noted that the acute larval information from the chronic larval honey bee study (MRID 50420005) indicated no significant increased mortality in any of the larvae treatment groups. Based on the available data, risk to bees from the use of sethoxydim from acute exposure is expected to be low. Terrestrial Plant Risk Assessment

11.1 Terrestrial Plant Exposure Assessment

EECs for terrestrial plants are calculated using TERRPLANT v.1.2.2. Exposure is estimated for a single application evaluating exposure via spray drift and runoff. For spray drift, exposure is estimated approximately 200 feet from the edge of the treated field. For a dry area adjacent to the treatment area, runoff exposure is estimated as sheet runoff. Sheet runoff is the amount of pesticide in water that runs off the soil surface of a target area of land that is equal in size to the non-target area (1:1 ratio of areas). For semi-aquatic areas, 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

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

Default assumptions in TerrPlant were considered for spray drift and runoff. For ground applications of liquid formulations, the spray drift fraction is 0.01 for ground applications and 0.05 for aerial applications. Regarding the runoff fraction, the default assumption for a pesticide with a solubility greater than 100 mg/L (sethoxydim, 4700 ppm) is 0.05.

Table 11-1. TerrPlant Calculated EECs for Terrestrial and Semi-Aquatic Plants near Sethoxydim Terrestrial Use Areas

Use Site	Single Max. Application Rate (lb a.i./A)	EECs (lb a.i./A)[1]		
		Aerial[3]		
		Dry Areas (Total)	Semi-Aquatic Areas (Total)	Spray Drift
Citrus, Pistachio, Tree Nuts, and Other Crops[4]	0.50	0.05	0.28	0.025
Orchards (unspecified)	0.10	0.01	0.055	0.0050

[1] Based on a runoff fraction of 0.05
[2] Based on a drift fraction of 1% (*i.e.*, 0.01).
[3] Based on a drift fraction of 5% (*i.e.*, 0.05).
[4] Citrus, Pistachio, Tree Nuts, Agricultural Fallow/Idleland/ Conservation Reserve, Alfalfa, Avocado, Clover, Cotton (Unspecified), Date, Fig, Nonagricultural Uncultivated Areas/Soils, Olive, Plum, Pome Fruits, Pomegranate, Prune, Sainfoin, Trefoil, Tuberous and corm vegetables subgroup, Rapeseed subgroup, Apricot, Artichoke, Asparagus, Beans, Dried-Type, Beans, Succulent (Snap), Beets (Unspecified), Blueberry, Borage, Buckwheat, Caneberries, Canola/Rape, Carrot (Including Tops), Cherry, Crambe, Cranberry, Dill, Grapes, Grasses Grown For Seed, Horseradish, Lentils, Mint, Nectarine, Ornamental Lawns and Turf, Peach, Peas, Dried Type, Potato, White/ Irish (or Unspecified), Safflower, Small Fruits, Soybeans (Unspecified), Sugar Beet, Sweet Potato, Endive (Escarole), Forest Plantings (Reforestation Programs) (Tree Farms, Tree Plantation, ETC.), Lettuce, Head, Rye, Root vegetables (except sugar beet) subgroup Field Corn, Sweet Corn, Mint/ Peppermint/ Spearmint, Peas, Dried Type, Soybeans (Unspecified), Strawberry, Sunflower

11.2 Terrestrial Plant Risk Characterization

At the highest application rate of 0.5 lb a.i./acre, based on the new plant toxicity endpoints and the EECs calculated using TerrPlant, the monocot RQ values exceeded the LOC of 1.0 for aerial spray application to dry areas, semi-aquatic areas, and spray drift (see **Table 11-2**). When the lowest application rate of 0.1 lb a.i./acre was run in Terrplant, RQ values for monocots still exceeded the LOC of 1.0 for semi-aquatic areas exposed to sethoxydim through runoff and spray drift, though they were under the LOC for dry areas and spray drift only exposure. The dicot RQ values did not exceed the LOC for non-listed plant species for either the lowest or highest application rate (see **Table 11-3**). The available data indicates that the monocot species

will be the most sensitive to sethoxydim. Sethoxydim is an herbicide, so risk to terrestrial plants is expected from the application of sethoxydim.

Table 11-4. Terrestrial Plant Risk Quotients (RQs) – Non-listed Species

Type of Plant	Aerial Spray RQs		
	Dry Areas	Semi-Aquatic Areas	Spray Drift Only
Citrus, pistachio, and tree nuts (0.5 lb a.i./acre)			
Monocot	**1.09**	**5.98**	**2.91**
Dicot	<0.10	0.15	<0.10
Orchards (unspecified) (0.1 lb a.i./acre)			
Monocot	0.22	**1.20**	0.58
Dicot	<0.10	<0.10	<0.10

Bolded RQ values exceed the LOC of 1.0.

The seedling emergence study determined that survival was the most sensitive endpoint, though the study is designed to capture sub-lethal effects. Sethoxydim's mode of action is designed to target monocots, so the exceedance of the level of concern makes sense. The two plant incidents involve possible damage done to terrestrial plants from both a misuse of sethoxydim (I018428-016, 2006) and a registered use (I021485-016, 2005). Therefore, based on the available data, risk to terrestrial plants is expected from the use of sethoxydim.

Spray drift analyses were conducted with AgDRIFT (version 2.1.1) to determine the distance from the treated field at which RQs exceed the LOC for terrestrial plants. The highest single application rate (0.5 lbs ai/A) was used in combination with the most sensitive endpoint for sethoxydim (0.0086 lbs ai/A for monocot plants). The analyses resulted in distances of up to 548 ft at which effects may occur for aerial applications with fine to medium droplet size distribution, and distances up to 144 ft for ground applications with very fine to fine droplet size distribution (see **Appendix D**).

12 Conclusions

Given the uses of sethoxydim and sethoxydim's environmental fate properties, there is a likelihood of exposure of sethoxydim to non-target terrestrial organisms. When used in accordance with the label, such exposure may result in adverse effects upon the survival, growth, and reproduction of non-target terrestrial and aquatic organisms. Consistent with previous risk assessments (USEPA 2005a), there is a potential for adverse chronic effects to mammals, and for adverse effects to terrestrial plants, especially monocots. Based on new data, risk to terrestrial invertebrates and birds is expected to be low although there is a potential for adverse chronic effects to adult bees. Assessment of the recently registered special local needs registrations for use on wetlands indicates that there is a potential for adverse effects to aquatic plants from this use.

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Appendix A. Full Use Site Descriptions

Sethoxydim is restricted from application through irrigation equipment for all uses. There were no legally enforceable spray drift restrictions or well setbacks on the labels except for direct applications to water which may only occur 500 or more ft. from an irrigation water well. Similarly, there are no water use restrictions except for the direct applications to water which may not be used as irrigation water for 30 days after the last sethoxydim application.

Appendix Table 1. Maximum Labeled Use Patterns for Sethoxydim

Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Alfalfa	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	Post-emerge	0.469	NS	1.22	14	14 (Dry hay) 7 (Forage)	NA
Apple	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	14	NA
Apricot	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	2	0.938	14	25	NA
Artichoke	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.938	14	7	NA
Asparagus	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.938	14	1	NA
Avocado	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	NS	1.41	14	365	NA
Beans, Dried-Type	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.75	14	30	NA
Beans, Succulent (Snap)	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.75	14	15	NA
Beets	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.938	14	60	NA

Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Blackberry	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	45	NA
Blueberry	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.938	14	30	Disallowed in CA
Borage	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.938	14	23	Disallowed in CA
Brassica (Head and Stem) Vegetables	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.281	NS	0.563	14	30	NA
Broccoli	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	30	NA
Buckwheat	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.938	14	21	NA
Bulb Vegetables	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.281	NS	0.844	14	30	NA
Bushberries	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.938	14	45	NA
Cabbage	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	30	NA
Caneberries	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.281	NS	0.563	14	45	Disallowed aerial in CA
Carrot (including Tops)	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS, H-ES	All	0.469	2	0.938	14	30	NA
Cauliflower	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	30	NA
Celery	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.284	2	0.563	14	30	Only hose-end sprayer allowed in FL
Cherry	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	2	0.938	14	25	NA

Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Citrus	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	2	0.938	14	15	NA
Clover	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	Post-emerge	0.469	NS	1.22	14	20 (Dry hay) 7 (Forage)	NA
Coniferous/Ever-green/Softwood (Non-Food)	SC/L	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	A, G, BP, HS	All	0.469	NS	NS	NS	NA	NA
Corn, Field	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	Pre-plant/ Post-emerge	0.281	NS	0.563	14	45 (Forage) 60 (Fodder) 60 (Grain)	Disallowed in CA
Corn, Sweet	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.938	10	35 (Forage) 45 (Fodder) 30 (Food)	Disallowed in CA
Cotton	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	1.41	14	40	NA
Crabapple	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	14	NA
Cranberry	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.938	14	60	Disallowed in CA
Cucumber	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.284	2	0.563	14	3	NA
Cucurbit Vegetables	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.281	NS	0.563	14	14	NA
Date	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	NS	1.41	14	365	NA
Deciduous/Broad-leaf/Hardwood (Non-Food)	SC/L	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	A, G, BP, HS	All	0.469	NS	NS	NS	NA	NA

Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Dill	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.938	14	14	Disallowed hose-end sprayer in CA
Eggplant	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	20	NA
Endive (Escarole)	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	15	NA
Fig	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	NS	1.41	14	365	NA
Flax	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.281	NS	0.75	14	75	Disallowed in CA
Flowing/Lotic Water Areas	EC	Foliage/ Plant	Bro/Dir	A (helicopter), G, BP, HS, BM	All	0.469	NS	1.88 lbs ai/A/yr	NS	NA	Allowed in FL, SC
Fruiting Vegetables	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.281	NS	0.844	14	20	NA
Garlic	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	30	NA
Grapes	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	2	0.938	14	50	NA
Grass/Turf	EC, SC/L	Foliage/ Plant	Ban/Bro/ Spot	G, BP, HS	All	0.469	2	0.938	14	NA	Some uses disallowed in CA & Pacific Northwest
Grasses Grown for Seed	EC	Foliage/ Plant	Bro	G	All	0.469	NS	NS	NS	21	Allowed in San Joaquin, Solano and Yolo Counties in CA
Horseradish	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	2	0.938	14	60	Only hose-end sprayer allowed in CA
Leaf Petioles (except Brassica)	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.281	NS	0.563	14	30	NA

Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Leafy Greens (except Brassica)	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.281	NS	0.563	14	30	NA
Leafy Vegetables	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.281	NS	0.563	14	15	NA
Lentils	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.75	14	50	Disallowed in CA
Lettuce, Head	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	30	NA
Lettuce, Leaf	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	15	NA
Loganberry	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	45	NA
Melons, Cantaloupe	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.284	2	0.563	14	3	NA
Melons, Musk	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	14	Disallowed in CA
Melons, Water	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	14	NA
Mint	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.938	14	20	NA
Mustard	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.281	NS	0.563	14	14	NA
Nectarine	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	2	0.938	14	25	NA
Non- or Slow-Flowing/Lentic Water Areas	EC	Foliage/ Plant	Bro/Dir	A (helicopter), G, BP, HS, BM	All	0.469	NS	1.88 lbs ai/A/yr	NS	NA	Allowed in FL, SC

Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Okra	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.284	2	1.03	14	14	Disallowed hose-end sprayer in CA
Olive	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	NS	1.41	14	365	NA
Onion	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	30	NA
Orchards (Unspecified)	EC	Foliage/ Plant	Ban/Bro/ Spot	G, BP, HS	All	0.0938	NS	0.0938	14	NA	Disallowed in CA
Ornamentals	EC, SC/L	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	NS	NS	NA	NA
Peach	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	2	0.938	14	25	NA
Peanuts	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.284	1	0.469	14	40	NA
Pear	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	14	NA
Peas, Dried-Type	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.75	14	30	NA
Peas, Succulent	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.75	14	15	NA
Pepper	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.284	2	0.844	14	7	NA
Pistachio	EC	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	G, BP, HS	All	0.469	NS	1.88	14	15	NA
Plum	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	NS	1.41	14	365	NA

Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Pome Fruits	EC	Foliage/ Plant	Ban/Bro/ Spot	G, BP, HS	All	0.469	NS	1.41	14	14	NA
Pomegranate	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	NS	1.41	14	365	NA
Potato, White/ Irish (or Unspecified)	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	2	0.938	14	30	NA
Premises/Areas	EC, SC/L	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	A, G, BP, HS	All	0.469	NS	0.938	14	NA	NA
Prune	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	NS	1.41	14	365	NA
Pumpkin	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	14	NA
Quince	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	14	Quince
Rapeseed Subgroup	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.938	14	60	Rapeseed Subgroup
Raspberry (Black, Red)	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	45	Raspberry (Black, Red)
Rhubarb	EC	Foliage/ Plant	Ban/Bro/ Spot	G, BP, HS	All	0.281	NS	0.563	14	15	Rhubarb
Root Vegetables (Except Sugar Beet)	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	1	0.469	14	14	Root Vegetables (except Sugar Beet)
Safflower	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.938	14	30	Safflower
Sainfoin	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	Post-emerge	0.469	NS	1.22	14	14	Sainfoin

Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Soil/Compost/ Mulch	EC	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	A, G, BP, HS	All	0.469	NS	0.938	14	NA	Soil/Compost/Mulch
Soybeans	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.938	14	75	Soybeans
Spinach	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	15	Spinach
Squash (All or Unspecified)	EC	Foliage/ Plant	Bro/Dir	H-ES	All	0.284	2	NS	NS	14	NA
Strawberry	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.469	1	0.469	14	7	Disallowed aerial in CA
Sugar Beet	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.938	14	60	NA
Sunflower	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.469	14	70	NA
Sweet Potato	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.938	14	30	Allowed in AL, AR, CA, FL, GA, HI, ID, LA, MS, NV, NC, OR, SC, TN, TX, VA, WA
Tobacco	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	Before/ After transplant	0.281	2	NS	14	42	Disallowed in CA
Tomato	EC	Foliage/ Plant	Ban/Bro/ Dir/Spot	A, G, BP, HS, H-ES	All	0.284	2	0.844	14	20	NA
Tree Nuts	EC	Foliage/ Plant, Soil (surface)	Ban/Bro/ Dir/Spot	G, BP, HS, H-ES	All	0.469	2	1.88	14	15	NA
Trefoil	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	1.22	14	14	NA

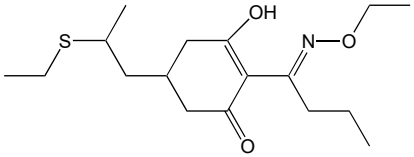
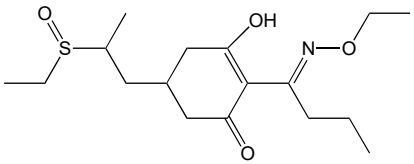
Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs ai/A	Max # App/CC	Max Annual Rate lbs ai/A/CC	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)
Tuberous and Corm Vegetables	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	All	0.469	NS	0.938	14	30	NA
Woodland/Nature Areas/Animal Habitat	EC	Foliage/ Plant	Ban/Bro/ Spot	A, G, BP, HS	Post-emerge	0.469	NS	1.41	14	NA	Do not use west of the Rocky Mountains

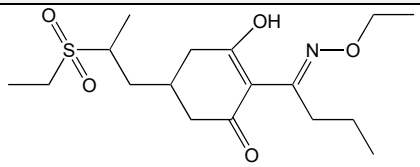
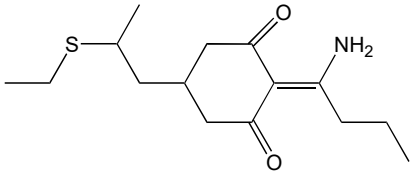
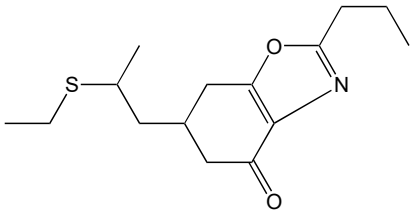
App=application; equip=equipment--=not specified; EC=emulsifiable concentrate; SC=soluble concentrate; L=liquid; G=granular; MRI = Minimum retreatment interval; PHI=preharvest interval; Ban= Banded; Bro=broadcast, Dir=directed; Spot=spot treatment A=aerial; G=ground; BP=back pack; HS=hand sprayer; H-ES=hose-end sprayer; BM=boat mounter sprayer; ai=active ingredient; CC=crop cycle; d=day; All=indicates that the product may be applied during any crop status. Typically, this occurs when the product is applied based on pest pressure; () Values in parenthesis were calculated based on other information provided on the label. These values are not on the label.

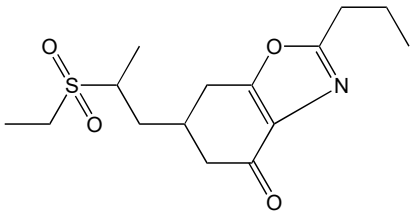
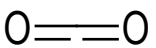
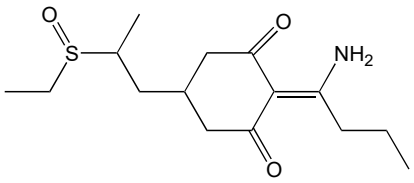
* Information is provided on a crop cycle (CC) basis, unless otherwise specified.

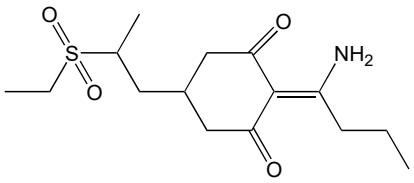
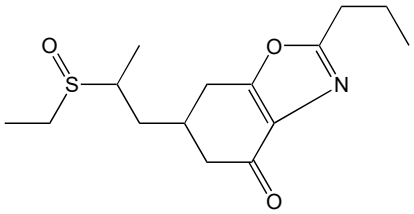
Appendix B. ROCKs Table

Table B1. Chemical Names and Structures of Sethoxydim and its Transformation Products

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (day)
PARENT						
Sethoxydim NP-55	2-(1-(ethoxyimino)butyl)-5-(2-(ethylthio)propyl)-3-hydroxy-2-cyclohexen-1-one **CAS No.:** 071441-80-0 **Formula:** $C_{17}H_{29}NO_3S$ **MW:** 327.48 g/mol **SMILES:** CCCC(=C1C(=O)CC(CC1=O)CC(C)SCC)NOCC		Hydrolysis	41475207		13.9% (28 d) @ pH 5 85.7% (28 d) @ pH 7 93.0% (28d) @ pH 8.6
			Photolysis	41475208		25.4% (10 d)
			Photodegradation on soil	41475209		3.2% (16 hr)
			Aerobic soil	41475210		<DL (12 m)
			Anaerobic soil	41475211		30.4% (61 d)
			Aerobic Aquatic	42165604		<DL (28 d)
			Anaerobic Aquatic	42165603		0.5% (12 m)
MAJOR (>10%) TRANSFORMATION PRODUCTS						
M-SO Sethoxydim-sulfoxide	2-(1-ethoxyiminobutyl)-5-(2-(ethylsulfinyl)propyl)-3-hydroxycyclohex-2-enone **Formula:** $C_{17}H_{29}NO_4S$ **MW:** 343.48 g/mol **SMILES:** C(C1C(=O)CC(CC(C)S(=O)CC)CC=1O)(CCC)=NOCC		Hydrolysis	41475207	1.3% (1 d) @ pH 5 0.9% (28 d) @ pH 7 1.3% (28d) @ pH 8.6	0.5% (28 d) @ pH 5 0.9 % (28 d) @ pH 7 1.3% (28d) @ pH 8.6
			Photodegradation on soil	41475209	**58.8**% (4 hr)	**43**% (16 hr)
			Photolysis	41475208	2% (4 d)	0.8% (10 d)
			Aerobic soil	41475210	**70.8**% (2 d)	0.5% (12 m)
			Anaerobic soil	41475211	**60.3**% (31 d)	**51.5**% (61 d)
			Aerobic Aquatic	42165604	**56.5**% (4 d)	**27.2**% (28 d)
			Anaerobic Aquatic	42165603	**47.7**% (0.5 m)	0.6% (12 m)

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (day)
M-SO_2	2-(1-ethoxyiminobutyl)-5(2-(ethylsulfonyl)propyl)-3-hydroxycyclohex-2-enone **Formula:** $C_{17}H_{29}NO_5S$ **MW:** 359.48 g/mol **SMILES:** C(C1C(=O)CC(CC(C)S(=O)(=O)CC)CC=1O)(CCC)=NOCC		Aerobic soil	41475210	11.2% (7 d)	0.4% (12 m)
			Anaerobic soil	41475211	**14**% (61 d)	**14**% (61 d)
			Aerobic Aquatic	42165604	**20.8**% (28 d)	**20.8**% (28 d)
			Anaerobic Aquatic	42165603	**12.0**% (0.5 m)	1.2% (12 m)
M1-S	2-(1-aminobutylidene)-5-(2-(ethylthio)-propyl)-cyclohex-1,3-dione **Formula:** $C_{15}H_{25}NO_2S$ **MW:** 283.43 g/mol **SMILES:** C1(=O)C(=C(N)CCC)C(=O)CC(CC(C)SCC)C1		Photodegradation on soil	41475209	3.2% (0)	0.8% (16 hr)
			Photolysis	41475208	**29.1**% (10 d)	**29.1**% (10 d)
			Aerobic soil	41475210	4.1% (1 d)	n.d. (12 m)
			Anaerobic soil	41475211	3.7% (0)	1.6% (61 d)
			Anaerobic soil	41475211	**21.6**% (61 d)	**21.6**% (61 d)
			Aerobic Aquatic	42165604	1.2% (1 d)	<DL (28 d)
			Anaerobic Aquatic	42165603	6.1% (4 m)	0.3% (12 m)
M2-S	6-(2-(ethylthio)propyl)-4-oxo-2-propyl-4,5,6,7-tetrahydrobenzoxazole **Formula:** $C_{15}H_{23}NO_2S$ **MW:** 281.42 g/mol **SMILES:** C1(=O)C2=C(CC(CC(C)SCC)C1)OC(CCC)=N2		Hydrolysis	41475207	**81.5**% (28 d) @ pH 5 9.7% (28 d) @ pH 7 2.3% (28d) @ pH 8.6	**81.5**% (28 d) @ pH 5 9.7% (28 d) @ pH 7 2.3% (28d) @ pH 8.6
			Photodegradation on soil	41475209	4.25% (0)	0.7% (16 hr)
			Photolysis	41475208	5.7% (10 d)	5.7% (10 d)
			Aerobic soil	41475210	1.6% (1 d)	n.d. (12 m)
			Anaerobic soil	41475211	2.6% (31 d)	2.4% (61 d)
			Anaerobic soil	41475211	6.1% (31 d)	4.6% (61 d)
			Aerobic Aquatic	42165604	3.2% (0 d)	0.4% (28 d)
			Anaerobic Aquatic	42165603	6.5% (0 d)	0.2% (12 m)
			Aerobic soil	41475210	**15.2**% (3 m)	9.0% (12 m)

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (day)
M2-SO_2	6-[2-(Ethylsulfonyl)propyl]-4-oxo-propyl-4,5,6,7-tetrahydrobenzoxazole **Formula:** $C_{15}H_{23}NO_4S$ **MW:** 313.41 g/mol **SMILES:** C1(=O)C2=C(CC(CC(C)S(=O)(=O)CC)C1)OC(CCC)=N2		Anaerobic soil	41475211	4.3% (61 d)	4.3% (61 d)
			Aerobic Aquatic	42165604	1.0% (28 d)	1.0% (28 d)
			Anaerobic aquatic	42165603	1.2% (0.5 m)	0.6% (12 m)
Unextracted residues	(not applicable)	(not applicable)	Aerobic soil	41475210	**37.1**% (14 d)	**31.8**% (12 m)
			Soil photolysis–light	41475209	7.12% (16 hr)	7.12% (16 hr)
			Soil photolysis–dark		1.14% (16 hr)	1.14% (16 hr)
			Anaerobic soil	41475211	**22.7**% (61 d)	**22.7**% (61 d)
			Aerobic aquatic	42165604	**16.7**% (28 d)	**16.7**% (28 d)
			Anaerobic aquatic	42165603	**40.3**% (6 m)	**31.6**% (12 m)
Carbon dioxide	Carbon dioxide **Formula:** CO_2 **MW:** 44.1 g/mol **SMILES:** O=C=O		Aerobic soil	41475210	**48.4**% (12 m)	**48.4**% (12 m)
			Soil photolysis–light	41475209	0% (16 hr)	0% (16 hr)
			Soil photolysis–dark		NS	NS
			Aqueous photolysis	41475208	not analyzed	
			Hydrolysis	41475207	not analyzed	
			Anaerobic soil	41475211	NS	NS
			Aerobic aquatic	42165604	**17.9**% (28 d)	**17.9**% (28 d)
			Anaerobic aquatic	42165603	**36.7**% (12 m)	**36.7**% (12 m)
MINOR (<10%) TRANSFORMATION PRODUCTS						
M1-SO	2-(1-aminobutylidene)-5-(2-(ethylsulfinyl)-propyl)-cyclohex-1,3-dione **Formula:** $C_{15}H_{25}NO_3S$ **MW:** 299.43 g/mol		Photodegradation on soil	41475209	3.6% (16 hr)	3.6% (16 hr)
			Photolysis	41475208	4.8% (10 d)	4.8% (10 d)
			Aerobic soil	41475210	2.8% (1 d)	0.4% (12 m)
			Anaerobic soil	41475211	1.9% (61 d)	1.9% (61 d)
			Aerobic Aquatic	42165604	2.5 (14 d)	1.4% (28 d)

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (day)
	SMILES:C1(=O)C(=C(N)CCC)C(=O)CC(CC(C)S(=O)CC)C1		Anaerobic aquatic	42165603	4.2% (2 m)	4.1% (12 m)
M1-SO_2	2-(1-aminobutylidene)-5-(2-(ethyltho)-propyl)-cyclohex-1,3-dione **Formula:** $C_{15}H_{25}NO_3S$ **MW:** 315.43 g/mol **SMILES:** C1(=O)C(=C(N)CCC)C(=O)CC(CC(C)S(=O)(=O)CC)C1		Aerobic soil	41475210	4.0% (1 d)	0.8% (12 m)
			Photolysis	41475208	1.9% (10 d)	1.9% (10 d)
			Anaerobic soil	41475211	1.4% (61 d)	1.4% (61 d)
			Aerobic Aquatic	42165604	2.3% (4 d)	1.0 (28 d)
			Anaerobic aquatic	42165603	1.4% (6 m)	0.7% (12 m)
M2-SO	6-[2-(Ethylsulfinyl)propyl]-4-oxo-propyl-4,5,6,7-tetrahydrobenzoxazole **Formula:** $C_{15}H_{23}NO_3S$ **MW:** 297.42 g/mol **SMILES:** C1(=O)C2=C(CC(CC(C)S(=O)CC)C1)OC(CCC)=N2		Hydrolysis	41475207	2.0% (28 d) @ pH 5 0.9% (28 d) @ pH 7 0.1% (28d) @ pH 8.6	2.0% (28 d) @ pH 5 0.9 % (28 d) @ pH 7 0.1% (28d) @ pH 8.6
			Photodegradation on soil	41475209	2.6% (16 hr)	2.6% (16 hr)
			Photolysis	41475208	1.5% (10 d)	1.5% (10 d)
			Aerobic soil	41475210	9.9% (1 d)	1.2% (12 m)
			Anaerobic soil	41475211	2.8% (31 d)	0 (61 d)
			Aerobic Aquatic	42165604	4.2% (14 d)	1.5% (28 d)
			Anaerobic aquatic	42165603	2.7% (0.5 m)	0.3% (12 m)

ND= means “not detected”. AR means “applied radioactivity”. MW means “molecular weight”. LOQ means “limit of quantitation”. d means “day”. m means “month”. Bolded values are laboratory study values >10%AR.

Appendix C. Ecotoxicity for Aquatic Organisms: New Studies

Aquatic Invertebrates Chronic Study

A study was conducted to assess the risk of sethoxydim to aquatic invertebrates on a chronic basis (MRID 50420001). Over 21 days water fleas (*Daphnia magna*) were exposed to concentrations of sethoxydim under flow through conditions. A NOAEC could not be determined in this study due to significant treatment-related effects on growth at all of the concentrations tested. A clear dose response could not be discerned from the results.

Replicates in two of the treatment levels exhibited high mortality, in contrast to little to no mortality in the other replicates, or in other treatment levels. This high mortality is not accounted for due to water quality issues or a distinct dose response. Though the results were statistically significant, it was unclear whether the effects in the replicates were caused by a response to the dosage, or if they were created by extenuating factors such as lab contamination due to the specificity of the effects and the lack of similar effects in other replicates. Because of the above reasons, the study was deemed "supplemental (qualitative)".

Clethodim (PC code 121011), like sethoxydim, is also a post-emergent selective herbicide within the cyclohexanedione family that inhibits lipid synthesis by inhibiting the acetyl-coenzyme A carboxylase (ACCase) enzyme of grass species. A chronic study was available for clethodim and freshwater invertebrates (*D. magna*) that resulted in NOAEC and LOAEC values of 0.93 mg a.i./L and 3.0 mg a.i./L, respectively, based on reduction in reproduction (offspring per female) and total length of surviving daphnids (MRID 48104305). Survival was also significantly decreased; however it was not the most sensitive endpoint. In addition, based on visual observations of the data, there also appears to be a significant delay in time to first brood release. This study was deemed "supplemental (quantitative)" (USEPA 2014c).

The aquatic EECs calculated for sethoxydim fall below the NOAEC and LOAEC values of the clethodim chronic *Daphnia magna* study, indicating that the environmental concentrations of clethodim—and potentially, by extension, sethoxydim—are too low to pose a risk to aquatic invertebrates. However, a chronic *Daphnid magna* study with valid measurable endpoints should be submitted before reaching any conclusions on the risk that sethoxydim poses to aquatic invertebrates on a chronic basis.

Appendix D. EECs and RQs Estimated using Terrplant v. 1.2.2,T-Rex v. 1.5.2, AgDrift v. 2.1.1, and BeeREX v. 1.0

Analysis using sethoxydim's minimum application rate (0.1 lb a.i./A)

Table 1. Chemical Identity.	
Chemical Name	**Sethoxydim**
PC code	**121001**
Use	**Citrus, Pistachio, Tree Nuts**
Application Method	**Foliar**
Application Form	**Spray**
Solubility in Water (ppm)	**4700**

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**0.5**	**lb/acre**
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for Sethoxydim. Units in lb/acre.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.025
Runoff to semi-aquatic areas	(A/I)*R*10	0.25
Spray drift	**A*D**	**0.025**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.05**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.275**

Table 4. Plant survival and growth data used for RQ derivation. Units are in lb/acre.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC25**	**NOAEC**	**EC25**	**NOAEC**
Monocot	**0.04**	**0.02**	**0.0086**	**0.00276**
Dicot	**1.8**	**0.0073**	**2.4**	**0.68**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Sethoxydim through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	1.25	6.88	2.91
Monocot	listed	2.50	13.75	9.06
Dicot	non-listed	<0.1	0.15	<0.1
Dicot	listed	6.85	37.67	3.42
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Analysis using sethoxydim's maximum application rate (0.5 lb a.i./A)

Table 1. Chemical Identity.	
Chemical Name	**Sethoxydim**
PC code	**121001**
Use	**Citrus, Pistachio, Tree Nuts**
Application Method	**Foliar**
Application Form	**Spray**
Solubility in Water (ppm)	**4700**

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**0.5**	**lb/acre**
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for Sethoxydim. Units in lb/acre.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.025
Runoff to semi-aquatic areas	(A/I)*R*10	0.25
Spray drift	**A*D**	**0.025**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.05**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.275**

Table 4. Plant survival and growth data used for RQ derivation. Units are in lb/acre.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**0.04**	**0.02**	**0.0086**	**0.00276**
Dicot	**1.8**	**0.0073**	**2.4**	**0.68**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Sethoxydim through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	1.25	6.88	2.91
Monocot	listed	2.50	13.75	9.06
Dicot	non-listed	<0.1	0.15	<0.1
Dicot	listed	6.85	37.67	3.42
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Chemical Name:	Sethoxydim
Use	citrus, pistachio, tree nuts
Formulation	0
Application Rate	0.5 lbs a.i./acre
Half-life	35 days
Application Interval	14 days
Maximum # Apps./Year	4
Length of Simulation	1 year
Variable application rates?	no

The maximum single day residue estimation is
both the acute and reproduction RQs.

**RQs reported as "0.00" in the RQ tables be
<0.01 in your assessment. This is due to r
figure issues in Excel.**

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	332.10
Tall Grass	152.21
Broadleaf plants	186.81
Fruits/pods/seeds	20.76
Arthropods	130.07

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams)		
	small 20	mid 100	large 1000
Short Grass	378.23	215.68	96.56
Tall Grass	173.35	98.85	44.26
Broadleaf plants	212.75	121.32	54.32
Fruits/pods	23.64	13.48	6.04
Arthropods	148.14	84.47	37.82
Seeds	5.25	3.00	1.34

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	0.29	0.13	0.04
Tall Grass	0.13	0.06	0.02
Broadleaf plants	0.16	0.07	0.02
Fruits/pods	0.02	0.01	0.00
Arthropods	0.11	0.05	0.02
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or	RQs	
	Acute	Chronic
Short Grass	0.08	0.71
Tall Grass	0.04	0.33
Broadleaf plants	0.04	0.40
Fruits/pods/seeds	0.00	0.04
Arthropods	0.03	0.28

Note: To provide risk management with the maximum possible information, it is recommended that both the dose-based and concentration-based RQs be calculated when data are available

Sethoxydim citrus, pistachio, tree nuts Upper bound Kenaga Residues

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
Grainvores	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	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07
Granivores	15	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams)		
	15	35	1000
Short Grass	316.63	218.83	50.74
Tall Grass	145.12	100.30	23.25
Broadleaf plants	178.10	123.09	28.54
Fruits/pods	19.79	13.68	3.17
Arthropods	124.01	85.71	19.87
Seeds	4.40	3.04	0.70

Dose-based RQs (Dose-based EEC/LD50 or	Small mammal 15 grams		Medium mammal 35 grams		Large mammal 1000 grams	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.05	4.80	0.05	4.10	0.02	2.20
Tall Grass	0.02	2.20	0.02	1.88	0.01	1.01
Broadleaf plants	0.03	2.70	0.03	2.31	0.01	1.24
Fruits/pods	0.00	0.30	0.00	0.26	0.00	0.14
Arthropods	0.02	1.88	0.02	1.61	0.01	0.86
Seeds	0.00	0.07	0.00	0.06	0.00	0.03

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	#DIV/0!	0.55
Tall Grass	#DIV/0!	0.25
Broadleaf plants	#DIV/0!	0.31
Fruits/pods/seeds	#DIV/0!	0.03
Arthropods	#DIV/0!	0.22

Chemical Name:	Sethoxydim
Use	Agricultural Fallow/Idleland etc.
Formulation	0
Application Rate	0.5 lbs a.i./acre
Half-life	35 days
Application Interval	14 days
Maximum # Apps./Year	3
Length of Simulation	1 year
Variable application rates?	no

The maximum single day residue estimation is
both the acute and reproduction RQs.

**RQs reported as "0.00" in the RQ tables be
<0.01 in your assessment. This is due to r
figure issues in Excel.**

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	279.86
Tall Grass	128.27
Broadleaf plants	157.42
Fruits/pods/seeds	17.49
Arthropods	109.61

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams) small 20	mid 100	large 1000
Short Grass	318.74	181.76	81.38
Tall Grass	146.09	83.31	37.30
Broadleaf plants	179.29	102.24	45.77
Fruits/pods	19.92	11.36	5.09
Arthropods	124.84	71.19	31.87
Seeds	4.43	2.52	1.13

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams) 20	100	1000
Short Grass	0.24	0.11	0.03
Tall Grass	0.11	0.05	0.02
Broadleaf plants	0.14	0.06	0.02
Fruits/pods	0.02	0.01	0.00
Arthropods	0.10	0.04	0.01
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or	RQs Acute	Chronic
Short Grass	0.06	0.60
Tall Grass	0.03	0.28
Broadleaf plants	0.04	0.34
Fruits/pods/seeds	0.00	0.04
Arthropods	0.03	0.24

Note: To provide risk management with the maximum possible information, it is recommended that both the dose-based and concentration-based RQs be calculated when data are available

Sethoxydim | Agricultural Fallow/Idleland etc. | Upper bound Kenaga Residues

Mammalian Results

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

Mammalian Class	Body Weight	Adjusted LD50	Adjusted NOAEL
	15	5881.39	65.93
Herbivores/	35	4758.68	53.35
insectivores	1000	2058.27	23.07
	15	5881.39	65.93
Granivores	35	4758.68	53.35
	1000	2058.27	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams) 15	35	1000
Short Grass	266.83	184.42	42.76
Tall Grass	122.30	84.52	19.60
Broadleaf plants	150.09	103.73	24.05
Fruits/pods	16.68	11.53	2.67
Arthropods	104.51	72.23	16.75
Seeds	3.71	2.56	0.59

Dose-based RQs (Dose-based EEC/LD50 or	Small mammal 15 grams Acute	Chronic	Medium mammal 35 grams Acute	Chronic	Large mammal 1000 grams Acute	Chronic
Short Grass	0.05	4.05	0.04	3.46	0.02	1.85
Tall Grass	0.02	1.85	0.02	1.58	0.01	0.85
Broadleaf plants	0.03	2.28	0.02	1.94	0.01	1.04
Fruits/pods	0.00	0.25	0.00	0.22	0.00	0.12
Arthropods	0.02	1.59	0.02	1.35	0.01	0.73
Seeds	0.00	0.06	0.00	0.05	0.00	0.03

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs Acute	Chronic
Short Grass	#DIV/0!	0.47
Tall Grass	#DIV/0!	0.21
Broadleaf plants	#DIV/0!	0.26
Fruits/pods/seeds	#DIV/0!	0.03
Arthropods	#DIV/0!	0.18

Chemical Name:	Sethoxydim
Use	Tuberous and Corm Vegetables, etc.
Formulation	0
Application Rate	0.5 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

The maximum single day residue estimation is
both the acute and reproduction RQs.

**RQs reported as "0.00" in the RQ tables be
<0.01 in your assessment. This is due to r
figure issues in Excel.**

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	210.94
Tall Grass	96.68
Broadleaf plants	118.66
Fruits/pods/seeds	13.18
Arthropods	82.62

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams) small 20	mid 100	large 1000
Short Grass	240.24	137.00	61.34
Tall Grass	110.11	62.79	28.11
Broadleaf plants	135.14	77.06	34.50
Fruits/pods	15.02	8.56	3.83
Arthropods	94.10	53.66	24.02
Seeds	3.34	1.90	0.85

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams) 20	100	1000
Short Grass	0.18	0.08	0.03
Tall Grass	0.08	0.04	0.01
Broadleaf plants	0.10	0.05	0.01
Fruits/pods	0.01	0.01	0.00
Arthropods	0.07	0.03	0.01
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or	RQs Acute	Chronic
Short Grass	0.05	0.45
Tall Grass	0.02	0.21
Broadleaf plants	0.03	0.25
Fruits/pods/seeds	0.00	0.03
Arthropods	0.02	0.18

Note: To provide risk management with the maximum possible information, it is recommended that both the dose-based and concentration-based RQs be calculated when data are available

Sethoxydim | Tuberous and Corm Vegetables, etc. | Upper bound Kenaga Residues

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
Grainvores	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	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07
Granivores	15	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams) 15	35	1000
Short Grass	201.12	139.00	32.23
Tall Grass	92.18	63.71	14.77
Broadleaf plants	113.13	78.19	18.13
Fruits/pods	12.57	8.69	2.01
Arthropods	78.77	54.44	12.62
Seeds	2.79	1.93	0.45

Dose-based RQs (Dose-based EEC/LD50 or	Small mammal 15 grams Acute	Chronic	Medium mammal 35 grams Acute	Chronic	Large mammal 1000 grams Acute	Chronic
Short Grass	0.03	3.05	0.03	2.61	0.02	1.40
Tall Grass	0.02	1.40	0.01	1.19	0.01	0.64
Broadleaf plants	0.02	1.72	0.02	1.47	0.01	0.79
Fruits/pods	0.00	0.19	0.00	0.16	0.00	0.09
Arthropods	0.01	1.19	0.01	1.02	0.01	0.55
Seeds	0.00	0.04	0.00	0.04	0.00	0.02

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs Acute	Chronic
Short Grass	#DIV/0!	0.35
Tall Grass	#DIV/0!	0.16
Broadleaf plants	#DIV/0!	0.20
Fruits/pods/seeds	#DIV/0!	0.02
Arthropods	#DIV/0!	0.14

Chemical Name:	Sethoxydim
Use	Ornamental Lawns and Turf
Formulation	0
Application Rate	0.5 lbs a.i./acre
Half-life	35 days
Application Interval	0 days
Maximum # Apps./Year	2
Length of Simulation	1 year
Variable application rates?	no

The maximum single day residue estimation is both the acute and reproduction RQs.

RQs reported as "0.00" in the RQ tables be <0.01 in your assessment. This is due to r figure issues in Excel.

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	120.00
Tall Grass	55.00
Broadleaf plants	67.50
Fruits/pods/seeds	7.50
Arthropods	47.00

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams) small 20	mid 100	large 1000
Short Grass	136.67	77.93	34.89
Tall Grass	62.64	35.72	15.99
Broadleaf plants	76.88	43.84	19.63
Fruits/pods	8.54	4.87	2.18
Arthropods	53.53	30.52	13.67
Seeds	1.90	1.08	0.48

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams) 20	100	1000
Short Grass	0.10	0.05	0.01
Tall Grass	0.05	0.02	0.01
Broadleaf plants	0.06	0.03	0.01
Fruits/pods	0.01	0.00	0.00
Arthropods	0.04	0.02	0.01
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or	RQs Acute	Chronic
Short Grass	0.03	0.26
Tall Grass	0.01	0.12
Broadleaf plants	0.02	0.14
Fruits/pods/seeds	0.00	0.02
Arthropods	0.01	0.10

Note: To provide risk management with the maximum possible information, it is recommended that both the dose-based and concentration-based RQs be calculated when data are available

Sethoxydim | Ornamental Lawns and Turf | Upper bound Kenaga Residues

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
Grainvores	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	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07
Granivores	15	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams) 15	35	1000
Short Grass	114.41	79.07	18.33
Tall Grass	52.44	36.24	8.40
Broadleaf plants	64.36	44.48	10.31
Fruits/pods	7.15	4.94	1.15
Arthropods	44.81	30.97	7.18
Seeds	1.59	1.10	0.25

Dose-based RQs (Dose-based EEC/LD50 or	Small mammal 15 grams Acute	Chronic	Medium mammal 35 grams Acute	Chronic	Large mammal 1000 grams Acute	Chronic
Short Grass	0.02	1.74	0.02	1.48	0.01	0.79
Tall Grass	0.01	0.80	0.01	0.68	0.00	0.36
Broadleaf plants	0.01	0.98	0.01	0.83	0.01	0.45
Fruits/pods	0.00	0.11	0.00	0.09	0.00	0.05
Arthropods	0.01	0.68	0.01	0.58	0.00	0.31
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!	0.20
Tall Grass	#DIV/0!	0.09
Broadleaf plants	#DIV/0!	0.11
Fruits/pods/seeds	#DIV/0!	0.01
Arthropods	#DIV/0!	0.08

Chemical Name:	Sethoxydim
Use	Beans, Dried-Type
Formulation	0
Application Rate	0.5 lbs a.i./acre
Half-life	35 days
Application Interval	14 days
Maximum # Apps./Year	1
Length of Simulation	1 year
Variable application rates?	no

The maximum single day residue estimation is
both the acute and reproduction RQs.

**RQs reported as "0.00" in the RQ tables be
<0.01 in your assessment. This is due to r
figure issues in Excel.**

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	120.00
Tall Grass	55.00
Broadleaf plants	67.50
Fruits/pods/seeds	7.50
Arthropods	47.00

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams) small 20	mid 100	large 1000
Short Grass	136.67	77.93	34.89
Tall Grass	62.64	35.72	15.99
Broadleaf plants	76.88	43.84	19.63
Fruits/pods	8.54	4.87	2.18
Arthropods	53.53	30.52	13.67
Seeds	1.90	1.08	0.48

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams) 20	100	1000
Short Grass	0.10	0.05	0.01
Tall Grass	0.05	0.02	0.01
Broadleaf plants	0.06	0.03	0.01
Fruits/pods	0.01	0.00	0.00
Arthropods	0.04	0.02	0.01
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or	RQs Acute	Chronic
Short Grass	0.03	0.26
Tall Grass	0.01	0.12
Broadleaf plants	0.02	0.14
Fruits/pods/seeds	0.00	0.02
Arthropods	0.01	0.10

Note: To provide risk management with the maximum possible information, it is recommended that both the dose-based and concentration-based RQs be calculated when data are available

Sethoxydim Beans, Dried-Type Upper bound Kenaga Residues

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
Grainvores	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	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07
Granivores	15	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams) 15	35	1000
Short Grass	114.41	79.07	18.33
Tall Grass	52.44	36.24	8.40
Broadleaf plants	64.36	44.48	10.31
Fruits/pods	7.15	4.94	1.15
Arthropods	44.81	30.97	7.18
Seeds	1.59	1.10	0.25

Dose-based RQs (Dose-based EEC/LD50 or	Small mammal 15 grams Acute	Chronic	Medium mammal 35 grams Acute	Chronic	Large mammal 1000 grams Acute	Chronic
Short Grass	0.02	1.74	0.02	1.48	0.01	0.79
Tall Grass	0.01	0.80	0.01	0.68	0.00	0.36
Broadleaf plants	0.01	0.98	0.01	0.83	0.01	0.45
Fruits/pods	0.00	0.11	0.00	0.09	0.00	0.05
Arthropods	0.01	0.68	0.01	0.58	0.00	0.31
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!	0.20
Tall Grass	#DIV/0!	0.09
Broadleaf plants	#DIV/0!	0.11
Fruits/pods/seeds	#DIV/0!	0.01
Arthropods	#DIV/0!	0.08

Chemical Name:	Sethoxydim
Use	Okra
Formulation	0
Application Rate	0.25 lbs a.i./acre
Half-life	35 days
Application Interval	14 days
Maximum # Apps./Year	4
Length of Simulation	1 year
Variable application rates?	no

The maximum single day residue estimation is
both the acute and reproduction RQs.

**RQs reported as "0.00" in the RQ tables be
<0.01 in your assessment. This is due to r
figure issues in Excel.**

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	166.05
Tall Grass	76.11
Broadleaf plants	93.40
Fruits/pods/seeds	10.38
Arthropods	65.04

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams) small 20	mid 100	large 1000
Short Grass	189.11	107.84	48.28
Tall Grass	86.68	49.43	22.13
Broadleaf plants	106.38	60.66	27.16
Fruits/pods	11.82	6.74	3.02
Arthropods	74.07	42.24	18.91
Seeds	2.63	1.50	0.67

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams) 20	100	1000
Short Grass	0.15	0.06	0.02
Tall Grass	0.07	0.03	0.01
Broadleaf plants	0.08	0.04	0.01
Fruits/pods	0.01	0.00	0.00
Arthropods	0.06	0.03	0.01
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or	RQs Acute	Chronic
Short Grass	0.04	0.36
Tall Grass	0.02	0.16
Broadleaf plants	0.02	0.20
Fruits/pods/seeds	0.00	0.02
Arthropods	0.01	0.14

Note: To provide risk management with the maximum possible information, it is recommended that both the dose-based and concentration-based RQs be calculated when data are available

Sethoxydim Okra Upper bound Kenaga Residues

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
Grainvores	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	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07
Granivores	15	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams) 15	35	1000
Short Grass	158.31	109.42	25.37
Tall Grass	72.56	50.15	11.63
Broadleaf plants	89.05	61.55	14.27
Fruits/pods	9.89	6.84	1.59
Arthropods	62.01	42.85	9.94
Seeds	2.20	1.52	0.35

Dose-based RQs (Dose-based EEC/LD50 or	Small mammal 15 grams Acute	Chronic	Medium mammal 35 grams Acute	Chronic	Large mammal 1000 grams Acute	Chronic
Short Grass	0.03	2.40	0.02	2.05	0.01	1.10
Tall Grass	0.01	1.10	0.01	0.94	0.01	0.50
Broadleaf plants	0.02	1.35	0.01	1.15	0.01	0.62
Fruits/pods	0.00	0.15	0.00	0.13	0.00	0.07
Arthropods	0.01	0.94	0.01	0.80	0.00	0.43
Seeds	0.00	0.03	0.00	0.03	0.00	0.02

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs Acute	Chronic
Short Grass	#DIV/0!	0.28
Tall Grass	#DIV/0!	0.13
Broadleaf plants	#DIV/0!	0.16
Fruits/pods/seeds	#DIV/0!	0.02
Arthropods	#DIV/0!	0.11

Chemical Name:	Sethoxydim
Use	Bulb Vegetables
Formulation	0
Application Rate	0.25 lbs a.i./acre
Half-life	35 days
Application Interval	14 days
Maximum # Apps./Year	3
Length of Simulation	1 year
Variable application rates?	no

The maximum single day residue estimation is
both the acute and reproduction RQs.

RQs reported as "0.00" in the RQ tables be
<0.01 in your assessment. This is due to r
figure issues in Excel.

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	139.93
Tall Grass	64.14
Broadleaf plants	78.71
Fruits/pods/seeds	8.75
Arthropods	54.81

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams) small 20	mid 100	large 1000
Short Grass	159.37	90.88	40.69
Tall Grass	73.04	41.65	18.65
Broadleaf plants	89.65	51.12	22.89
Fruits/pods	9.96	5.68	2.54
Arthropods	62.42	35.59	15.94
Seeds	2.21	1.26	0.57

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams) 20	100	1000
Short Grass	0.12	0.05	0.02
Tall Grass	0.06	0.03	0.01
Broadleaf plants	0.07	0.03	0.01
Fruits/pods	0.01	0.00	0.00
Arthropods	0.05	0.02	0.01
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or	RQs Acute	Chronic
Short Grass	0.03	0.30
Tall Grass	0.01	0.14
Broadleaf plants	0.02	0.17
Fruits/pods/seeds	0.00	0.02
Arthropods	0.01	0.12

Note: To provide risk management with the maximum possible information, it is recommended that both the dose-based and concentration-based RQs be calculated when data are available

Sethoxydim | Bulb Vegetables | Upper bound Kenaga Residues

Mammalian Results

Mammalian Class	Body Weight	Ingestion (Fdry) (g bw/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
Grainvores	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	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07
Granivores	15	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams) 15	35	1000
Short Grass	133.41	92.21	21.38
Tall Grass	61.15	42.26	9.80
Broadleaf plants	75.05	51.87	12.03
Fruits/pods	8.34	5.76	1.34
Arthropods	52.25	36.11	8.37
Seeds	1.85	1.28	0.30

Dose-based RQs (Dose-based EEC/LD50 or	Small mammal 15 grams Acute	Chronic	Medium mammal 35 grams Acute	Chronic	Large mammal 1000 grams Acute	Chronic
Short Grass	0.02	2.02	0.02	1.73	0.01	0.93
Tall Grass	0.01	0.93	0.01	0.79	0.00	0.42
Broadleaf plants	0.01	1.14	0.01	0.97	0.01	0.52
Fruits/pods	0.00	0.13	0.00	0.11	0.00	0.06
Arthropods	0.01	0.79	0.01	0.68	0.00	0.36
Seeds	0.00	0.03	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!	0.23
Tall Grass	#DIV/0!	0.11
Broadleaf plants	#DIV/0!	0.13
Fruits/pods/seeds	#DIV/0!	0.01
Arthropods	#DIV/0!	0.09

Chemical Name:	Sethoxydim
Use	Corn, Sweet
Formulation	0
Application Rate	0.25 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

The maximum single day residue estimation is
both the acute and reproduction RQs.

**RQs reported as "0.00" in the RQ tables be
<0.01 in your assessment. This is due to r
figure issues in Excel.**

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	105.47
Tall Grass	48.34
Broadleaf plants	59.33
Fruits/pods/seeds	6.59
Arthropods	41.31

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams) small 20	mid 100	large 1000
Short Grass	120.12	68.50	30.67
Tall Grass	55.06	31.40	14.06
Broadleaf plants	67.57	38.53	17.25
Fruits/pods	7.51	4.28	1.92
Arthropods	47.05	26.83	12.01
Seeds	1.67	0.95	0.43

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams) 20	100	1000
Short Grass	0.09	0.04	0.01
Tall Grass	0.04	0.02	0.01
Broadleaf plants	0.05	0.02	0.01
Fruits/pods	0.01	0.00	0.00
Arthropods	0.04	0.02	0.01
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or	RQs Acute	Chronic
Short Grass	0.02	0.23
Tall Grass	0.01	0.10
Broadleaf plants	0.01	0.13
Fruits/pods/seeds	0.00	0.01
Arthropods	0.01	0.09

Note: To provide risk management with the maximum possible information, it is recommended that both the dose-based and concentration-based RQs be calculated when data are available

Sethoxydim | Corn, Sweet | Upper bound Kenaga Residues

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
Grainvores	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	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07
Granivores	15	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams) 15	35	1000
Short Grass	100.56	69.50	16.11
Tall Grass	46.09	31.85	7.39
Broadleaf plants	56.56	39.09	9.06
Fruits/pods	6.28	4.34	1.01
Arthropods	39.39	27.22	6.31
Seeds	1.40	0.97	0.22

Dose-based RQs (Dose-based EEC/LD50 or	Small mammal 15 grams Acute	Chronic	Medium mammal 35 grams Acute	Chronic	Large mammal 1000 grams Acute	Chronic
Short Grass	0.02	1.53	0.01	1.30	0.01	0.70
Tall Grass	0.01	0.70	0.01	0.60	0.00	0.32
Broadleaf plants	0.01	0.86	0.01	0.73	0.00	0.39
Fruits/pods	0.00	0.10	0.00	0.08	0.00	0.04
Arthropods	0.01	0.60	0.01	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!	0.18
Tall Grass	#DIV/0!	0.08
Broadleaf plants	#DIV/0!	0.10
Fruits/pods/seeds	#DIV/0!	0.01
Arthropods	#DIV/0!	0.07

Chemical Name:	Sethoxydim
Use	Corn, Sweet
Formulation	0
Application Rate	0.25 lbs a.i./acre
Half-life	35 days
Application Interval	10 days
Maximum # Apps./Year	2
Length of Simulation	1 year
Variable application rates?	no

The maximum single day residue estimation is both the acute and reproduction RQs.

RQs reported as "0.00" in the RQ tables be <0.01 in your assessment. This is due to r figure issues in Excel.

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	109.22
Tall Grass	50.06
Broadleaf plants	61.44
Fruits/pods/seeds	6.83
Arthropods	42.78

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams)		
	small 20	mid 100	large 1000
Short Grass	124.39	70.93	31.76
Tall Grass	57.01	32.51	14.56
Broadleaf plants	69.97	39.90	17.86
Fruits/pods	7.77	4.43	1.98
Arthropods	48.72	27.78	12.44
Seeds	1.73	0.99	0.44

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	0.10	0.04	0.01
Tall Grass	0.04	0.02	0.01
Broadleaf plants	0.05	0.02	0.01
Fruits/pods	0.01	0.00	0.00
Arthropods	0.04	0.02	0.01
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or	RQs	
	Acute	Chronic
Short Grass	0.03	0.23
Tall Grass	0.01	0.11
Broadleaf plants	0.01	0.13
Fruits/pods/seeds	0.00	0.01
Arthropods	0.01	0.09

Chemical Name:	Sethoxydim
Use	Non-agricultural Rights-of-Way
Formulation	0
Application Rate	0.25 lbs a.i./acre
Half-life	35 days
Application Interval	0 days
Maximum # Apps./Year	1
Length of Simulation	1 year
Variable application rates?	no

The maximum single day residue estimation is
both the acute and reproduction RQs.

RQs reported as "0.00" in the RQ tables be
<0.01 in your assessment. This is due to r
figure issues in Excel.

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	60.00
Tall Grass	27.50
Broadleaf plants	33.75
Fruits/pods/seeds	3.75
Arthropods	23.50

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams) small 20	mid 100	large 1000
Short Grass	68.33	38.97	17.45
Tall Grass	31.32	17.86	8.00
Broadleaf plants	38.44	21.92	9.81
Fruits/pods	4.27	2.44	1.09
Arthropods	26.76	15.26	6.83
Seeds	0.95	0.54	0.24

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams) 20	100	1000
Short Grass	0.05	0.02	0.01
Tall Grass	0.02	0.01	0.00
Broadleaf plants	0.03	0.01	0.00
Fruits/pods	0.00	0.00	0.00
Arthropods	0.02	0.01	0.00
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or	RQs Acute	Chronic
Short Grass	0.01	0.13
Tall Grass	0.01	0.06
Broadleaf plants	0.01	0.07
Fruits/pods/seeds	0.00	0.01
Arthropods	0.01	0.05

Note: To provide risk management with the maximum possible information, it is recommended that both the dose-based and concentration-based RQs be calculated when data are available

Sethoxydim | Non-agricultural Rights-of-Way | Upper bound Kenaga Residues

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
Grainvores	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	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07
Granivores	15	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams) 15	35	1000
Short Grass	57.21	39.54	9.17
Tall Grass	26.22	18.12	4.20
Broadleaf plants	32.18	22.24	5.16
Fruits/pods	3.58	2.47	0.57
Arthropods	22.41	15.49	3.59
Seeds	0.79	0.55	0.13

Dose-based RQs (Dose-based EEC/LD50 or	Small mammal 15 grams Acute	Chronic	Medium mammal 35 grams Acute	Chronic	Large mammal 1000 grams Acute	Chronic
Short Grass	0.01	0.87	0.01	0.74	0.00	0.40
Tall Grass	0.00	0.40	0.00	0.34	0.00	0.18
Broadleaf plants	0.01	0.49	0.00	0.42	0.00	0.22
Fruits/pods	0.00	0.05	0.00	0.05	0.00	0.02
Arthropods	0.00	0.34	0.00	0.29	0.00	0.16
Seeds	0.00	0.01	0.00	0.01	0.00	0.01

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs Acute	Chronic
Short Grass	#DIV/0!	0.10
Tall Grass	#DIV/0!	0.05
Broadleaf plants	#DIV/0!	0.06
Fruits/pods/seeds	#DIV/0!	0.01
Arthropods	#DIV/0!	0.04

Chemical Name:	Sethoxydim
Use	Orchards
Formulation	0
Application Rate	0.1 lbs a.i./acre
Half-life	35 days
Application Interval	0 days
Maximum # Apps./Year	1
Length of Simulation	1 year
Variable application rates?	no

The maximum single day residue estimation is
both the acute and reproduction RQs.

RQs reported as "0.00" in the RQ tables be
<0.01 in your assessment. This is due to r
figure issues in Excel.

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	2510.00
	Canary	LC50 (mg/kg-diet)	4341.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	466.00
Mammals		LD50 (mg/kg-bw)	2676.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	24.00
Tall Grass	11.00
Broadleaf plants	13.50
Fruits/pods/seeds	1.50
Arthropods	9.40

Avian Results

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

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1303.26
100	1659.11
1000	2343.56

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams) small 20	mid 100	large 1000
Short Grass	27.33	15.59	6.98
Tall Grass	12.53	7.14	3.20
Broadleaf plants	15.38	8.77	3.93
Fruits/pods	1.71	0.97	0.44
Arthropods	10.71	6.10	2.73
Seeds	0.38	0.22	0.10

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	0.01	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	RQs Acute	Chronic
Short Grass	0.01	0.05
Tall Grass	0.00	0.02
Broadleaf plants	0.00	0.03
Fruits/pods/seeds	0.00	0.00
Arthropods	0.00	0.02

Note: To provide risk management with the maximum possible information, it is recommended that both the dose-based and concentration-based RQs be calculated when data are available

Sethoxydim Orchards Upper bound Kenaga Residues

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
Grainvores	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	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07
Granivores	15	5881.39	65.93
	35	4758.68	53.35
	1000	2058.27	23.07

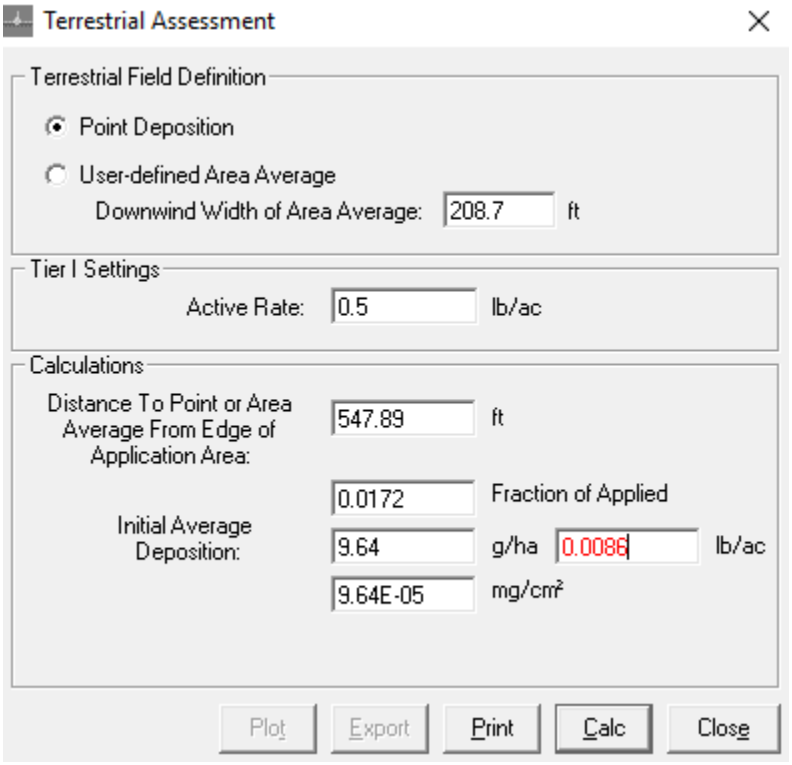
Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams) 15	35	1000
Short Grass	22.88	15.81	3.67
Tall Grass	10.49	7.25	1.68
Broadleaf plants	12.87	8.90	2.06
Fruits/pods	1.43	0.99	0.23
Arthropods	8.96	6.19	1.44
Seeds	0.32	0.22	0.05

Dose-based RQs (Dose-based EEC/LD50 or	Small mammal 15 grams Acute	Chronic	Medium mammal 35 grams Acute	Chronic	Large mammal 1000 grams Acute	Chronic
Short Grass	0.00	0.35	0.00	0.30	0.00	0.16
Tall Grass	0.00	0.16	0.00	0.14	0.00	0.07
Broadleaf plants	0.00	0.20	0.00	0.17	0.00	0.09
Fruits/pods	0.00	0.02	0.00	0.02	0.00	0.01
Arthropods	0.00	0.14	0.00	0.12	0.00	0.06
Seeds	0.00	0.00	0.00	0.00	0.00	0.00

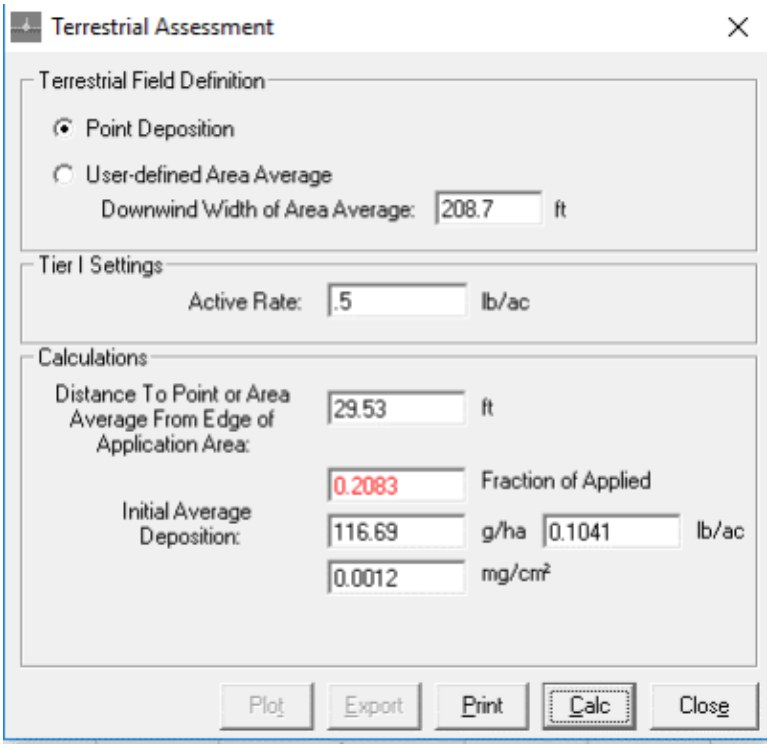
Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs Acute	Chronic
Short Grass	#DIV/0!	0.04
Tall Grass	#DIV/0!	0.02
Broadleaf plants	#DIV/0!	0.02
Fruits/pods/seeds	#DIV/0!	0.00
Arthropods	#DIV/0!	0.02

AgDrift 2.1.1. Drift Distance Calculations

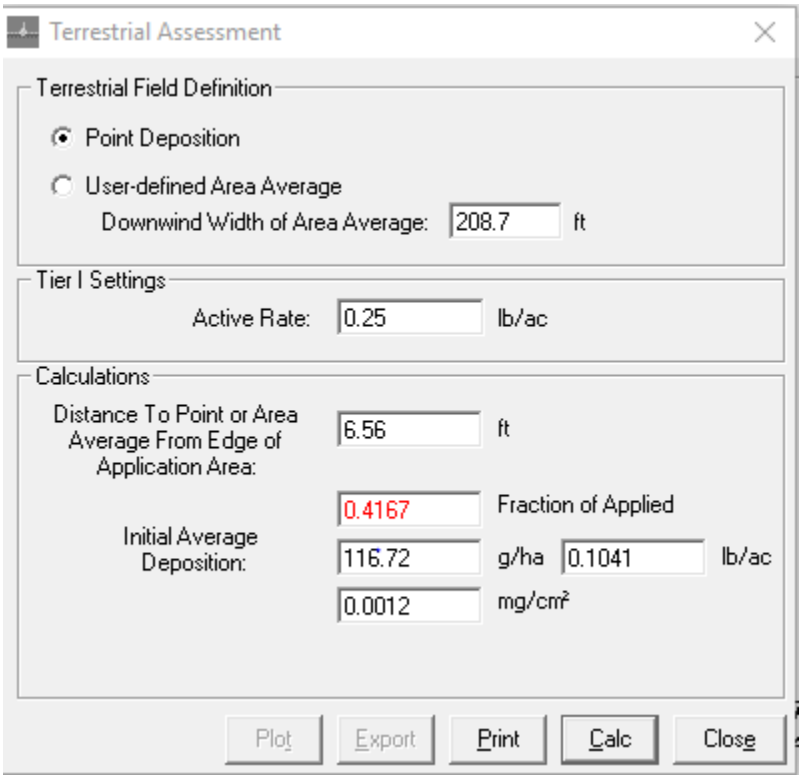
Terrestrial and Wetland Applications Affecting Monocots (EC_{25})



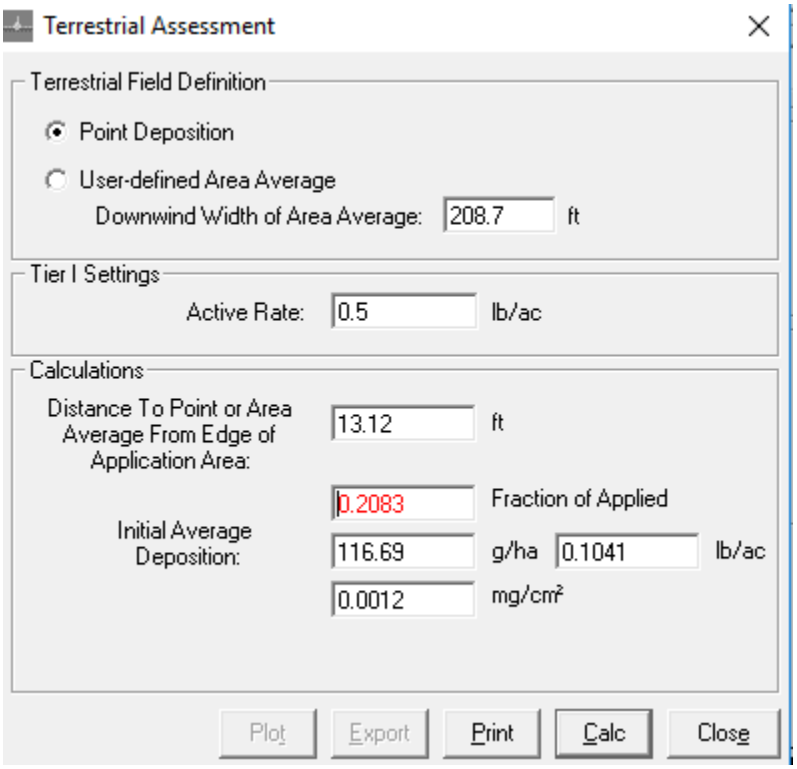
Terrestrial Mammals at 0.5 lbs a.i./A Application Rate at 4 Aerial Applications (14 RTI)



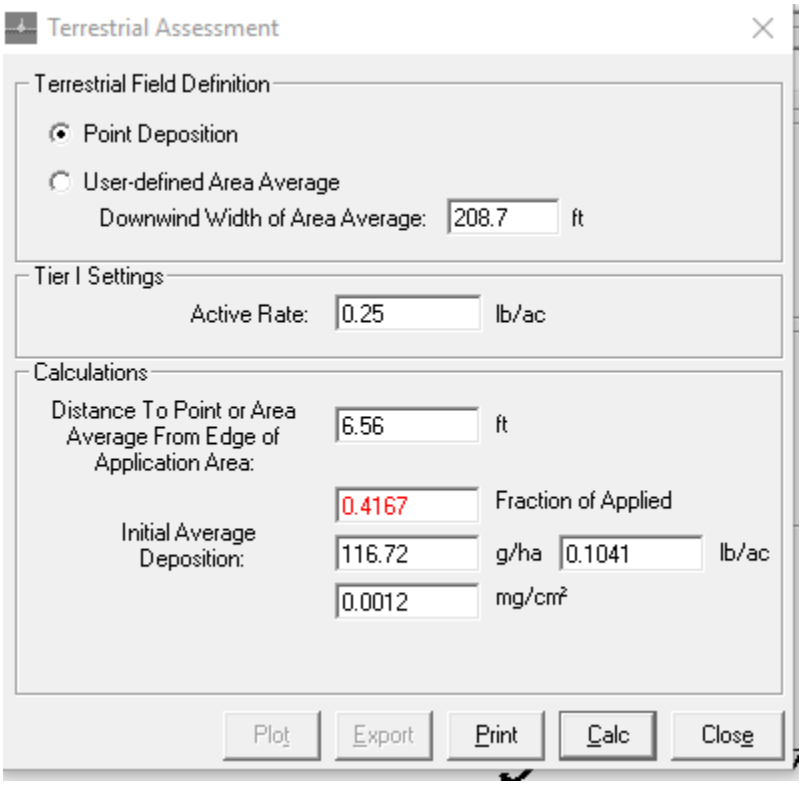
Terrestrial Mammals at 0.25 lbs a.i./A Application Rate at 4 Aerial Applications (14 RTI)



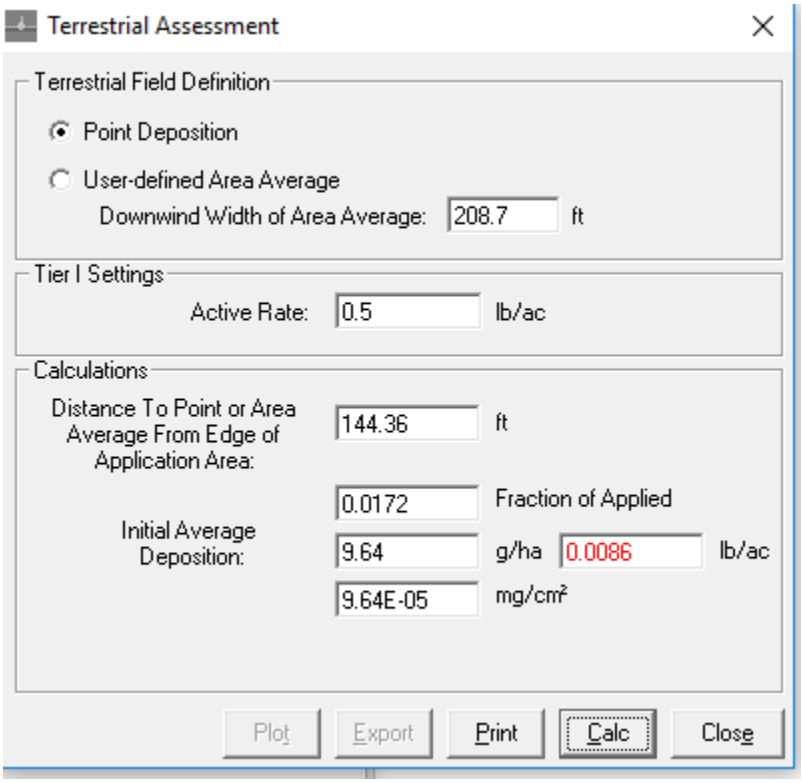
Terrestrial Mammals at 0.5 lbs a.i./A Application Rate at 4 Ground Applications



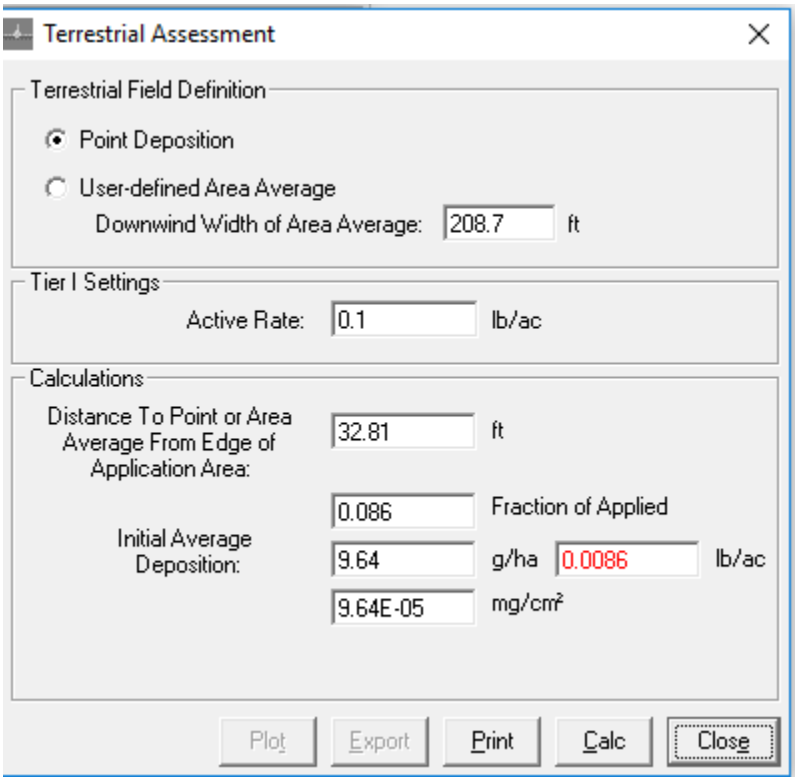
Terrestrial Mammals at 0.5 lbs a.i./A Application Rate at 4 Ground Applications



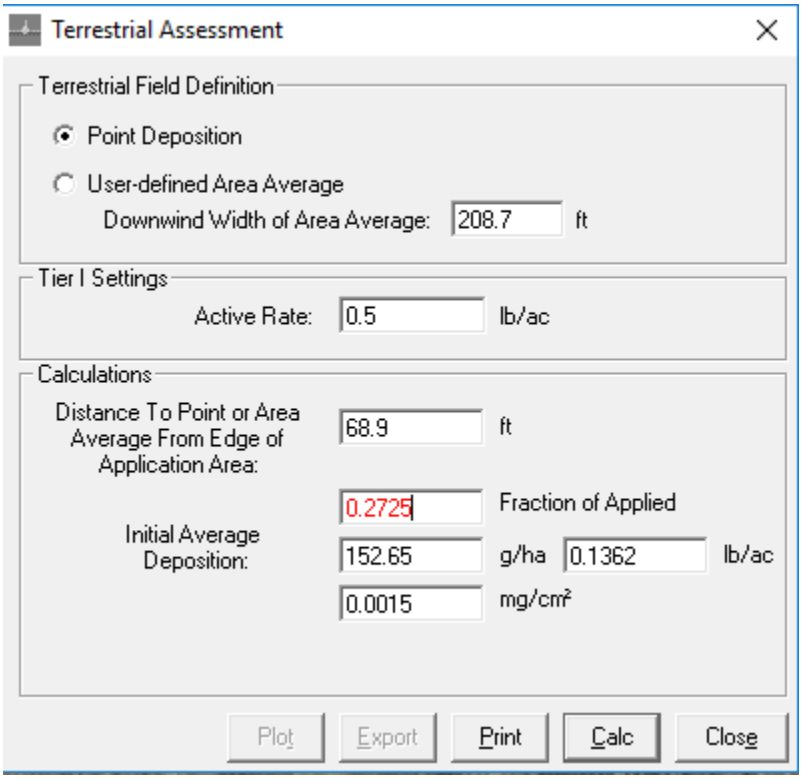
Terrestrial Plants at 0.5 lb a.i./A Application Rate, Ground Application



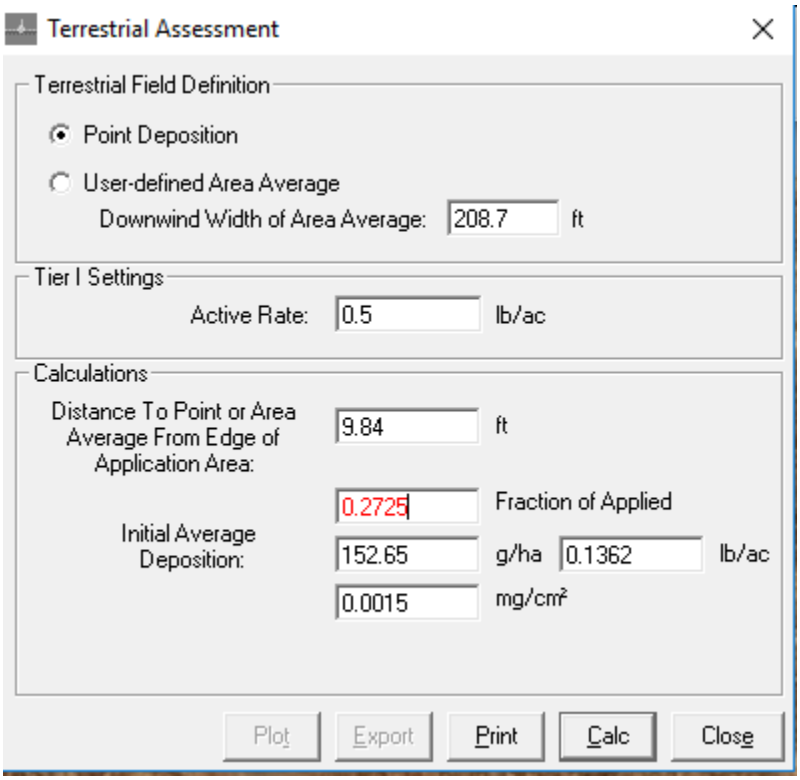
Terrestrial Plants at 0.1 lb a.i./A Application Rate, Ground Application



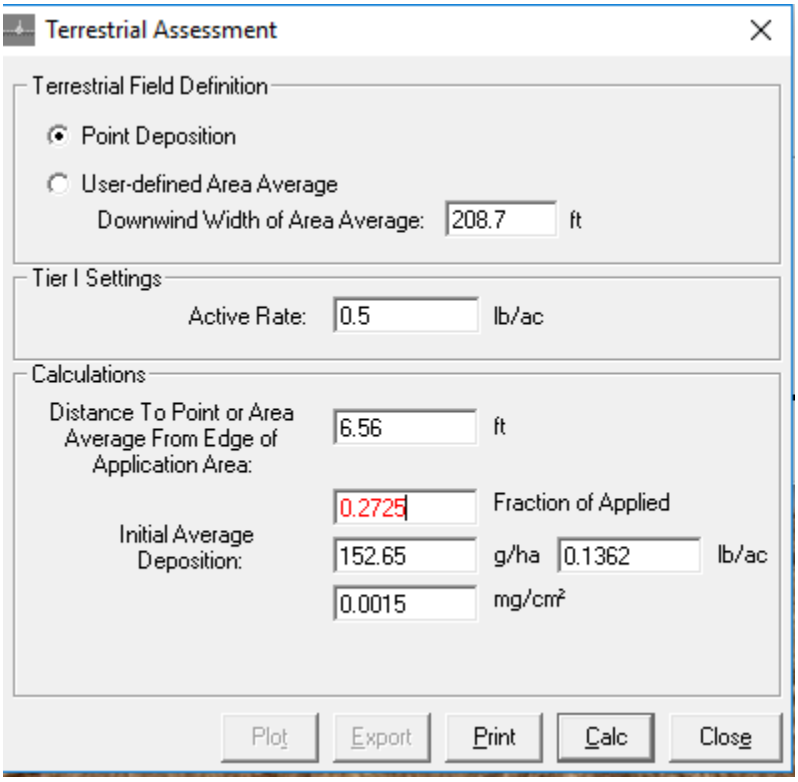
Terrestrial Invertebrates at 0.5 lb a.i./A, Aerial (Very Fine to Fine)



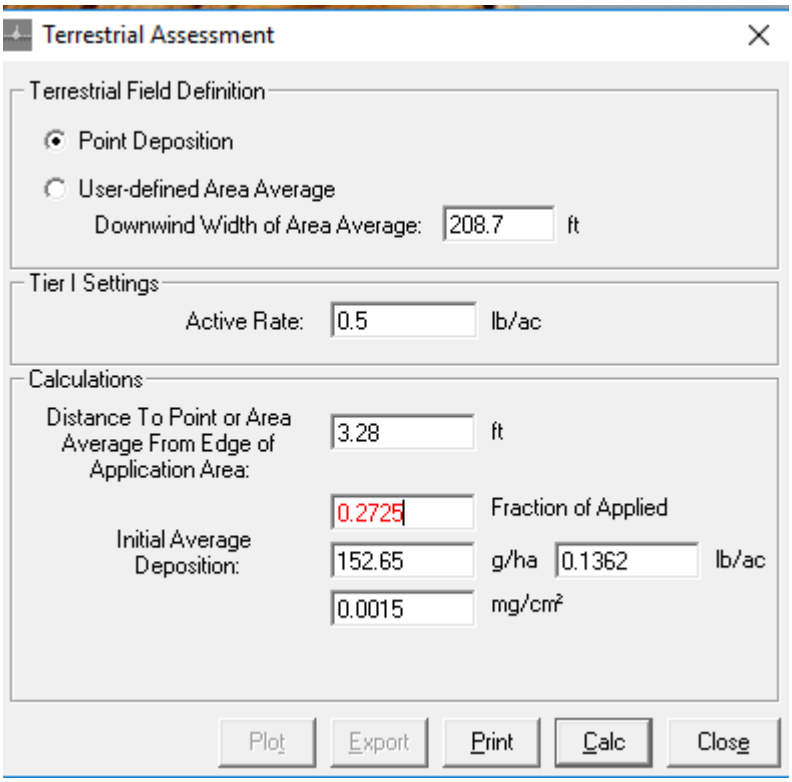
Terrestrial Invertebrates at 0.5 lb a.i./A, Aerial (Fine to Medium Coarse)



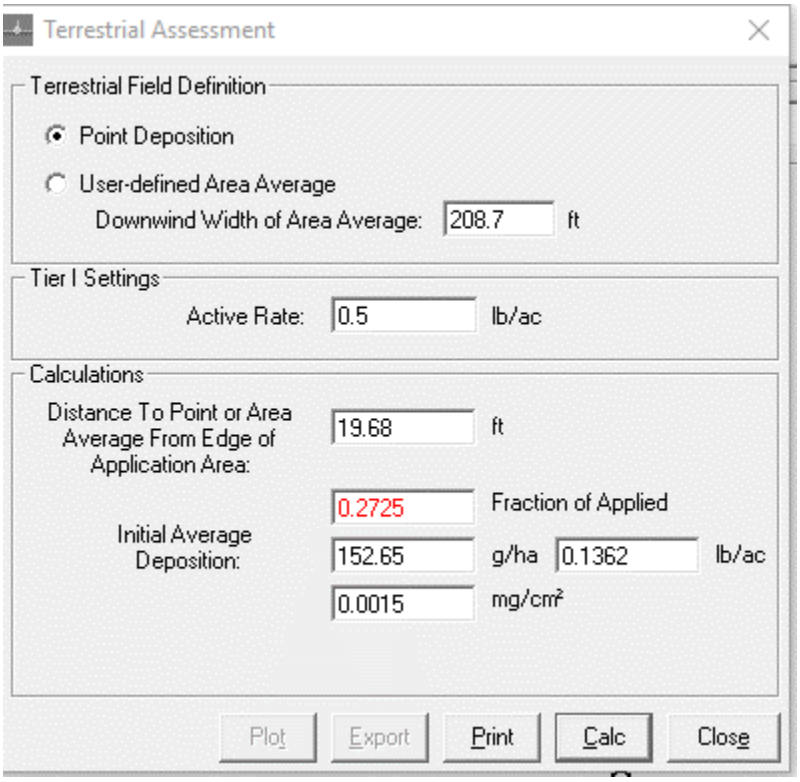
Terrestrial Invertebrates at 0.5 lb a.i./A, Ground, Low Boom (Very Fine to Fine)



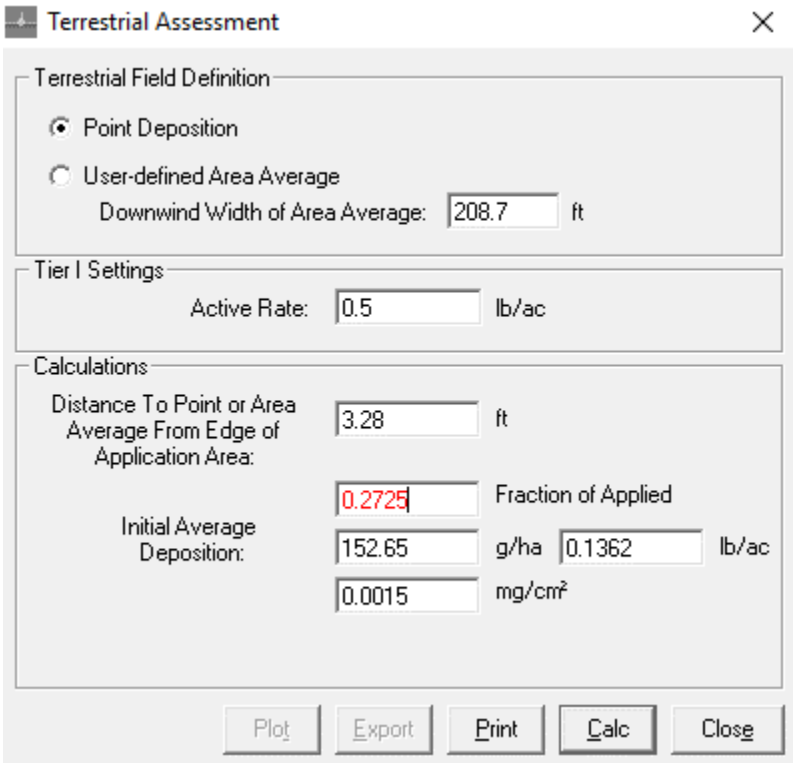
Terrestrial Invertebrates at 0.5 lb a.i./A, Ground, Low Boom (Fine to Medium Coarse)



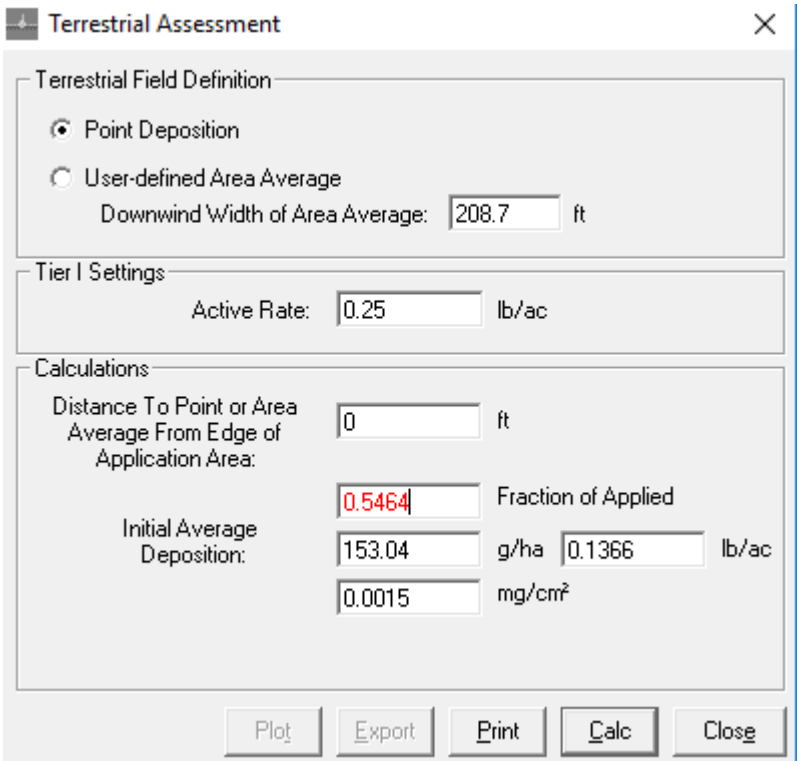
Terrestrial Invertebrates at 0.5 lb a.i./A, Ground, High Boom (Very Fine to Fine)



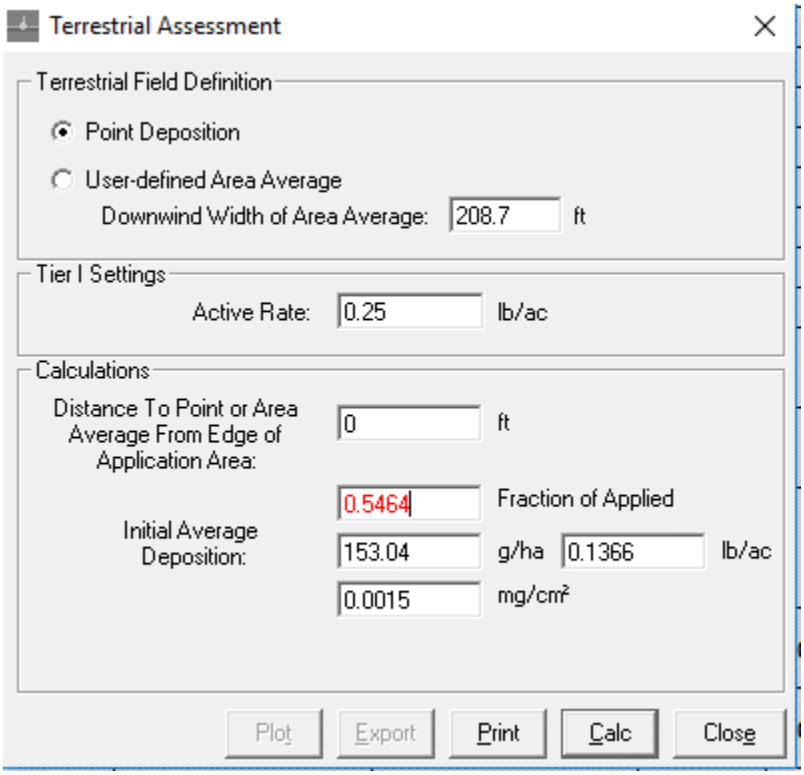
Terrestrial Invertebrates at 0.5 lb a.i./A, Ground, High Boom (Fine to Medium Coarse)



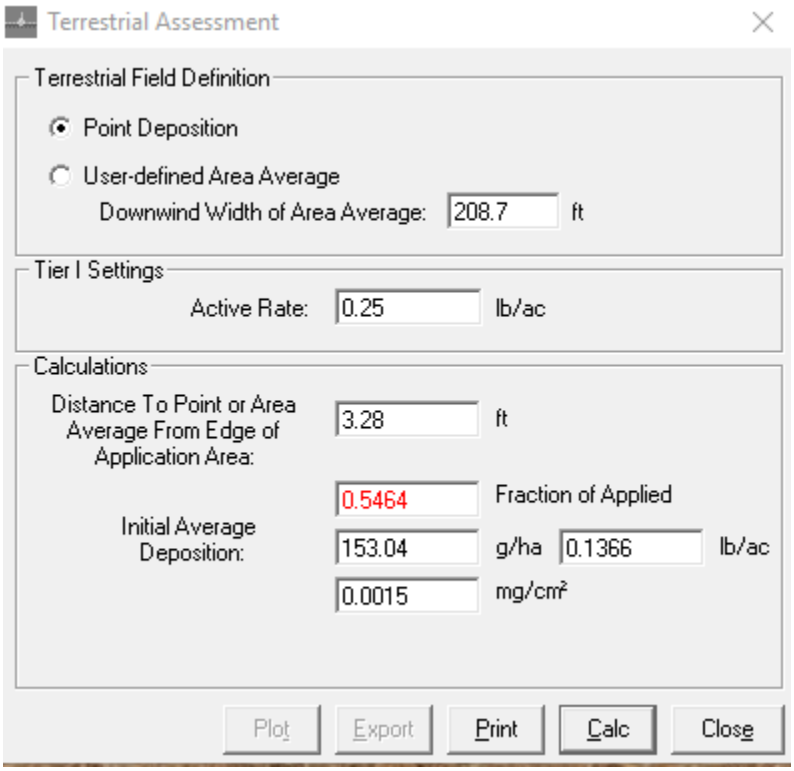
Terrestrial Invertebrates at 0.25 lb a.i./A, Aerial (Very Fine to Fine)



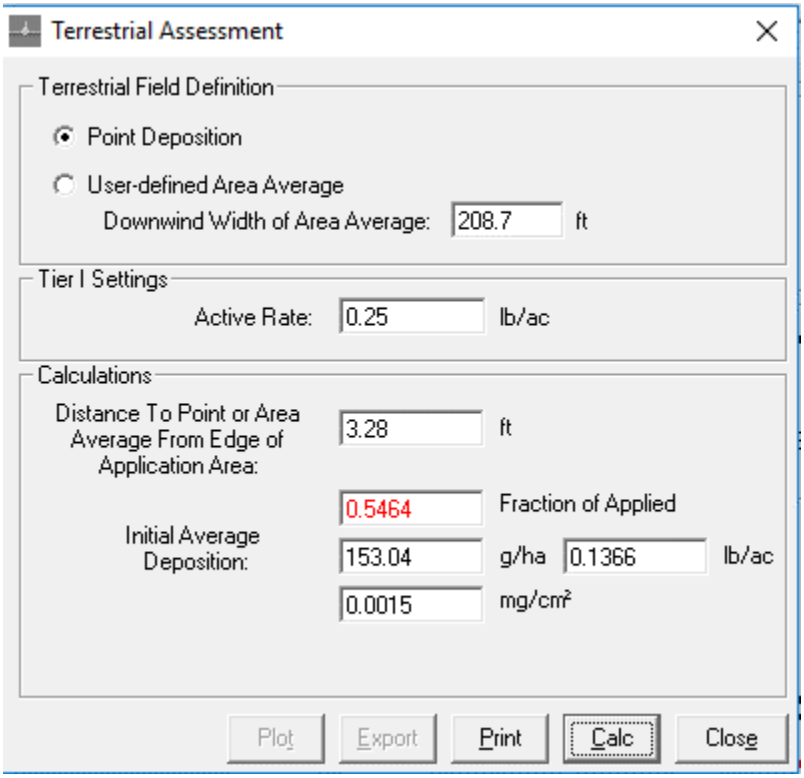
Terrestrial Invertebrates at 0.25 lb a.i./A, Aerial (Fine to Medium Coarse)



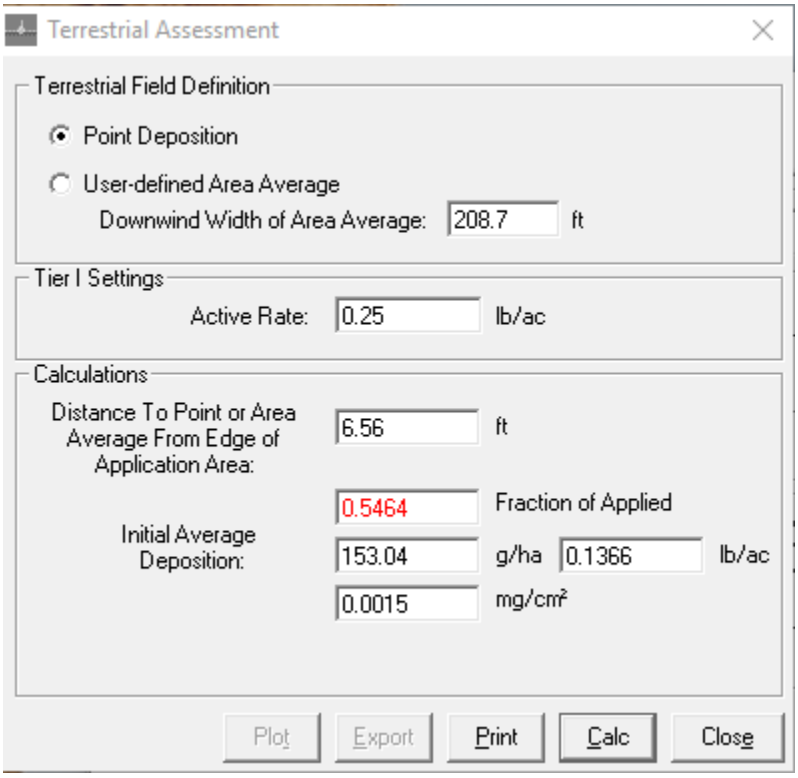
Terrestrial Invertebrates at 0.25 lb a.i./A, Ground, Low Boom (Very Fine to Fine)



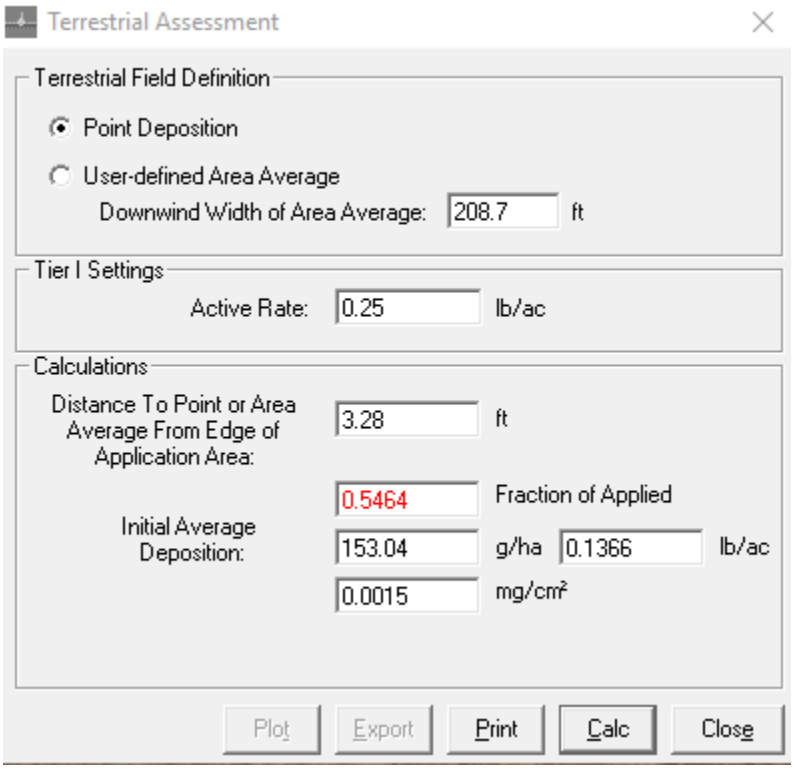
Terrestrial Invertebrates at 0.25 lb a.i./A, Ground, Low Boom (Fine to Medium Coarse)



Terrestrial Invertebrates at 0.25 lb a.i./A, Ground, High Boom (Very Fine to Fine)



Terrestrial Invertebrates at 0.25 lb a.i./A, Ground, High Boom (Fine to Medium Coarse)



BeeREX 1.0 at 0.5 lb/A Application Rate

Table 1. User inputs (related to exposure)

Description	Value
Application rate	0.5
Units of app rate	lb a.i./A
Application method	foliar spray
Are empirical residue data available?	no

Table 5. Results (highest RQs)

Exposure	Adults	Larvae
Acute contact	0.006743	NA
Acute dietary	0.08	0.32
Chronic dietary	3.67	0.32

Table 2. Toxicity data

Description	Value (µg a.i./bee)
Adult contact LD50	200.2
Adult oral LD50	200.2
Adult oral NOAEL	4.38
Larval LD50	21
Larval NOAEL	21

Table 3. Estimated concentrations in pollen and nectar

Application method	EECs (mg a.i./kg)	EECs (µg a.i./mg)
foliar spray	55	0.055
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	0.001045	4.9762E-05	4.98E-05
		2	9.4	0	0	0.00517	0.00024619	0.000246
		3	19	0	0	0.01045	0.00049762	0.000498
		4	0	60	1.8	3.399	0.16185714	0.161857
		5	0	120	3.6	6.798	0.32371429	0.323714
	Drone	6+	0	130	3.6	7.348	0.34990476	0.349905
	Queen	1	1.9	0	0	0.001045	4.9762E-05	4.98E-05
		2	9.4	0	0	0.00517	0.00024619	0.000246
		3	23	0	0	0.01265	0.00060238	0.000602
		4+	141	0	0	0.07755	0.00369286	0.003693
Adult	Worker (cell cleaning and capping)	0-10	0	60	6.65	3.66575	0.01831044	0.836929
	Worker (brood and queen tending, nurse bees)	6 to 17	0	140	9.6	8.228	0.0410989	1.878539
	Worker (comb building, cleaning and food handling)	11 to 18	0	60	1.7	3.3935	0.01695055	0.774772
	Worker (foraging for pollen)	>18	0	43.5	0.041	2.394755	0.01196181	0.546748
	Worker (foraging for nectar)	>18	0	292	0.041	16.062255	0.08023104	3.667182
	Worker (maintenance of hive in winter)	0-90	0	29	2	1.705	0.00851648	0.389269
	Drone	>10	0	235	0.0002	12.925011	0.06456049	2.950916
	Queen (laying 1500 eggs/day)	Entire lifestage	525	0	0	0.28875	0.00144231	0.065925

BeeREX 1.0 at 0.25 lb/A Application Rate

Table 1. User inputs (related to exposure)

Description	Value
Application rate	0.25
Units of app rate	lb a.i./A
Application method	foliar spray
Are empirical residue data available?	no

Table 5. Results (highest RQs)

Exposure	Adults	Larvae
Acute contact	0.003372	NA
Acute dietary	0.04	0.16
Chronic dietary	1.83	0.16

Table 2. Toxicity data

Description	Value (µg a.i./bee)
Adult contact LD50	200.2
Adult oral LD50	200.2
Adult oral NOAEL	4.38
Larval LD50	21
Larval NOAEL	21

Table 3. Estimated concentrations in pollen and nectar

Application method	EECs (mg a.i./kg)	EECs (µg a.i./mg)
foliar spray	27.5	0.0275
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	0.0005225	2.4881E-05	2.49E-05
		2	9.4	0	0	0.002585	0.0001231	0.000123
		3	19	0	0	0.005225	0.00024881	0.000249
		4	0	60	1.8	1.6995	0.08092857	0.080929
		5	0	120	3.6	3.399	0.16185714	0.161857
	Drone	6+	0	130	3.6	3.674	0.17495238	0.174952
	Queen	1	1.9	0	0	0.0005225	2.4881E-05	2.49E-05
		2	9.4	0	0	0.002585	0.0001231	0.000123
		3	23	0	0	0.006325	0.00030119	0.000301
		4+	141	0	0	0.038775	0.00184643	0.001846
Adult	Worker (cell cleaning and capping)	0-10	0	60	6.65	1.832875	0.00915522	0.418465
	Worker (brood and queen tending, nurse bees)	6 to 17	0	140	9.6	4.114	0.02054945	0.939269
	Worker (comb building, cleaning and food handling)	11 to 18	0	60	1.7	1.69675	0.00847527	0.387386
	Worker (foraging for pollen)	>18	0	43.5	0.041	1.1973775	0.00598091	0.273374
	Worker (foraging for nectar)	>18	0	292	0.041	8.0311275	0.04011552	1.833591
	Worker (maintenance of hive in winter)	0-90	0	29	2	0.8525	0.00425824	0.194635
	Drone	>10	0	235	0.0002	6.4625055	0.03228025	1.475458
	Queen (laying 1500 eggs/day)	Entire lifestage	525	0	0	0.144375	0.00072115	0.032962

BeeREX 1.0 at 0.1 lb/A Application Rate

Table 1. User inputs (related to exposure)

Description	Value
Application rate	0.1
Units of app rate	lb a.i./A
Application method	foliar spray
Are empirical residue data available?	no

Table 5. Results (highest RQs)

Exposure	Adults	Larvae
Acute contact	0.001349	NA
Acute dietary	0.02	0.06
Chronic dietary	0.73	0.06

Table 2. Toxicity data

Description	Value (µg a.i./bee)
Adult contact LD50	200.2
Adult oral LD50	200.2
Adult oral NOAEL	4.38
Larval LD50	21
Larval NOAEL	21

Table 3. Estimated concentrations in pollen and nectar

Application method	EECs (mg a.i./kg)	EECs (µg a.i./mg)
foliar spray	11	0.011
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	0.000209	9.9524E-06	9.95E-06
		2	9.4	0	0	0.001034	4.9238E-05	4.92E-05
		3	19	0	0	0.00209	9.9524E-05	9.95E-05
		4	0	60	1.8	0.6798	0.03237143	0.032371
		5	0	120	3.6	1.3596	0.06474286	0.064743
	Drone	6+	0	130	3.6	1.4696	0.06998095	0.069981
	Queen	1	1.9	0	0	0.000209	9.9524E-06	9.95E-06
		2	9.4	0	0	0.001034	4.9238E-05	4.92E-05
		3	23	0	0	0.00253	0.00012048	0.00012
		4+	141	0	0	0.01551	0.00073857	0.000739
Adult	Worker (cell cleaning and capping)	0-10	0	60	6.65	0.73315	0.00366209	0.167386
	Worker (brood and queen tending, nurse bees)	6 to 17	0	140	9.6	1.6456	0.00821978	0.375708
	Worker (comb building, cleaning and food handling)	11 to 18	0	60	1.7	0.6787	0.00339011	0.154954
	Worker (foraging for pollen)	>18	0	43.5	0.041	0.478951	0.00239236	0.10935
	Worker (foraging for nectar)	>18	0	292	0.041	3.212451	0.01604621	0.733436
	Worker (maintenance of hive in winter)	0-90	0	29	2	0.341	0.0017033	0.077854
	Drone	>10	0	235	0.0002	2.5850022	0.0129121	0.590183
	Queen (laying 1500 eggs/day)	Entire lifestage	525	0	0	0.05775	0.00028846	0.013185

Appendix E. Endocrine Disruptor Screening Program (EDSP)

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

EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a "naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect. Under FFDCA section 408(p), the Agency must screen all pesticide chemicals. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. A second list of chemicals identified for EDSP screening was published on June 14, 2013[1] and includes some pesticides scheduled for registration review and chemicals found in water. Neither of these lists should be construed as a list of known or likely endocrine disruptors. Sethoxydim is not on List 1. For further information on the status of the EDSP, the policies and procedures, the lists of chemicals, future lists, the test guidelines and Tier 1 screening battery, please visit our website[2].

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

Appendix F. Listed Species

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

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

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

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

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