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MEMORANDUM

SUBJECT: Environmental Fate and Ecological Risk Assessment for Foliar, Soil Drench, and Seed Treatment Uses of the New Insecticide Flupyradifurone (BYI 02960)

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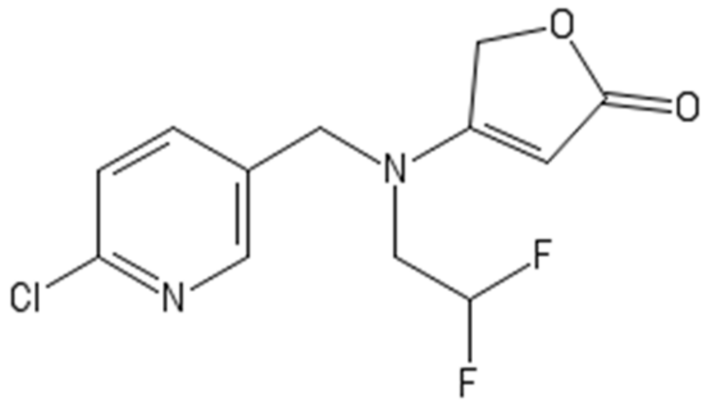
The Environmental Fate and Effects Division (EFED) has completed a review of the new systemic insecticide flupyradifurone (BYI 02960; PC Code 122304). Attached is the environmental fate and ecological risk assessment chapter written in support of the registration decision for foliar, soil drench, and deed treatment uses of the compound.

Environmental Fate and Ecological Risk Assessment for Foliar, Soil Drench, and Seed Treatment Uses of the New Insecticide Flupyradifurone (BYI 02960)



Flupyradifurone
CAS 907204-31-3 PC Code 122304

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Table of Contents

1. Executive Summary **6**
2. Problem Formulation **10**
2.1. Chemical Class and Mode of Action 10
2.2. Overview of Proposed Uses 10
2.3. Identification of Residues of Concern 10
2.4. Receptors 10
2.5. Assessment Endpoints 11
2.6. Conceptual Model 11
2.6.1. Risk Hypothesis 11
2.6.2. Conceptual Model 11
2.7. Analysis Plan 13
2.7.1. Conclusions from Previous Risk Assessments 14
2.7.2. Data Gaps 14
2.7.3. Measures of Exposure 15
2.7.4. Measures of Effect 15
2.7.5. Integration of Exposure and Effects 16
3. Analysis **16**
3.1. Use Characterization 16
3.2. Exposure Characterization 18
3.4. Terrestrial Exposure 49
3.5. Ecological Effects Characterization 59
3.5.1. Ecotoxicity Data 59
3.5.1. Incident Reports 88
4. Risk Characterization **88**
4.1. Risk Estimation 88
4.1.1. Aquatic Organisms 88
4.1.2. Terrestrial Organisms 94
4.2. Risk Description and Conclusions 105
4.2.1. Aquatic Organisms 105
4.2.2. Terrestrial Organisms 107
4.2.3. Conclusions 113
5. Additional Description of Assumptions, Limitations, Uncertainties, Strengths **114**
5.1. Label Uncertainties 114
5.2. Aquatic Exposure 115
5.2.1. Unextracted residues 115
5.2.2. Soybean Seed Planting Depth and Application Rate 115
5.2.3. Model Input Values 116
5.2.4. EPA Pond 117
5.2.5. Dilution of Sediment 118
5.2.6. A Well-Mixed Pond 118
5.2.7. Lack of Averaging Time for Exposure 118
5.3. Terrestrial Exposure 118
5.4. Effects Assessment Uncertainties 118
6. Federally Threatened and Endangered (Listed) Species of Concern **119**
6.1. Action Area 119
6.2. Taxonomic Groups Potentially at Risk 119
7. References **121**
7.1. Literature Cited 121

List of Figures

Figure 1. Example of a biphasic decline curve with an initial rapid rate of loss that slows over time 22

Figure 2. Decline curve for aerobic soil metabolism in the Neosolo soil 23
Figure 3. Decline curve for aerobic aquatic metabolism in the German gravel pit sediment 23
Figure 4. Flupyradifurone dissipation in the terrestrial field dissipation study completed in Florida 29
Figure 5. Potential degradation pathways of flupyradifurone....32
Figure 6. Measured flupyradifurone residues on various crops over time after foliar application. 104
Figure 7. Relationship between the measured K_{oc} and the flupyradifurone equilibrium concentration in water in the Argissolo soil (1/n =0.81) 117

List of Tables

Table 1. Summary of risk conclusions for non-target animals for proposed uses of flupyradifurone. 8
Table 2. Summary of risk conclusions for non-target plants for proposed uses of flupyradifurone. 9
Table 3. List of the various models and the related taxa for which the models will be used to assess risk. 13
Table 4. Proposed uses of flupyradifurone 17
Table 5. Summary of physical-chemical properties of flupyradifurone[1] 19
Table 6. Maximum amount of unextracted residues observed in aerobic metabolism studies 21
Table 7. Abiotic and biotic transformation kinetics of flupyradifurone, flupyradifurone plus M48 plus M47, and flupyradifurone plus unextracted residues. 24
Table 8. Biotic degradation kinetics for 6CNA and DFA....26
Table 9. Summary of submitted sorption studies for flupyradifurone and its degradates 2-chloronicotinic acid (6CNA), and difluoroacetic acid (DFA) 27
Table 10. Summary of terrestrial field dissipation study results for flupyradifurone 30
Table 11. Summary of DT_{50} and DT_{90} of flupyradifurone in outdoor microcosm studies (MRID 48843673)....31
Table 12. Summary of maximum amount of transformation products observed in fate studies....33
Table 13. Use site group, associated crops, and PRZM scenarios used to calculate EDWC for the use site group ...36
Table 14. Summary of scenario alterations of the Flcarrot scenario for the multiple crop cycle per year analysis....39
Table 15. Proposed uses with possible multiple crop cycles per year[1] 40
Table 16. SCI-GROW (v2.3) input parameter values for total residues of flupyradifurone plus unextracted residues (abbreviated as "FLU-UN") and for flupyradifurone alone (abbreviated as "FLU")[1] 40
Table 17. Tier I PRZM-GW input parameters....40
Table 18. Input values used for Tier II surface water modeling with SWCC....41
Table 19. Summary of EECs estimated for radishes assuming a different number of crop cycles per year....44
Table 20. Comparison of representative model inputs for parent and parent plus unextracted residues 45
Table 21. Comparison of EEC for residues of FLU-UN versus FLU....46
Table 22. Estimated concentrations of flupyradifurone plus unextracted residues (FLU-UN) and flupyradifurone alone (FLU) in surface water* 46
Table 23. Estimated concentrations of flupyradifurone plus unextracted residues (FLU-UN) or flupyradifurone alone (values designated with an asterick) in groundwater source irrigation water....48
Table 24. Terrestrial EECs as food residues for animals exposed to flupyradifurone as a result of the proposed foliar uses. 50
Table 25. Terrestrial dose-based EECs for the range of seed treatment uses proposed for flupyradifurone. 52
Table 26. Summary of contact and dietary exposure estimates used for foliar application, soil treatment, and seed treatment uses of pesticides for honeybee Tier I risk assessment. 53
Table 27. Screening-level EECs for honeybees based on foliar, drench, and seed treatment applications 54
Table 28. Empirical pollen, nectar, and flower residue data for applications of flupyradifurone formulations to different crops....56
Table 29. EECs for non-target terrestrial and semi-aquatic plants based on proposed uses of flupyradifurone based on TERRPLANT. 59
Table 30. Acute toxicity endpoints used in risk estimation and characterization for fish and aquatic invertebrates exposed to flupyradifurone. 63
Table 31. Chronic toxicity endpoints used in risk estimation and characterization for fish and aquatic invertebrates exposed to flupyradifurone. 65
Table 32. Toxicity endpoints used in risk estimation and characterization for aquatic plants exposed to flupyradifurone. 66
Table 33. Acute toxicity endpoints used in risk estimation and characterization for terrestrial animals exposed to

flupyradifurone. 69
Table 34. Chronic toxicity endpoints used in risk estimation and characterization for terrestrial animals exposed to flupyradifurone. 75
Table 35. Additional non-guideline toxicity data for hazard characterization of beneficial arthropods exposed to flupyradifurone. 76
Table 36. Toxicity endpoints used in risk estimation and characterization for terrestrial and semi-aquatic plants exposed to flupyradifurone. 77
Table 37. Summary of higher tiered honeybee semi-field and field studies for flupyradifurone. 82
Table 38. RQ values for aquatic invertebrates exposed to flupyradifurone TGAI in the water column. 90
Table 39. RQ values for sediment-dwelling invertebrates exposed to flupyradifurone TGAI. 92
Table 40. Acute and chronic RQ values for birds exposed to flupyradifurone as a result of the proposed uses. 94
Table 41. Chronic dietary and dose-based RQ values for mammals exposed to flupyradifurone as a result of the proposed uses. 96
Table 42. Chronic dietary RQ values for mammals exposed to flupyradifurone following the proposed seed treatment uses. 98
Table 43. Comparison of EECs (foliar and soil drench) and body-weight adjusted NOAELs for DFA (degradate). 99
Table 44. Screening level RQ values for insect pollinators. 100
Table 45. Refined Tier I RQ values for honeybees based on empirical residue data from pollen and nectar. 101
Table 46. Impact of different foliar dissipation half-lives on terrestrial vertebrate RQs. 109
Table 47. Potential effects to federally listed taxa associated with the proposed uses of flupyradifurone. 120

Appendices

Appendix A. Fate Data Table for Flupyradifurone 137
Appendix B. Effects Data Table for Flupyradifurone 142
Appendix C. Summary of Aquatic Modeling Completed 148
Appendix D. Example Aquatic Modeling Output for the Groundwater Modeling 153
Appendix E. Example Aquatic Modeling Output for the SWCC 155
Appendix F. Estimation of Exposure of Terrestrial Plants to Flupyradifurone and Unextracted Residues in Groundwater Used as Irrigation Water 180
Appendix G. Example STIR (v. 1.0) input and output data 181
Appendix H. Example T-REX (v. 1.5.2) input and output data 182
Appendix I. Toxicity Comparisons of Flupyradifurone and Transformation Products. 184
Appendix J. OECD and OPP Rating System for Data Evaluation Records and/or Monographs 187

1. Executive Summary

Flupyradifurone, a butenolide insecticide, is an active ingredient proposed for registration as both a foliar treatment on many agricultural crops and a seed treatment for soybeans. The compound can be taken up and systemically distributed in plants.   Flupyradifurone is characterized as being persistent to very persistent and is moderately mobile to mobile depending on soil conditions; therefore, it has the potential to reach aquatic environments, including surface and groundwater, for several months or more following application. Flupyradifurone is nonvolatile, and thus movement through air will not constitute a major transport pathway.[1] The available fate data suggest that flupyradifurone is likely to dissipate from the point of application through various transport mechanisms, including runoff, erosion, and leaching to groundwater, although times to 90% decline of pesticide mass (DT_{90}) from surface soils in terrestrial field dissipation studies often exceeded one year (see Section 3.2 for the Exposure Characterization).

Based on a log octanol-water partition coefficient (log K_{ow}) of 0.08 and organic-carbon normalized soil-water distribution coefficients (K_{oc}) ranging from 80 to 283 L/kg-organic carbon, a higher percentage of flupyradifurone is expected in the water column as compared to sediment, although the chemical's persistence in aquatic environments will lead to some diffusive transfer into sediment pore water.

For aquatic organisms, the primary risks of concern in this assessment are for freshwater and estuarine/marine invertebrates inhabiting both the water column and benthic environments. Flupyradifurone is very highly toxic to both freshwater insects and estuarine/marine crustaceans on an acute exposure basis. Acute risk to federally threatened and endangered (listed) species and chronic risk Levels of Concern (LOCs) for freshwater and estuarine/marine invertebrates were exceeded for the majority of proposed uses in this assessment. Flupyradifurone is mobile to moderately mobile and persistent in the aquatic environment, and as a result, there is the potential for both short-term and long-term exposure to aquatic organisms. After the contribution of spray drift was removed from aquatic exposure estimates, many proposed uses still exceeded the acute risk to listed species and chronic risk LOCs. Therefore, the proximity of foliar applications from a water body are not likely to substantially change the potential for risks of concern to aquatic organisms. While any setback buffer between an aquatic water body and the treated field is expected to reduce exposure, methodologies are not available to determine the distance that is needed to eliminate the risk concern from transport in runoff. In this assessment, the influence of multiple crop cycles on aquatic invertebrates from multiple foliar applications of flupyradifurone was considered. In general, the use of a single crop cycle (2 applications at 0.18 lbs ai/A) did not lead to acute risks of concern to non-listed freshwater invertebrates; however, multiple crop cycles (*i.e.*, ≥2) did lead to risks of concern for this group.

Although flupyradifurone is classified as ranging between practically nontoxic and moderately toxic to birds on acute oral exposure basis, and is classified as slightly toxic to birds on a subacute dietary exposure basis, risk estimates exceeded the acute risk to listed birds LOC for all proposed foliar and soil drench uses, as does the proposed seed treatment use of flupyradifurone

[1] Flupyradifurone is classified as non-volatile under field conditions (according to the classification system in Guideline 835.6100) (USEPA, 2008). Based on results of the Screening Tool for Inhalation Risk model, exposure through inhalation is not a potential pathway of concern for either avian or mammalian species on an acute basis.

on soybean. In addition, the acute risk LOC for non-listed birds was exceeded for the seed treatment use and all foliar and drench uses, except for hops. The modeling of multiple crop cycles generally increased the number of dietary items for which the acute risk to non-listed species LOC was exceeded. Flupyradifurone is classified as practically nontoxic to mammals on an acute oral exposure basis; however, chronic risks of concern (based on reductions in growth following long-term exposure) were identified for multiple size classes of mammals foraging on multiple dietary items and for all proposed uses evaluated.

Consistent with the fact that the compound is an insecticide, terrestrial invertebrates are relatively sensitive to the compound as well. However, while flupyradifurone is highly toxic to honeybees on an acute oral exposure basis, the compound is practically nontoxic to adult bees on an acute contact exposure basis. These data indicate that the primary exposure route of concern is through ingestion of residues in pollen/nectar rather than through contact. Although laboratory-based studies with individual adult bees indicate that 50% of bees will be subject to acute mortality following ingestion of residues at relatively low exposure levels, semi-field studies with whole colonies, in which applications were made while bees were actively foraging at full bloom using maximum proposed foliar application rates, only identified relatively transient increases in adult bee mortality within hours to several days of treatment as compared to untreated control colonies. Colonies exposed to flupyradifurone did not exhibit any detectable long-term effects. Field studies examining colonies through overwintering did not demonstrate any adverse effects in the treated colonies.

Other than for bees, this assessment does not evaluate risk to terrestrial invertebrates. However, in non-guideline toxicity studies submitted for terrestrial arthropods exposed to formulated flupyradifurone (BYI 02960 SL 200 G), reduced survival was observed at exposure levels below the maximum proposed label application rate for flupyradifurone, in some cases several orders of magnitude lower. The most sensitive non-target arthropod was the parasitoid wasp. These data indicate that potential for effects of flupyradifurone to non-target terrestrial arthropods is possible at or below proposed application rates.

Table 1. Summary of risk conclusions for non-target animals for proposed uses of flupyradifurone.

Group	RQs		Risks of Concern			Refinements Used	Uncertainties
	Acute[1,2,3,4]	Chronic[5] (Effects)	Acute: Listed	Acute: Non-listed	Chronic		
Freshwater Vertebrates	NC[6]	≤0.01 (fry survival)	None	None	None		--
Estuarine/Marine Vertebrates	NC[6]	NC[7]	None	None	Not expected[7]		No chronic toxicity data available[7]
Freshwater Invertebrates	0.05-1	0.87-18.8 (emergence/ development rates)	All uses	≥2 crop cycles per season	Most uses		
Estuarine/Marine Invertebrates	0.01-0.26	0.22-4.70 (young/female/day)	Most uses	None	Most uses		
Birds, Reptiles, and Terrestrial Phase Amphibians	<0.01-1.13	0.01-1.49 (parental survival & body weight; multiple reproductive endpoints)	All Uses	All Uses (except hops)	Seed treatment only		
Mammals	NC[6]	0.01-5.6 (pup body weight and weight gain)	Not Expected	Not Expected	All uses	Days exceeding chronic LOC calculated (spray/drench applications); examined influence of foliar dissipation half-life on RQs	
Honeybees	<0.01-4.8	0.02-12.5[8]	NA	All foliar Uses[9]	All foliar uses[9]	RQs refined based on empirical residue data; higher-tiered studies available	No chronic oral effects near dose at which acute oral mortality observed

NC = Not calculated; NA = Not applicable
[1] Acute risk to listed species LOC = 0.05 for all animals.
[2] Acute risk to non-listed species LOC = 0.5 for aquatic animals.
[3] Acute risk to non-listed species LOC = 0.1 for terrestrial vertebrates.
[4] Acute risk to non-listed species LOC = 0.4 for terrestrial invertebrates.
[5] Chronic risk LOC = 1 for all animals.
[6] RQs could not be calculated because toxicity endpoints are non-definitive (*i.e.*, greater than the highest concentration tested)
[7] Chronic toxicity data are not available for estuarine/marine fish; however, based on risk estimations for freshwater fish, chronic risks to this group of organisms are not expected.
[8] No effects at highest concentration tested.
[9] Although laboratory-based studies with individual adult bees indicate that 50% of bees will be subject to acute mortality following ingestion of residues at relatively low exposure levels, semi-field studies with whole colonies, in which applications were made while bees were actively foraging at full bloom using maximum proposed foliar application rates, only identified transient increases in adult bee mortality within hours to several days of treatment as compared to untreated control colonies. Colonies exposed to flupyradifurone did not exhibit any detectable long-term effects. Field studies examining colonies through overwintering did not demonstrate any adverse effects in the treated colonies.

Table 2. Summary of risk conclusions for non-target plants for proposed uses of flupyradifurone.

Group	RQs		Risks of Concern		Uncertainties
	Listed Spp.[1]	Non-Listed Spp.[1]	Listed Spp.	Non-Listed Spp.	
Aquatic Vascular Plants	<0.01	NC	None	Not expected	
Aquatic Non-Vascular Plants	<0.01	NC	None	Not expected	
Terrestrial Monocotyledonous Plants	<0.01-0.5	NC[2]	None	Not expected	
Terrestrial Dicotyledonous Plants	NC[3]	NC[2]	Uncertain[3]	Not expected	NOAEC not established in seedling emergence or vegetative vigor studies

NC = Not calculated

[1] Risk to aquatic and terrestrial plant listed and non-listed LOC is 1.

[2] RQs could not be calculated because toxicity endpoints are non-definitive (*i.e.*, greater than the highest concentration tested)

[3] RQs could not be calculated because a NOAEC was not established in seedling emergence or vegetative vigor studies.

2. Problem Formulation

2.1. Chemical Class and Mode of Action

Flupyradifurone (PC Code 122304, 2(5H-(furanone), 4-{{(6-chloro-3-pyridinyl)methyl](2,2-difluoroethyl)amino]-, also known as BYI 02960) is a new active ingredient proposed for use as a systemic insecticide. The chemical belongs to the butenolide class of insecticides and the insecticidal activity of flupyradifurone is similar to the neonicotinoids with agonist activity in nicotinic acetylcholine receptors, making it a member of the Insecticide Resistance Action Committee (IRAC) Group 4 insecticide class (IRAC, 2012).

2.2. Overview of Proposed Uses

Flupyradifurone has proposed foliar uses on crop group 15 cereal grains (except rice), cotton, nongrass animal feeds (forage, fodder, straw, hay), peanut, root vegetables (except sugarbeet), tuberous and corm vegetables, leafy vegetables (except Brassica), *Brassica* (cole leafy vegetables), legume vegetables (succulent or dried), fruiting vegetables, cucurbit vegetables, hops, citrus fruit, pome fruit, bushberry (except cranberry), low growing berry (except cranberry), small fruit vine climbing group (except fuzzy kiwifruit), tree nuts, prickly pear, and soybean seeds. The registrant (Bayer CropScience) is seeking registration of flupyradifurone on two labels:

- Sivanto™ 200 SL (Sivanto) for use as a foliar and soil drench application to various agricultural crops, and
- BYI 02960 480 FS (BYI 02960), a systemic seed treatment insecticide for use on soybean seeds.

Both are liquid formulations and each only has the one active ingredient. Sivanto is proposed for application to agricultural crops before bloom, during bloom, or following bloom up to the stated pre-harvest interval (PHI). Sivanto may be applied via ground, airblast, aerial, or chemigation equipment while BYI 02960 is proposed for application to soybean seeds via commercial seed treatment application only.

2.3. Identification of Residues of Concern

Based on available data for degradates, the residues of concern for estimating aquatic exposure are flupyradifurone (parent) and unextracted residues that have not been characterized. The residues of concern for terrestrial vertebrates include parent and difluoroacetic acid. Only flupyradifurone (parent) is considered a residue of concern for terrestrial invertebrates based on honeybee toxicity data. Justification of the residues of concern are further discussed in Section 3.2.5 and 3.5.

2.4. Receptors

The receptor is the biological entity that is exposed to the stressor (USEPA, 1998). For this assessment, the receptor includes terrestrial animals inhabiting fields where flupyradifurone foliar applications occur or treated seeds are planted, and non-target areas to where flupyradifurone is transported (via spray drift, runoff or leaching to groundwater) where terrestrial and aquatic animals may be exposed. Consistent with the process described in the Overview Document (USEPA, 2004), the risk assessment uses a surrogate species approach in its evaluation. Toxicological data generated from surrogate test species, which are intended to be representative of broad taxonomic groups, are used to extrapolate to potential effects on a variety of species (receptors) included under these taxonomic groupings.

2.5. Assessment Endpoints

Assessment endpoints represent the actual environmental value that is to be protected, defined by an ecological entity (species, community, or other entity) and its attributes (USEPA, 1998). For flupyradifurone, the ecological entities include birds (as well as reptiles and terrestrial-phase amphibian for which birds serve as surrogates), mammals, freshwater fish (as well as aquatic-phase amphibians for which fish serve as surrogates) and invertebrates, estuarine/marine fish and invertebrates, terrestrial plants, insects, and aquatic vascular and nonvascular plants. The attributes evaluated for each of these entities may include growth, reproduction, and survival.

2.6. Conceptual Model

A conceptual model provides a written description and visual representation of the predicted relationships between flupyradifurone, the potential routes of exposure, and the predicted effects for each assessment endpoint. A conceptual model consists of two major components: the risk hypothesis and the conceptual diagram (USEPA, 1998).

2.6.1. Risk Hypothesis

For flupyradifurone, the following ecological risk hypothesis is employed for this risk assessment:

> *Given the uses of flupyradifurone and its environmental fate properties, there is a likelihood of exposure to non-target terrestrial and/or aquatic organisms. Flupyradifurone may be transported to surface water and groundwater via runoff, leaching, and spray drift. It may be transported to offsite terrestrial environments via spray drift. When used in accordance with the label, flupyradifurone may result in potential adverse effects upon the survival, growth, and reproduction of non-target terrestrial and aquatic organisms. Based on the reduced risk assessment (USEPA, 2013, D408685), there will be potential direct risks to aquatic invertebrates and birds.*

2.6.2. Conceptual Model

The environmental fate properties of flupyradifurone indicate that for foliar applications, spray drift, runoff, and leaching are potential transport mechanisms to aquatic habitats where non-target organisms may be exposed. It is expected that non-target terrestrial organisms can be exposed to foliar applications of flupyradifurone through consumption of exposed plants and invertebrates on the treated field. Additionally, flupyradifurone may reach terrestrial environments off the field via spray drift, and via application of irrigation water containing residues of flupyradifurone. With regards to the seed treatments, flupyradifurone may reach aquatic habitats via leaching of the chemical from the seed coat, and subsequent transport via runoff and/or infiltration. It is expected that non-target terrestrial organisms can be exposed to flupyradifurone through consumption of treated seeds. A summary of the transport pathways and the models used for those pathways in the assessment are provided in **Table 3**.

As flupyradifurone is nonvolatile, atmospheric transport is not a major transport pathway. Additionally, the Screening Tool for Inhalation Risk (STIR) version 1.0 (November 23, 2010) indicates that exposure via inhalation is not likely to be a risk concern for birds and mammals (**Appendix G**). These results combined with the estimated atmospheric half-life of less than two days indicate that long-range transport in the vapor phase is not an exposure pathway of concern for terrestrial and aquatic organisms. Additionally, the octanol-air K_{OA} and octanol-water K_{OW} partition coefficients suggest that flupyradifurone is not likely to bioconcentrate or bioaccumulate in aquatic or terrestrial organisms.[2] Organic-carbon normalized sorption coefficient (K_{OC}) values range from 80 to 283 L/kg-OC indicating that flupyradifurone is classified as mobile to moderately mobile under the FAO mobility classification system. Therefore, flupyradifurone does have the potential to leach to groundwater. While flupyradifurone does not have K_{oc} values that indicate most flupyradifurone will quickly move into sediment, some flupyradifurone will be transported to sediment and pore water and flupyradifurone is toxic to aquatic invertebrates. Therefore, risk to sediment dwelling organisms due to exposure to flupyradifurone in pore water is evaluated in this assessment. Flupyradifurone may be applied as a flowable or seed treatment; spray drift is expected to result in significant exposure to organisms off of the field with broadcast applications of liquids (both aerial and ground boom spray). Spray drift is not modeled for seed treatments.

The exposure pathways may result in exposure to various aquatic and terrestrial organisms. With exposure, the following attribute changes have the potential to occur:

- effects to individual organisms,
- effects to the food chain (reduction in prey and food, modification of primary constituent elements (PCE) related to prey availability), and
- effects to habitat integrity (reduction in primary productivity, reduced cover, community change, and modification of PCE related to habitat).

[2] A recent scientific advisory panel (SAP) reported, "Gobas *et al.* (2003) concluded that chemicals with a log K_{OA} > 5 can biomagnify in terrestrial food chains if log K_{OW} >2 and the rate of chemical transformation is low. However, further proof is needed before accepting these limits without reservations" (SAP, 2009). This was also supported by Armitage and Gobas's work completed in 2007 (Armitage and Gobas, 2007).

Table 3. List of the various models and the related taxa for which the models will be used to assess risk.

Environment	Taxa of Concern	Exposure Media	Exposure Pathway	Model(s) or Pathway	Attribute Change
Aquatic	Vertebrates/ Invertebrates	Surface water/ sediment	Runoff and spray drift to water and sediment	SWCC	Individual Organisms Food Chain Habitat Integrity
	Aquatic Plants (vascular and nonvascular)				Food Chain Habitat Integrity
	Riparian plants	See terrestrial exposure pathways			Habitat Integrity
Terrestrial	Vertebrate	Dietary items	Ingestion of residues in/on dietary items, including treated seeds as a result of direct application	T-REX	Individual Organisms Food Chain Habitat Integrity
		Consumption of aquatic organisms	*Residues taken up by aquatic organisms*	*Not a major transport pathway*	---
	Plants	Spray drift/runoff	Runoff and spray drift to plants	TERRPLANT	Food Chain Habitat Integrity
		Surface water	Residues in irrigation water leaching to groundwater	SWCC	
		Groundwater		SCIGROW	
				PRZM-GW	
	Bees and other terrestrial invertebrates[1]	Dietary items	Spray contact and ingestion of residues in/on dietary items as a result of direct application	Multiple models	Individual Organisms Colony/Population Integrity
All Environments	All	Movement through air to aquatic and terrestrial media	Spray drift	AgDRIFT (Spray drift)	Individual Organisms Food Chain Habitat Integrity
				AgDISP (Spray drift)	
			Atmospheric transport	*Not a major transport pathway*	

Text in *italics* represent transport pathways that are not of concern.
[1] See pollinator SAP white paper for full list of modelling approaches for evaluating exposure used in this assessment (USEPA, 2012d).

2.7. Analysis Plan

The analysis plan is the final step in Problem Formulation. During this step, an assessment design is developed, the scope of the assessment is outlined, the methods for conducting the assessment are determined, measurements of effects and exposure to evaluate the risk hypothesis are delineated, and initial data gaps and assumptions required to address them are identified.

2.7.1. Conclusions from Previous Risk Assessments

A reduced risk assessment has been completed for flupyradifurone. The reduced risk assessment was completed prior to reviewing all available data. Additionally, the toxicity endpoints used in the reduced risk assessment were not the same as those used in this risk assessment. The reduced risk assessment was specific for use on pome fruit, citrus, cotton, and vegetables, and indicated that flupyradifurone had less environmental risk as compared to some alternatives but not others. The flupyradifurone request for reduced risk was granted based on the full comparison of all potential risk as compared to alternatives (including considerations for risk to human health).

2.7.2. Data Gaps

The following environmental fate and ecological effects data gaps are identified in this assessment:

- The test on photodegradation in water (OCSPP Guideline 835.2240[3]) did not fully characterize potential degradates.
- Terrestrial field dissipation studies (OCSPP Guideline 835.6100[4]) are currently available on bare ground sites only, and did not track some of the major degradates observed in photolysis studies.
- Submitted adsorption/desorption data (OCSPP Guideline 835.1230[5]) did not include sorption of flupyradifurone to an aquatic sediment, as is recommended in the guideline.
- There are no acceptable chronic toxicity data for estuarine/marine fish (OCSPP Draft Guideline 850.1400). However, the potential for chronic risk to this group of organisms is considered low.
- At the time of this assessment, there are no acceptable toxicity data for several aquatic nonvascular plants including diatoms (freshwater or estuarine/marine) and freshwater cyanobacteria (OCSPP Guidelines 850.4500 and 850.4550). Although risks of concern to aquatic plants from proposed uses of flupyradifurone are not anticipated based on available toxicity data for green algae, toxicity data for additional species would allow for a more robust risk conclusion for this groups of organisms.
- Definitive no observed adverse effects concentrations (NOAEC) were not established for terrestrial dicotyledonous plants as the lowest observed adverse effects concentrations (LOAEC) occurred at the only concentration tested in submitted seedling emergence and vegetative vigor studies. Without additional toxicity data on terrestrial plants, risks of concern to listed dicotyledonous plants cannot be ruled out.

Appendix A and **Appendix B** contain data tables with details on whether additional data are needed to address the uncertainties for these data gaps.

[3] http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0152-0012
[4] http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0152-0040
[5] http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0152-0006

2.7.3. Measures of Exposure

Screening-level assessments are intended to be protective of wildlife on a national level, as opposed to being regionally- or locally-specific. Therefore, this assessment is not intended to represent a spatially- or temporally-specific analysis. Maximum application rates are used to model estimated environmental concentrations (EECs). Measures of exposure are based on aquatic and terrestrial models that calculate EECs using proposed application rates and methods. Exposure modeling assumes that the seed treatment use will not result in spray drift. Particulate drift (also known as "dust-off" or "fugitive dust"), which may occur from abrasion of treated seeds during field application, is not assessed in screening-level exposure models. Groundwater is assessed, due to the mobility of flupyradifurone and the potential that contaminated groundwater could be used as irrigation water on crops. As this is a new registration, there are currently no monitoring data for flupyradifurone for comparison with model-generated EECs.

The Surface Water Concentration Calculator (SWCC, version 1.1) is used to calculate surface water EECs and EECs for sediment-dwelling invertebrates. The SWCC is a graphical user interface that runs the Pesticide Root Zone Model (PRZM, version 5, November 15, 2006) and the Variable Volume Water Body Model (VVWM, 3/6/2014) (USEPA, 2006). Groundwater concentrations are estimated using the Screening Concentration in Groundwater (SCI-GROW, version 2.3, 7/30/2003) model and the Pesticide Root Zone Model for Groundwater (Pesticide Root Zone Model for Groundwater, version 1.07, August 31, 2012). The Terrestrial Residue Exposure Model (T-REX, version 1.5.2, 06/06/2013) is used to derive terrestrial EECs on food items for terrestrial vertebrates (USEPA, 2012c). The TerrPlant model (v. 1.2.2, 12/26/2006) is used to derive runoff EECs for estimating exposures to terrestrial plants inhabiting dry and semi-aquatic areas (USEPA, 2009). AgDRIFT (version 2.1.1) was used to evaluate exposure to all taxa via spray drift according to guidance on modeling spray drift (USEPA, 2013b). Exposure models are parameterized using relevant use and environmental fate data according to EFED input parameter guidance for water modeling (USEPA, 2009), EFED guidance on calculating degradation kinetics (NAFTA, 2012; USEPA, 2012b), and the EFED input parameter guidance specific to PRZM-GW (USEPA, 2013a; USEPA and Health Canada, 2013). Information on EFED models is available at http://www.epa.gov/pesticides/science/models_db.htm. The registrant provided a suite of Office of Chemical Safety and Pollution Prevention (OCSPP) guideline-compliant environmental fate and product chemistry studies that provide data for these various estimates of exposure.

2.7.4. Measures of Effect

Measures of effect are obtained from a suite of registrant-submitted guideline studies which are conducted with a limited number of surrogate species. The test species are not intended to be representative of the most sensitive species but rather are selected based on their ability to thrive under laboratory conditions. For example, toxicity testing reported in this risk assessment utilizes surrogate species to represent all freshwater fish (>2000 species) and birds (>680 species) identified in the U.S. Open literature searches are not conducted to identify data for potential use in this risk assessment because flupyradifurone is a new active ingredient.

The acute measures of effect used in this screening-level assessment include the median lethal dose (LD_{50}), median lethal concentration (LC_{50}), and the median effect concentration (EC_{50}). These are measures of acute toxicity which result in 50% of the respective effect in tested organisms. The endpoints for chronic measures of effect are the No Observed Adverse Effects Concentration (NOAEC) and the No Observed Adverse Effects Level (NOAEL). Toxicity studies are submitted for freshwater fish and invertebrates, estuarine/marine fish and invertebrates, aquatic and terrestrial plants, birds, mammals and honeybees. The measurement endpoints used for risk characterization are derived from studies which underwent review and are classified as "fully reliable" (conducted under guideline conditions and considered to be scientifically sound) or "reliable with restrictions" (conditions deviated from guidelines but the results are scientifically sound). Please see **Appendix J** for more information on the study classification system.

2.7.5. Integration of Exposure and Effects

The exposure and toxicity effects data are integrated to evaluate the risks of adverse ecological effects on non-target species. For the screening-level assessment of flupyradifurone, the deterministic, risk quotient (RQ) method is used to compare estimated exposure and measured toxicity values. The RQ method involves dividing EECs by acute and chronic toxicity values. The resulting RQs are then compared to the Agency's levels of concern (LOCs) (USEPA, 2004). When the RQ is greater than the LOC, it indicates that applications of flupyradifurone have the potential to cause adverse effects to non-target organisms when used as directed on the label.

Although risk is often described in terms of the likelihood and magnitude of adverse effects, the risk quotient-based approach does not provide a *quantitative* estimate of likelihood or magnitude of an adverse effect, but rather provides a "yes" or "no" answer depending upon whether or not LOCs are exceeded.

3. Analysis

3.1. Use Characterization

The registrant (Bayer CropScience) is seeking registration of several uses (described in **Table 4**) of flupyradifurone on two labels:

- Sivanto™ 200 SL (Sivanto) for use as a foliar and soil drench application to various agricultural crops.
- BYI 02960 480 FS (BYI 02960), a seed treatment insecticide for use on soybean seeds.

Both are liquid formulations. Sivanto is proposed for application to agricultural crops before bloom, during bloom, or following bloom up to the stated pre-harvest interval (PHI). Sivanto is proposed for application via ground, airblast, aerial, or chemigation equipment; BYI 02960 is proposed for application to soybean seeds via commercial seed treatment only.

Most uses have the same proposed maximum single and seasonal application rates of 0.18 lbs active ingredient per acre (lbs ai/A) and 0.37 lbs ai/A per season, respectively. A few crops (fruiting vegetables, cucurbit vegetables, citrus fruit, small fruit and vine climbing group) have both proposed maximum single and seasonal application rates of 0.37 lbs ai/A. The number of proposed seasonal or annual applications is not specified for any use, and retreatment intervals range from "not specified" to 10 days. The proposed labels include a maximum seasonal application rate and thus the maximum number of applications per season may be estimated by dividing the maximum seasonal application rate by the maximum single application rate.

Table 4. Proposed uses of flupyradifurone

Use Site	Single App. Rate in lbs. ai/A (kg ai/ha)	# of App	Seasonal App. Rate lbs. ai/A (kg ai/ha)	MRI (days)	PHI (days)	Geographic Restrictions	Comments
Crop Group 15: Cereal Grains (except Rice)	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	7	7 forage and sweet corn	--	foliar
					21 dried grain	--	
Cotton	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	10	14	--	foliar
Nongrass Animal Feeds (Forage, Fodder, Straw, Hay)	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	10	7 forage, silage, hay or seed of alfalfa	--	foliar
					14 all others	--	
Peanut	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	10	7	--	foliar
Root Vegetables (except Sugarbeet)	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	10	7	--	foliar
Tuberous and Corm Vegetables	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	7	7	West of MS river	
Leafy Vegetables (except *Brassica*)	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	7	1	--	foliar
Brassica (Cole) Leafy Vegetables	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	7	1	--	foliar
Legume Vegetables (Succulent or Dried)	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	10	7 forage, leaves, vines, pods, cutting for hay or seed	--	foliar
					21 dry soybean seed	--	foliar
Fruiting Vegetables	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	7	1	West of MS river	foliar
	0.27 – 0.37 (0.31 – 0.41)	NS	0.365 (0.409)	NS	45	--	soil, chemigation to root zone, injection below seed line, potting hole drench at transplanting, post-transplant drench following setting and covering
Cucurbit Vegetables	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	7	1	West of MS river	foliar

Use Site	Single App. Rate in lbs. ai/A (kg ai/ha)	# of App	Seasonal App. Rate lbs. ai/A (kg ai/ha)	MRI (days)	PHI (days)	Geographic Restrictions	Comments
	0.27 – 0.37 (0.31 – 0.41)	NS	0.365 (0.409)	7	21	--	soil, chemigation to root zone, injection below seed line, potting hole drench at transplanting, post-transplant drench following setting and covering
Hop	0.09 – 0.14 (0.10 - 0.15)	NS	0.14 (0.15)	NS	21	--	foliar
Citrus Fruit	0.27 – 0.37 (0.31 – 0.41)	NS	0.365 (0.409)	10	30	--	Soil, chemigation into root zone through low pressure drip, trickle, micro-sprinkler; basal drench in sufficient water to move into root zone
	0.09 - 0.18 (0.10 - 0.20)	NS		10	1	--	foliar
Pome Fruit	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	10	14	--	Foliar, combine with horticultural oil for early season applications targeting San Jose scale and Pear psylla
Bushberry	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	7	3	--	foliar
Low Growing Berry	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	10	0	--	foliar
Small Fruit Vine Climbing (except Fuzzy Kiwifruit)	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	10	0	--	foliar
	0.27 – 0.37 (0.31 – 0.41)	NS		NS	30	--	Soil, chemigation into root-zone through low pressure drip, trickle, micro-sprinkler or equivalent equipment; basal drench in sufficient water to move into root zone.
Tree Nut	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	14	7	--	foliar
Prickly Pear/Cactus pear	0.09 - 0.18 (0.10 - 0.20)	NS	0.365 (0.409)	14	7	--	foliar, ground only
Soybean Seeds	0.037 (0.041)	NA	0.365	NA	NS	--	Maximum single application rate calculated from label restriction of 0.068 mg ai/seed and an assumption of 250,000 seeds planted per acre which may occur in North Dakota (USEPA, 2011).

App=application; MRI=minimum retreatment interval; PHI=preharvest interval; NA=not applicable; NS=not specified; ai=active ingredient; A=acre

*Application limitations were on a single and seasonal application basis. It is possible that the chemical could be applied over multiple seasons to one field.

3.2. Exposure Characterization

3.2.1. Physical-Chemical Properties

Table 5 summarizes the identity information and physical-chemical properties of flupyradifurone. While flupyradifurone reportedly does not dissociate at environmentally relevant pH values, water solubility does decrease from 3200 mg/L at pH 4 and 7 to 3000 mg/L at pH 9. Based on its vapor pressure, water solubility, octanol-water partition coefficient (K_{OW}), and solid-water distribution coefficients (K_d), flupyradifurone is classified as non-volatile from water, moist soils, and dry surfaces (OPPTS Guideline 835.6100 classification system). Based on flupyradifurone's log K_{OW} value of 0.08, and log octanol-air partition coefficient (K_{OA}) values of 11, it is not likely to bioconcentrate in terrestrial organisms.[6] This conclusion is strengthened by the chemical's predicted reactivity in the vapor phase (estimated atmospheric decay half-life of 0.4 days, **Table 7)**. Compounds with log K_{OW} of three and above are generally considered to have the potential to bioconcentrate in aquatic organisms. Because flupyradifurone's log K_{OW} falls well below this at 0.08, it is not expected to bioconcentrate in aquatic organisms.

Table 5. Summary of physical-chemical properties of flupyradifurone[1]

<table>
<tr><th>Parameter</th><th colspan="3">Value and Units</th><th>Source and/or Comment</th></tr>
<tr><td>PC Code</td><td colspan="3">122304</td><td>--</td></tr>
<tr><td>CAS Number</td><td colspan="3">951659-40-8</td><td>--</td></tr>
<tr><td>SMILES Code</td><td colspan="3">C1=CC(=NC=C1CN(CC(F)F)C2=CC(OC2)=O)Cl</td><td>--</td></tr>
<tr><td>Chemical Name</td><td colspan="3">Flupyradifurone</td><td>--</td></tr>
<tr><td>Empirical Formula</td><td colspan="3">$C_{12}H_{11}ClF_2N_2O_2$</td><td>--</td></tr>
<tr><td>Molecular Weight</td><td colspan="3">288.68 g/mole</td><td>--</td></tr>
<tr><td>UV/Visible Absorption</td><td colspan="3">λ_{max} (nm): 213 and 259 nm</td><td>MRID 48843628</td></tr>
<tr><td rowspan="4">Water Solubility at 20°C (mg/L)</td><td>pH</td><td colspan="2">Solubility</td><td rowspan="4">MRID 48843644</td></tr>
<tr><td>4</td><td colspan="2">3200</td></tr>
<tr><td>7</td><td colspan="2">3200</td></tr>
<tr><td>9</td><td colspan="2">3000</td></tr>
<tr><td rowspan="4">Vapor Pressure</td><td rowspan="2">°C</td><td colspan="2">Vapor Pressure</td><td rowspan="4">MRID 48843650. Non-volatile under field conditions</td></tr>
<tr><td>Pascal</td><td>Torr</td></tr>
<tr><td>20</td><td>9.1×10^{-7}</td><td>6.8×10^{-9}</td></tr>
<tr><td>25</td><td>1.7×10^{-6}</td><td>1.3×10^{-8}</td></tr>
<tr><td>Henry's Law constant at 20°C</td><td colspan="3">8.1×10^{-13} atm-m^3/mol (pH 4 and 7)</td><td>Estimated from vapor pressure and water solubility at 20°C.</td></tr>
<tr><td>Log Dissociation Constant (pK_a)</td><td colspan="3">No dissociation between pH 1 -12</td><td>MRID 48843634. Not expected to ionize in natural waters</td></tr>
<tr><td>Octanol-water partition coefficient (K_{ow}) at 25°C</td><td colspan="3">1.2 (log K_{OW}=0.08) pH 4, 7, and 9</td><td>MRID 48843639. Not likely to bioconcentrate.</td></tr>
<tr><td>Air-water partition coefficient (K_{AW})</td><td colspan="3">3.3×10^{-11} (log K_{AW} = -11)</td><td>Estimated from vapor pressure and water solubility at 20°C and pH 7. Nonvolatile from water.</td></tr>
<tr><td>Octanol-air partition coefficient (K_{OA})</td><td colspan="3">3.6×10^{10} (log K_{OA} = 11)</td><td>Estimated from K_{AW} and K_{OW}.</td></tr>
</table>

[6] A recent scientific advisory panel (SAP) reported, "Gobas *et al.* (2003) concluded that chemicals with a log K_{OA} > 5 can biomagnify in terrestrial food chains if log K_{OW} >2 and the rate of chemical transformation is low. However, further proof is needed before accepting these limits without reservations" (SAP, 2009). This was also supported by Armitage and Gobas's work completed in 2007 (Armitage and Gobas, 2007).

Parameter	Value and Units	Source and/or Comment
Solubility in organic solvents	Methanol >250 g/L n-Heptane 0.0005 g/L Toluene 3.7 g/L Dichloromethane >250 g/L Acetone >250 g/L Ethylacetate >250 g/L Dimethyl sulfoxide >250 g/L	

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

3.2.2. Transformation Rates in Laboratory Studies

Table 7 summarizes abiotic and biotic transformation data. Study results indicate that flupyradifurone is persistent to very persistent[7] in soil, sediment and water. Measured aerobic soil DT_{50} (time interval where mass has declined by 50%) values of 38 to 401 days are uncertain because of high amounts (greater than 10% applied radioactivity) of unextracted residues which may or may not constitute residues of concern. Aerobic soil DT_{50} values calculated assuming that the unextracted residues constitute residues of concern range from 79 to 799 days and are approximately double those for parent alone. Flupyradifurone is stable to hydrolysis at pH 4, 7, and 9, though it does degrade via aqueous photolysis, with a DT_{50} of 2.5 days. Aqueous photolysis would be limited to surface waters that are shallow and clear. Under aerobic aquatic conditions, DT_{50} values ranged from 237 to 365 days for parent alone, and from 676 to 893 days for parent plus unextracted residues.[8] Estimated DT_{50} values for soil photolysis (1 soil), anaerobic soil metabolism (4 soils), and anaerobic aquatic metabolism (2 sediments) were all very high (*i.e.*, >391 days) or not quantifiable (*i.e.*, stable), indicating that these degradation pathways contribute little to the degradation of flupyradifurone. Based on graphical analysis and visual inspection, there was not a relationship between pH or percent organic carbon and degradation rates

Unextected residues were present at greater than 10% applied radioactivity (AR) in the aerobic soil and aerobic aquatic studies. They were also present at greater than 10% applied radioactivity in the anaerobic soil and anaerobic aquatic studies; however, the amount of unextracted residues were relatively constant after the system was anaerobic. In most studies, the extraction procedure involved shaking one time in each of the following solvent systems: 50:50 acetonitrile:water, 80:20 acetonitrile:water, and 100% acetonitrile. Finally, soils were extracted once in a microwave at 70°C with 80:20 acetonitrile:water. The extraction procedure did not include a range of polar and nonpolar solvents with a sufficient range of chemical properties. Therefore, it is uncertain whether all potentially available residues were extracted. There were different percentages of unextracted residues in studies with the same soil but with different radiolabels, indicating that a portion of the unextracted residues are likely degradates(s).

[7] According to the Toxic Release Inventory Classification System, chemicals with half-lives greater than 60-days are classified as persistent and chemicals with half-lives greater than 180 days are classified as very persistent (USEPA, 2012a).

[8] Unextracted residues in aerobic aquatic metabolism studies were greater than 10% applied radioactivity and it is uncertain whether the extraction procedures were sufficiently exhaustive.

However, it is unknown what portion may be degradate and what portion may be parent. Thus, degradation kinetics and risk were explored with assuming that the unextracted residues were parent and with assuming they were not a residue of concern.

Table 6. Maximum amount of unextracted residues observed in aerobic metabolism studies

Study (number of test systems)*	Maximum %AR associated with unextracted residues
Aerobic Soil (18)	12.7 – 33.8
Anaerobic Soil (5)	13.6 – 30.8
Aerobic Aquatic (6)	13.9 – 27.3
Anaerobic Aquatic (2)	5.4 – 12.0

*The number of test systems reflects the individual studies with different radiolabels.

Many of the decline curves were biphasic with an initial rapid rate of decline that slows as time passes. The curves where this occurred were generally described using the indeterminate order rate equation (IORE) and the double first order in parallel (DFOP) models and can be understood by considering both the DT_{50} and DT_{90} values. **Figure 1** gives an example of a biphasic decline curve. Half or the initial concentration declined over 59 days. This was followed by a 10% loss of flupyradifurone over the next 61 days. As shown in **Table 7**, the majority of decline curves for metabolism were biphasic.

EFED exposure models require first-order inputs for pesticide transformation processes even though pesticide transformations in soil and aquatic systems often do not follow a single exponential decline pattern. For this reason, the North American Free Trade Agreement (NAFTA) guidance introduced a "representative half-life (t_R)", to estimate a single first order (SFO) half-life for model input from a degradation curve that does not follow the SFO equation.[9] These values are shown in **Table 7**. The representative half-life considers both the initial and the slower portions of the decline curve and is not necessarily numerically similar to the value of the DT_{50}, rather it provides a conservative input value for modeling. The actual DT_{50} and DT_{90} from the representative degradation kinetic equations for the curve are used for descriptive purposes and understanding the decline curve and the representative half-life is used in modeling.

[9] http://www.epa.gov/oppefed1/ecorisk_ders/degradation_kinetics/NAFTA_Degradation_Kinetics.htm

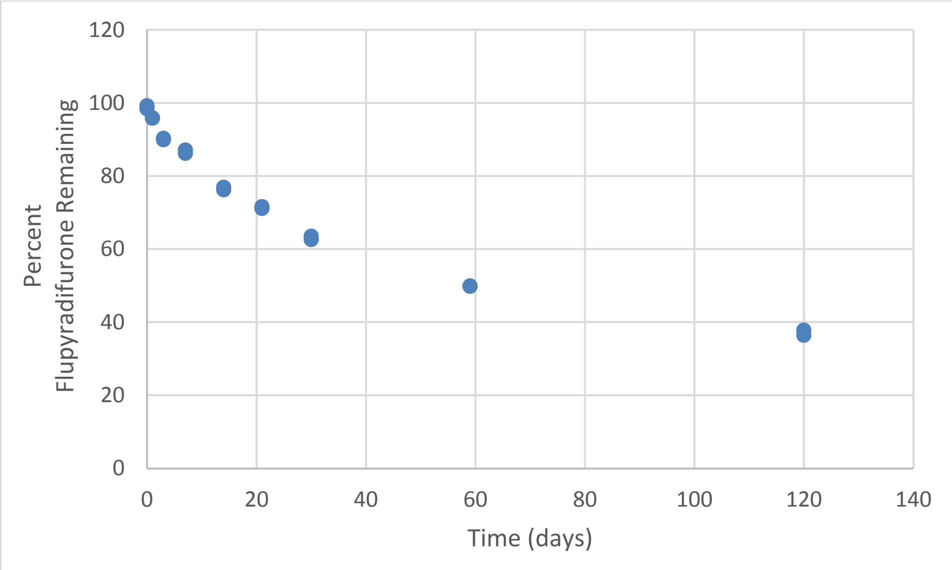


Figure 1. Example of a biphasic decline curve with an initial rapid rate of loss that slows over time
The curve shown is an aerobic soil metabolism study conducted on the German AX soil (MRID 48843674).

The DT_{50} for the Neossolo soil and parent flupyradifurone alone was determined using the DFOP model. However, the SFO model was used to describe the decline curve for residues of flupyradifurone plus unextracted residues. Because different equations were used, the DT_{50} and DT_{90} for parent plus unextracted residues were shorter than the DT_{50} and DT_{90} for parent alone. This is an artifact of the methodology used to select which equation is used to describe the decline curve and the tool used to fit the curves. In the Neossolo soil, the DFOP model did not regress correctly in the R program (*i.e.*, a negative values calculated for the slow rate) and the IORE results were very high resulting in a very high recommended representative model input half-life (T_{IORE}) of 7.12×10^7 days. Finally, 70% of residues were remaining at the end of the 120 day study. Therefore, the SFO model was chosen as the representative model for that soil. **Figure 2** shows the decline curve for this soil. While it is counterintuitive that the DT_{50} and DT_{90} are shorter for parent plus unextracted residues, the overall the value is the result for one soil. When calculating the input parameters for modeling, results from all 10 soils were used and the estimated model input value for both flupyradifurone alone and flupyradifurone plus unextracted residues is conservative.

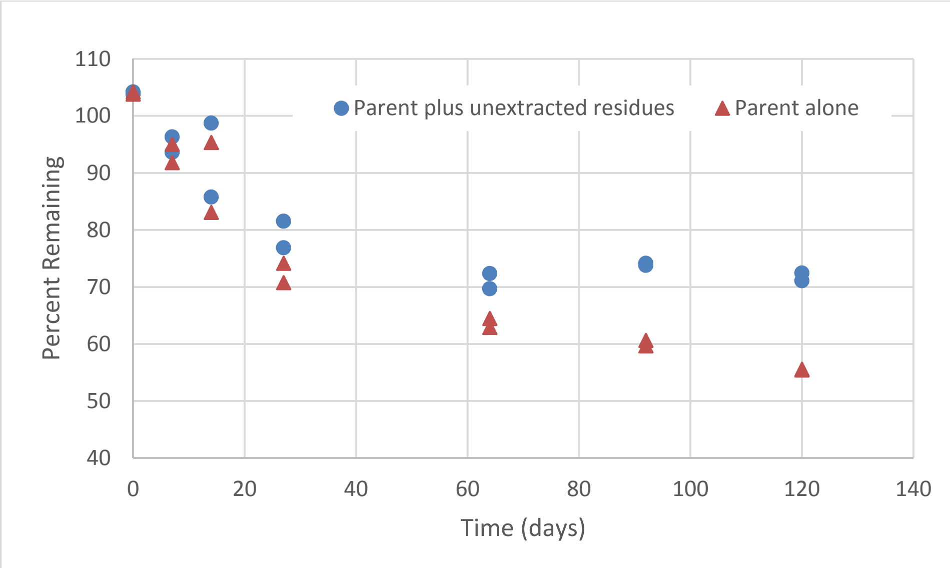


Figure 2. Decline curve for aerobic soil metabolism in the Neosolo soil

A similar situation occurred in the aerobic aquatic metabolism study with sediment from a German gravel pit. In this case, all of the equations converged appropriately and the equation recommended using the NAFTA procedure was used to characterize degradation kinetics. Again, the important thing is that both selected values are reasonable based on available data and the model input chosen to represent aerobic aquatic metabolism is conservative.

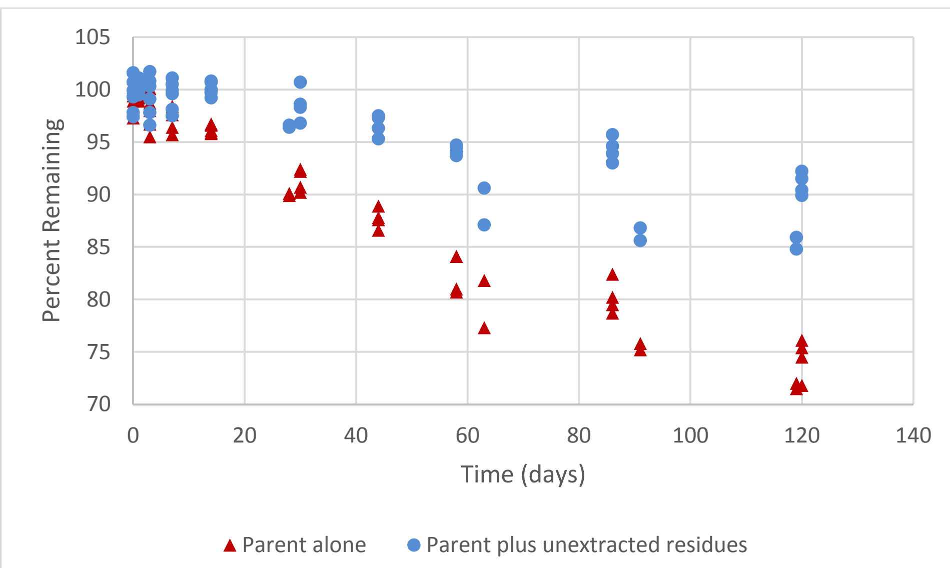


Figure 3. Decline curve for aerobic aquatic metabolism in the German gravel pit sediment

Table 7. Abiotic and biotic transformation kinetics of flupyradifurone, flupyradifurone plus M48 plus M47, and flupyradifurone plus unextracted residues.

Study	System Details (Kinetic Equation)	Kinetic Equation Fitted[1] Value[1] DT50 (days)	DT90 (days)	Representative Half-life to Derive Model Input (days)[2]	Reference Or (MRID), Study Classification[3] And Comments
Hydrolysis (50°C)	pH 4	No significant degradation		Stable	MRID 48843667, Fully Reliable
	pH 7				
	pH 9				
Atmospheric Degradation	Hydroxyl Radical (SFO)	0.4	NA	Not applicable	Estimated using EPIWEB v.4.1 for 12-hour day, $1.5x10^{6}$ OH- molecules/cm^3. Flupyradifurone is not expected to undergo long range transport in the vapor phase.
Aqueous Photolysis (25°C)	pH 7 Sterile 40°N sunlight (SFO, SFO**)	2.5 13.0**	8.2 43.2**	2.5 13.0**	MRID 48843669, Fully reliable. Corrected for 40°N latitude. Furanone ring labeled.
	pH 8 Natural water 40°N sunlight (SFO, SFO**)	2.5 9.6**	8.4 31.9**	2.5 9.3**	MRID 48843670, Fully reliable. Corrected for 40°N latitude. Furanone ring labeled.
Soil Photolysis	CA loam pH 6.5, 20°C (SFO)	449	1495	Not applicable	MRID 48843672, Fully reliable. Soil photolysis is of minor importance for the degradation of BYI 02960 under outdoor conditions and a major phototransformation product is not expected.
Aerobic Soil Metabolism (20°C)	German AX pH 6.8, 1.2% OC (DFOP, DFOP*)	62.9 169*	468 767*	178 258*	MRIDs 48843674, 48843676, 48843677, 48843679, 48843681, 48843682, 48843683. Reliable with restrictions. Results are shown for combined study results for the German and U.S. soils. The furanone label soils had a higher percentage of unextracted residues than the other labels. The differences suggest that at least some of the unextracted residues are degradate. The German DD soil had some divergence in the results for different labels, DT_{50} ranged from 34 to 56 days for the individual studies.
	German HF pH 7.0, 1.8%OC (IORE, IORE*)	37.5 78.8*	260 1292*	78.4 389*	
	German HN pH 5.9, 2.3%OC (DFOP, DFOP*)	112 303*	562 1100*	194 343*	
	German DD pH 7.7, 4.6%OC (IORE, IORE*)	45.4 96.7*	249 1510*	75 455*	
	NE silt loam pH 6.7, 2.3%OC (DFOP, SFO*)	215 355*	743 1179*	227 355*	
	CA sandy loam pH 7.4, 0.57%OC (IORE, IORE*)	56.6 173*	378 3139*	114 945*	
	Argissolo pH 6.0, 2.8 %OC (SFO, SFO*)	202 296*	671 982*	202 296*	
	Latossolo pH 5.2, 1.8 %OC (DFOP, SFO*)	134 291*	364 966*	97.9 291*	

Study	System Details (Kinetic Equation)	Kinetic Equation Fitted[1] Value[1]		Representative Half-life to Derive Model Input (days)[2]	Reference Or (MRID), Study Classification[3] And Comments
		DT_{50} (days)	DT_{90} (days)		
	Neossolo pH 4.9, 0.21%OC (DFOP, SFO*)	170 221*	1293 734*	484 221*	
	Gleissolo pH 4.1, %OC 7.8 (SFO, SFO*)	401 799*	1331 2655*	401 799*	
Anaerobic Soil Metabolism (20ºC)	German HF soil pH 6.4, %OC 2.7 (DFOP, SFO*)	632 3793*	2098 12601*	711 3793*	MRID 48843686. Reliable with restrictions. Dissolved oxygen concentrations were near 1 mg/L at some time points. Unextracted residues exceeded 10%AR but were relatively constant post flood. An overall DFOP DT_{50} and DT_{90} are not available for parent only. The values shown are the results for the SFO model.
	Sanger, CA pH 7.2, %OC 0.45 (SFO)	392	1303	392	MRID 48843687. Reliable with restrictions. Oxygen concentrations were near 1 mg/L at some time points after flooding but redox conditions were appropriate days 30-121 post flood. Unextracted residues were greater than 10%AR but were relatively constant during the anaerobic phase.
	NE soil pH 6.7, %OC 1.9	Essentially stable over 30 days			MRID 48843688. Reliable with restrictions. Study terminated 60 days after flooding. No loss over 30 days of appropriate redox conditions.
Aerobic Aquatic (20ºC)	German pond HW pH 7.4, 3.59 %OC 20ºC (IORE, SFO*)	237 893*	1818 2965*	547 893*	MRID 48843690 and 48843692. Reliable with restrictions due to presence of unextracted residues at greater than 10%AR. Results are shown for combined study results.
	German gravel pit (AW) pH 7.0, 1.20 %OC 20ºC (IORE, SFO*)	365 676*	5793 2247*	1740 676*	
Anaerobic Aquatic (24ºC)	KS pond Water: pH 8.3, 7.8% OC (SFO)	1999 Stable*	6640 Stable*	1999 Stable*	MRID 48843689. Reliable with restrictions. Up to 12%AR present as unextracted residues in NC system and it is uncertainty whether the extraction procedure was sufficiently exhaustive.
	NC pond Water: pH 7.4, 11.9%OC (SFO, SFO*)	416 2470*	1381 8204*	416 2470*	

AR=applied radioactivity; OC=organic carbon; DT_X=time for concentration/mass to decline by X percentage; SFO=single first order; DFOP=double first order in parallel; IORE=indeterminate order (IORE); SFO DT_{50}=single first order half-life; T_{IORE}=the half-life of a SFO model that passes through a hypothetical DT_{90} of the IORE fit; DFOP slow DT_{50}=slow rate half-life of the DFOP fit, NA=not available, AR=applied radioactivity

* Value calculated for parent and unextracted residues which may or may not be parent. These values are relevant in understanding the uncertainty in data due to unextracted residues.

** Value calculated for parent plus M47 plus M48.

1 DT_{50} and DT_{90} values were calculated using nonlinear regression and SFO, DFOP, or IORE equations. The

equations can be found in the document, *Standard Operating Procedure for Using the NAFTA Guidance to Calculate Representative Half-life Values and Characterizing Pesticide Degradation* (USEPA, 2012b).
[2] The value used to estimate a model input value is the calculated SFO DT_{50}, T_{IORE}, or the DFOP slow DT_{50} from the DFOP equation. The model chosen is consistent with that recommended using the, *Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media (NAFTA, 2012).* The same kinetic equation used to determine the representative model input value was used to describe the DT_{50} and DT_{90} results based on standard kinetic equations.
[3] See **Appendix J** for a comparison of OPP and OECD classification systems. OECD classifications were used because the monograph was harmonized with other countries.

Four degradates were present in one or more fate studies at greater than 10% of applied radioactivity (AR):

- 6-chloronicotinic acid (6-CNA)[10],
- difluoroacetic acid (DFA),
- BYI 02960-succinamide (M48), and
- BYI 02960-azabicyclosuccinamide (M47).

Table 8 summarizes available degradation studies for 6-CNA and DFA; 6-CNA is degraded rapidly in three aerobic soil systems (DT_{50} ranged from 3 to 7 days). The degradate DFA was persistent to very persistent in two aerobic aquatic systems (DT_{50} ranged from 121 to 951 days). More information on the amount formed and sorption of these degradates is available in other sections. Degradation studies were not conducted with M47 and M48; however, they were detected at maximum amounts at the end of the aqueous photolysis study. This suggests that M47 and M48 have the potential to be persistent in aqueous environments.

Table 8. Biotic degradation kinetics for 6CNA and DFA

Study	System Details (Kinetic Equation)	DT_{50} (days)	DT_{90} (days)	Representative Half-life to Derive Model Input (days)[2]	Reference Or (MRID), Study Classification
Aerobic Soil Metabolism – 6CNA	UK sandy loam, 20°C pH 6.7, 3.1%OC (IORE)	3.5	8.6	2.6	MRID 44651882. Reliable with restrictions.
	UK clay, 20°C pH 7.8, 3.8%OC (IORE)	2.7	7.1	2.1	
	UK loam, 20°C pH 7.2, 2.9%OC (IORE)	6.5	13.2	4.0	
Aerobic Aquatic Metabolism - DFA	German pond HW, 20°C pH 7.4, 3.59 %OC (SFO, SFO*)	121 226*	403 752*	121 226*	MRID 48843691. Reliable with restrictions. Unextracted residues were less than 10%AR in the AW system and 16% in the HW system, except for an outlier presumed due to experimental error. There was one outlier at the same sampling point in both systems that resulted in high mass balances.
	German gravel pit (AW), 20°C pH 7.0, 1.20 %OC (SFO)	951	3159	951	

[10] 6-chloronicotinic acid is a degradate for flupyradifurone, acetamiprid, and imidacloprid.

OC=organic carbon; DT_{50}=time for concentration/mass to decline by 50%; SFO=single first order; DFOP=double first order in parallel; IORE=indeterminate order (IORE)
* Value calculated for parent and unextracted residues which may or may not be parent. These values are relevant in understanding the uncertainty in data due to unextracted residues.
[1] DT_{50} values were calculated using nonlinear regression and SFO, DFOP, or IORE equations. The equations can be found in the document, *Standard Operating Procedure for Using the NAFTA Guidance to Calculate Representative Half-life Values and Characterizing Pesticide Degradation* (USEPA, 2012b).
[2] The value used to estimate a model input value is the calculated SFO DT_{50}, T_{IORE}, or the DFOP slow DT_{50} from the DFOP equation. The model chosen is consistent with that recommended using the, *Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media (NAFTA, 2012)*. The same kinetic equation used to determine the representative model input value was used to describe the DT_{50} and DT_{90} results based on standard kinetic equations.

3.2.3. Sorption and Mobility

Unlike degradation, study results indicate that soil sorption of flupyradifurone is influenced by percent organic carbon (**Table 9**). Nevertheless, based on organic-carbon water normalized soil-water distribution coefficients (K_{oc}) ranging from 80 to 283 L/kg-organic carbon (measured in 10 soils), flupyradifurone is classified as mobile to moderately mobile (FAO, 2000) (MRID 48843662, 48843663, 48843664). Flupyradifurone therefore has the potential to move with runoff, and/or to infiltrate the soil and leach into groundwater. The aquatic field dissipation results indicate that most flupyradifurone residues will not be quickly transported into sediment and sediment pore water; however, some residues will occur in sediment. While K_{oc} values indicate that flupyradifurone has a higher affinity for organic matter than water, they are well below 1000 L/kg. In most aquatic environments, a greater percentage of flupyradifurone is expected to be present in the water column as compared to sediment.

The degradate, 6-CNA, is mobile to moderately mobile, with K_{oc} values ranging from 17.2 to 134 L/kg in five soils and one sediment (FAO, 2000) (MRID 44651884). DFA is highly mobile, with K_{oc} values ranging from 1.55 to 8.75 L/kg in five soils (FAO, 2000) (MRID 48843665). Both 6-CNA and DFA thus also have the potential to runoff or leach to groundwater. Sorption data are not available for M47 or M48.

Table 9. Summary of submitted sorption studies for flupyradifurone and its degradates 2-chloronicotinic acid (6CNA), and difluoroacetic acid (DFA)

Soil texture Source	% OC	soil pH	Regressed K_d (L/kg-soil)	K_{OC} (L/kg-OC)	K_F (mg/L)(mg/kg)$^{-1/n}$	1/n	K_{FOC} (mg/L) (mg/kg)$^{-1/n}$
Parent, 20ºC, MRID 48843662, Fully Reliable							
Sandy loam AX, Germany	2.1	6.2	2.193	104.4	2.077	0.8445	98.9
Loam HF, Germany	2.4	6.6	2.353	98.05	2.213	0.8682	92.2
Loam HN, Germany	2.2	5.3	2.506	113.9	2.354	0.8643	107.0
Loam DD, Germany	5.1	7.2	4.118	80.74	3.822	0.8648	74.9
Parent, 20ºC, MRID 48843663, Fully Reliable							
Sandy loam California	0.7	6.8	0.627	89.5	0.597	0.9021	85.2
Silt loam,	1.9	6.5	2.824	148.6	2.512	0.8505	132.2

Soil texture Source	% OC	soil pH	Regressed K_d (L/kg-soil)	K_{OC} (L/kg-OC)	K_F (mg/L)(mg/kg)$^{-1/n}$	1/n	K_{FOC} (mg/L) (mg/kg)$^{-1/n}$
Nebraska							
Parent, 20ºC, MRID 48843664, Fully Reliable							
Clay, Argissolo, Brazil	2.8	5.66	7.104	254	6.7	0.8153	241
Clay,Latossolo, Brazil	1.7	4.59	1.462	86	1.5	0.9263	86
Loamy sand, Neossolo, Brazil	0.5	4.93	0.563	113	0.6	0.9246	115
Silty clay loam, Gleissolo, Brazil	7.8	3.51	22.07	283	21.1	0.8317	270
2-chloronicotinic acid, MRID 44651884, Fully Reliable							
Loamy sand 1 NC	0.25	4.4	0.335	134	0.377	0.803	151
Loamy sand 2 NC	1.5	6.2	0.863	57.6	0.818	1.11	54.5
Silt loam MS	0.44	6.6	0.244	55.4	0.274	0.808	62.3
Clay MS	0.82	7.5	0.205	17.2	0.21	0.96	17.6
Clay loam CA	1.2	8.3	0.168	20.5	0.191	0.794	23.3
Sandy loam sediment NC	2.5	5.6	1.64	65.7	1.8	0.762	72.1
DFA, MRID 48843665, Fully Reliable							
Silt loam HF Germany	2.4	6.5	0.210	8.75	0.229	0.910	9.53
Loam HN Germany	2.9	5.8	0.211	7.27	0.230	0.816	7.94
Clay loam DD Germany	4.5	7.4	0.361	8.03	0.372	0.964	8.26
Sandy loam CA	0.5	6.0	0.030	6.05	0.034	0.703	6.83
Silty clay loam NE	1.7	6.5	0.026	1.55	0.025	0.719	1.46

NR=not reported

3.2.4. Field Dissipation

Several terrestrial field dissipation studies have been completed for flupyradifurone (**Table 10**). Studies were all completed on bare ground sites in the United States (California, Florida, and Idaho), Canada (Ontario, Prince Edward Island, and Saskatchewan) and Europe (Germany, Italy, United Kingdom, and Spain). The application rate at each North American site was a single application of 0.6 kg ai/ha (0.54 lbs ai/A). This is higher than the highest proposed single application rate of 0.41 kg ai/ha (0.37 lbs ai/A) in the United States. For each of the European sites, the application rate was 0.25 kg ai/ha (0.22 lbs ai/A). The study completed for the European sites did not have an independent laboratory validation (ILV) and consequently the levels detected and study conclusions are not considered fully reliable. However, available information suggests that other than this, the analytical chemistry method was acceptable. Values of DT_{50} for flupyradifurone and for the whole soil profile ranged from 8 to 310 days. Time to 90% loss (DT_{90} value) values for flupyradifurone ranged from 205 to greater than 1000 days. The difference between the DT_{50} and DT_{90} show that there was an initial fast rate of dissipation in the first few months followed by a slow rate of dissipation. This is consistent with the results observed in the laboratory aerobic soil metabolism studies. As you can see in **Figure 4**, the dissipation of flupyradifurone slowed down substantially after 50 days.

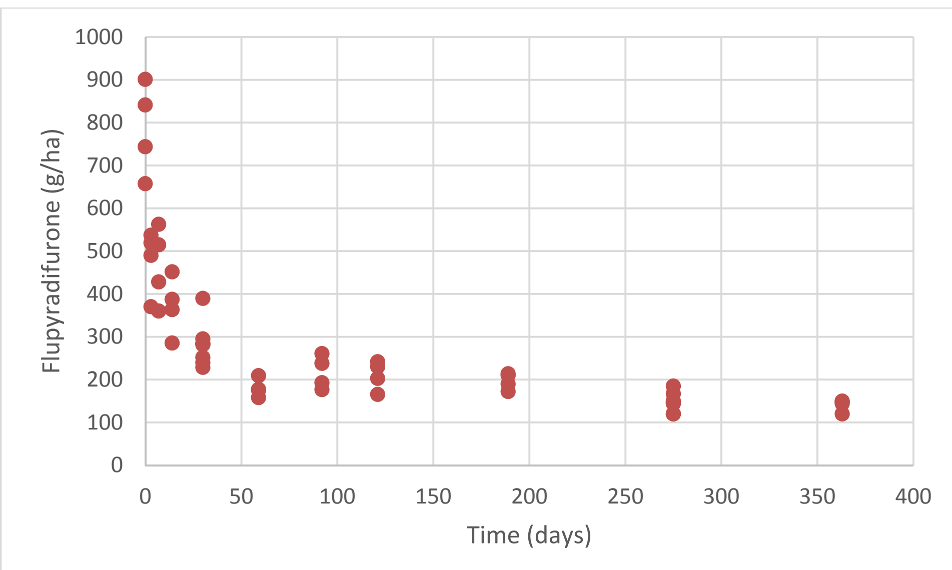


Figure 4. Flupyradifurone dissipation in the terrestrial field dissipation study completed in Florida

At all sites most residues (flupyradifurone and degradates) were observed in the top 15 cm; however, a small portion of flupyradifurone was observed up to a depth of 40 cm. Field sites varied in percent organic matter (range from 0.8 to 4.4%OM), soil properties, and pH (range from 5.5 to 8.2) and based on graphical analysis, there was not a relationship between DT_{50} values for flupyradifurone and pH or %OM. Carryover of flupyradifurone at the end of the sampling period ranged from 8 to 59% applied flupyradifurone, indicating that a portion of applied flupyradifurone does have the potential to build up in soil with subsequent applications from year to year. Two of the major degradates observed in laboratory studies, 6-CNA and DFA, were also observed in the field studies; degradates M47 and M48 were not evaluated in the field dissipation studies. Based on available data, the DT_{50} and DT_{90} observed in terrestrial field dissipation studies is likely due to a combination of leaching (based on the flupyradifurone being mobile to moderately mobile) and degradation (shown by the presence of degradates and observed degradation in laboratory studies). As the studies were conducted on bare ground, these results do not reflect dissipation on a cropped plot. Foliar interception and uptake would likely contribute substantially to dissipation of flupyradifurone in a cropped plot.

Table 10. Summary of terrestrial field dissipation study results for flupyradifurone

MRID (Year)	Study Site, Crop Application Rate Formulation	% Parent remaining at final sampling interval (Days)	DT_{50} (days)	DT_{90} (days)	Average Max Conc in Soil (µg/kg-soil) Max Depth detected (cm)			Comments
					Parent	DFA	6CNA	
48843693 (2012)	Tulare Co. California, USA pH 8.2, 0.9 %OM	28 (272)	55.9[+]	767[+]	200.6 30	12.4 60*	5.6 15	Reliable with restrictions. No cropped plots. All plots were bare ground and used a flowable formulation.
48843694 (2012)	Jefferson Co. Florida, USA pH 6.5, 0.8%OM	19 (275)	9.62[+]	577[+]	304.5 15	8.2 15	5.2 15	
48843695 (2012)	Blaine Co. Idaho, USA pH 8.0, 1.4%OM	30 (280)	45.6[+]	566[+]	416.5 30	5.0 106*	10.8 15	
48843696 (2012)	Ontario CANADA pH 7.0, 4.4%OM	25 (337)	99.6[+]	751[+]	275.2 30	10.9 30*	3.8 15	
	Prince-Edward-Island CANADA pH NA, 3.6%OM	33 (345)	87.8[+]	897[+]	220.2 30	8.0 30*	4.8 15	
	Saskatchewan CANADA pH 7.6, 2.5%OM	59 (337)	304[#]	1.4×10^{4}[#]	238.5 30	4.7 15	2.1 15	
48843697 (2011)	Monheim, Germany pH 6.3, 1.2%OM	27 (354)	38.4[+]	743[+]	236.6 30	11.2 30	NA	Reliable with restrictions. Missing ILV but available information suggests methods were acceptable. Application rate (250 g ai/ha) much lower than maximum proposed rate. All plots were bare ground and used a flowable formulation.
	Great Chishill, United Kingdom pH 5.8, 2.2%OC	45 (394)	310[+]	4651[+]	235.9 30	7.2 20	NA	
	Burscheid, Germany pH 6.3, 0.9%OC	22 (357)	42.0[+]	476[+]	244.9 30	10.1 30	NA	
	Albaro, Italy pH 7.4, 1.3%OC	8 (360)	8.3[+]	278[+]	267.5 30	8.7 30	NA	
	Vilobi d'Onyar, Spain pH 5.9, 0.7%OC	9 (357)	27.7[#]	205[#]	239.6 40	6.1 20	NA	

MRID (Year)	Study Site, Crop Application Rate Formulation	% Parent remaining at final sampling interval (Days)	DT_{50} (days)	DT_{90} (days)	Average Max Conc in Soil (µg/kg-soil) Max Depth detected (cm)			Comments
					Parent	DFA	6CNA	
	Hanscheider Hof, Germany pH 5.5, 1.5%OC	19 (357)	40.8#	477#	252.9 20	13.5 30	NA	

NA=not analyzed, ILV=independent laboratory validation, OC=organic carbon, OM=organic matter; Conc=concentration
*Detected below the LOQ at the depth.
+ The DFOP equation was used to calculate dissipation kinetics.
# The IORE equation was used to calculate dissipation kinetics.

A study was also conducted examining dissipation of flupyradifurone in water and sediment in four outdoor microcosms spiked at two different concentrations (10 and 100 µg/L). Dissipation half-lives are summarized in **Table 11**. The DT_{50} values in the water and whole system ranged from 64 to 109 days and DT_{90} values ranged from 212 to 363 days. Concentrations of transformation products were not followed in the study. Two to 11% of applied material was observed in sediment. Overall, this indicates that most flupyradifurone residues will be observed in the water column but exposure may also occur in sediment. Degradation rates in the sediment could not be determined because concentrations in the sediment continued to increase over the duration of the study. This indicates transfer from the water column was occurring at a greater rate than transformation in sediments over this period. These results are consistent with the persistence observed in the laboratory sediments. Finally, regardless of the initial exposure concentration, dissipation rates were relatively similar.

Table 11. Summary of DT_{50} and DT_{90} of flupyradifurone in outdoor microcosm studies (MRID 48843673)

Nominal Test Concentration µg/L	Water Phase		Whole System	
	DT_{50} (days)	DT_{90} (days)	DT_{50} (days)	DT_{90} (days)
10	63.9	212	74.0	246
100	95.0	316	109	363

3.2.5. Transformation Products of Toxicological and Exposure Concern

As discussed in Section 3.2.2, the following four transformation products were measured in environmental fate studies at 10% or greater of applied radioactivity: 6-CNA, DFA, M48, and M47.

The following three transformation products were also measured in environmental fate studies, at less than 10% of applied radioactivity:

- BYI 02960-deschlorohydroxysuccinamide (DCHS);
- BYI 02960-des-difluoroethyl (M19); and,
- BYI 02960-chloro (M01).

Finally, BYI 02960-difluoro-ethylamino-furanone (DFEAF) was observed in studies conducted to evaluate residues in flowers, pollen, and nectar after drench and foliar applications to different commodity crops that are potentially of use for refining exposure if initial screening-level risk estimates exceed LOCs for honeybees. DFEAF was also observed in the plant metabolism studies submitted to the Health Effects Division.

IUPAC names, molecular weights, formula's, and SMILES codes are available for these compounds in the document titled, *Data on Flupyradifurone and Its Environmental Transformation Products in Support of the ROCKs* (USEPA, 2013, D415161) .

Figure 5 shows potential degradation pathways of flupyradifurone based on chemical structures and observed transformation products in various studies.

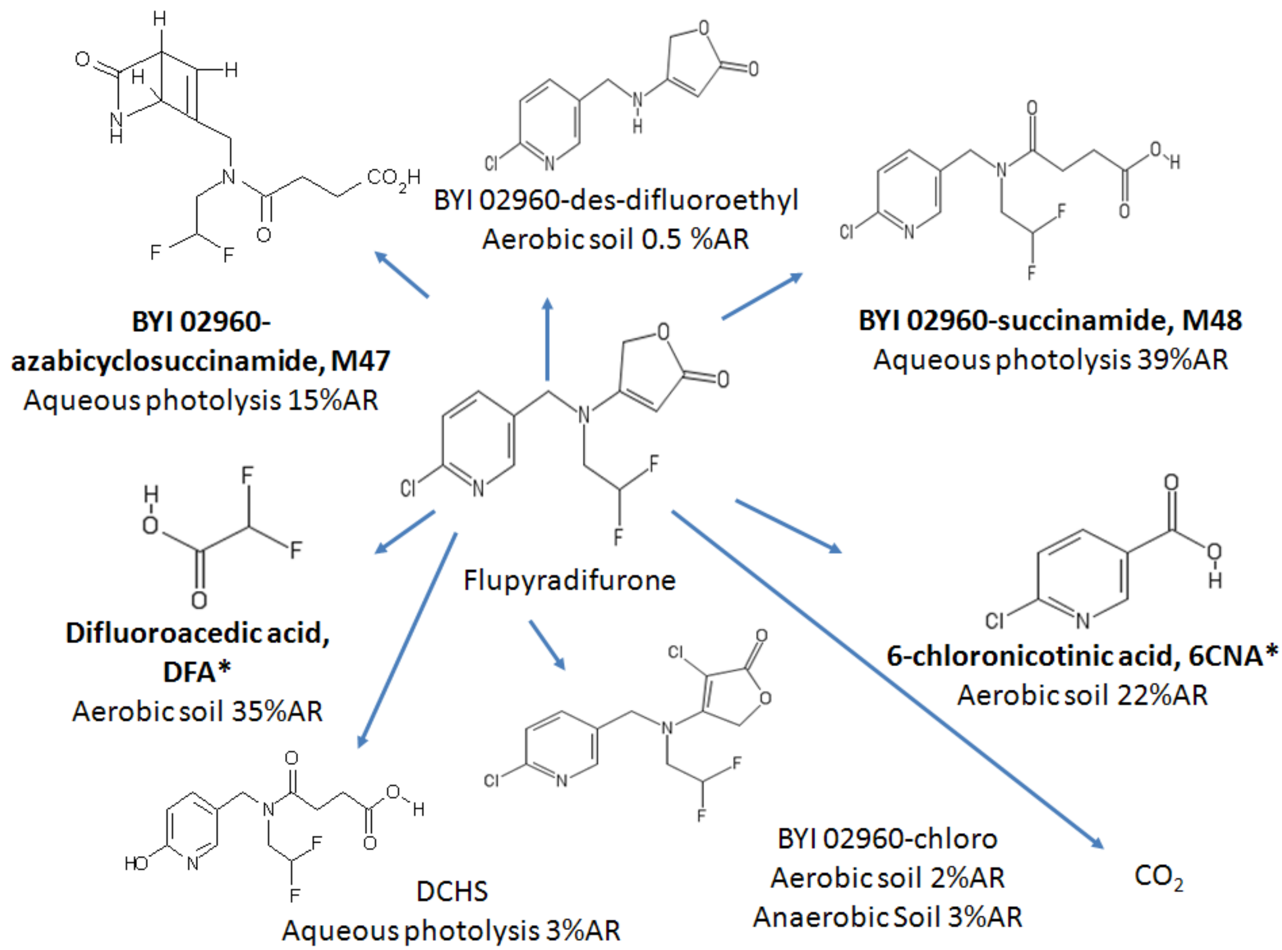


Figure 5. Potential degradation pathways of flupyradifurone
Bolded values were present at greater than 10% of applied radioactivity and the asterisk indicates the compound was observed in a field study. Abbreviations are defined in text above figure.

Table 12 shows the maximum percent applied radioactivity for each identified transformation product and corresponding study type. The transformation products DFA and 6-CNA were observed in aerobic environments, especially soils, while M48 and M47 were present in aqueous photolysis studies. All other transformation products were present at less than 10% applied radioactivity. There is some uncertainty as to whether additional major transformation products would have been identified had the unextracted residues been characterized (which is why the unextracted residues have been included in the modeling runs). Often the maximum amount of AR associated with a degradate was observed at the final sampling interval. This indicates that the maximum amount of degradate that could form may not have been observed or captured during the study. The transformation products evaluated in field studies were DFA and 6-CNA and they were observed at less than 15 µg/kg-soil, at concentrations much lower than flupyradifurone concentrations (maximum of 416 µg/kg-soil).

Table 12. Summary of maximum amount of transformation products observed in fate studies

Compound	Maximum % of Applied Radioactivity Associated with Degradate (Time of Peak) Amount Detected at Final Sampling Interval in Corresponding Study							
	Hydrolysis	**Soil Photolysis**	**Aerobic Soil**	**Anaerobic Soil**	**Aqueous Photolysis**	**Aerobic Aquatic**	**Anaerobic Aquatic**	**Observed in Field Dissipation**
DFA	NE	NE	35 (48d) 24 (117d)	27 (37d) 27 (153d)	NE	NE	NE	Yes
6-CNA	NE	NE	22 (64d) 6.2 (120d)	15 (14d) 13 (121d)	NE	NE	NE	Yes
M48 (succinamide)	NE	NE	NE	NE	39 (35hr)[a]	NE	NE	NA
M47 (azabicyclosuccinamide)	NE	NE	NE	NE	15 (28hr)[a]	NE	NE	NEA
BYI 02960-des-difluoroethyl	NE	NE	0.5 (59d) ND (120d)	NE	NE	NE	NE	NE
BYI 02960-chloro	NE	NE	1.8 (120d)[a]	2.8 (59d) 2.4 (121d)	NE	NE	NE	NE
DCHS	NE	NE	NE	NA	2.8 (35hr)[a]	NE	NE	NE
Unextracted Residues	NE	1.1(4d) 0.7 (8d)	34 (120d)[a]	31 (120d) 30 (123d)	NE	27 (120d)[a]	12 (102d)[a]	NE
CO_2	NE	2.3 (8d)	59 (120d)[a]	27	ND	9 (119d)[a]	0.1(102d)[a]	NE

NE=not evaluated; ND=not detected

[a] Peak at final sampling interval in some studies.

[b] In some aerobic soil metabolism studies, significant mineralization occurred while in others minimal mineralization occurred (max CO_2 in one soil was 4% of AR).

Residues of concern are chosen based on available toxicity data for parent and degradates (see Section 3.5 for a discussion of toxicity data and **Appendix I** for summary information of toxicity data of parent and degradates) and structural similarity to the parent or to other structures of known toxicity concern. Based on the available ecotoxicity data, none of the transformation products of flupyradifurone tested appear to be more toxic than the parent to freshwater fish (rainbow trout, *Onchorhynchus mykiss*), freshwater aquatic invertebrates (*Daphnia magna;* non-biting midges, *Chironomus spp.*), terrestrial invertebrates (honeybees, *Apis mellifera*; earthworms, *Eisenia fetida*) and freshwater aquatic algae (green algae; *Pseudokirchneriella subcapitata*). However, in some cases, toxicity studies with transformation products were not carried out at high enough concentrations to definitively conclude that they are not of equal or greater toxicity to the organisms tested as compared to the parent compound.

HED data on degradates indicates that degradates are less toxic than the parent. There is one exception for DFA. When comparing the NOAEL and LOAEL for DFA for a study to a similar 90-day oral study with the parent compound (MRID 48844111; NOAEL and LOAEL of 38 and 156 mg/kg bw, respectively), on a molar basis, the NOAELs and LOAELs of DFA and the parent are comparable, however, the effects are different. Therefore, DFA was considered a residue of concern for risk to mammals. See the Section 3.5 for more discussion on the toxicity of DFA.

DFEAF residues made up 10% applied radioactivity or less in plant metabolism studies, and given the low acute toxicity of DFEAF to honeybees, they are not considered a residues of concern.

3.3. Aquatic Exposure

3.3.1. Input Parameters

As aquatic EECs were anticipated to exceed ecological LOCs based on the reduced risk analysis (USEPA, 2013, D408685), the SWCC (Tier II modeling) was used to estimate EECs in surface water. Groundwater EECs for evaluation of residues of flupyradifurone in groundwater-derived irrigation water were generated using SCI-GROW and PRZM-GW. EECs were generated based on maximum labeled use rates (**Table 4**), and fate input parameters (**Table 8** and **Table 9**) selected in accordance with EFED's guidance documents:

- Guidance for *Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides*, Version 2.1[11] (USEPA, 2009),
- *Guidance for Selecting Input Parameters for Modeling Pesticide Concentrations in Groundwater Using the Pesticide Root Zone Model*, Version 1 (USEPA and Health Canada, 2013),
- *Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media*[12] (NAFTA, 2012; USEPA, 2012b), and
- *Guidance on Modeling Offsite Deposition of Pesticides Via Spray Drift for Ecological and Drinking Water Assessment*[13] (USEPA, 2013b)

Summaries of the model input parameter values used in SCI-GROW, PRZM-GW, and SWCC are presented in **Table 16**, **Table 17**, and **Table 18**, respectively.

Sorption Coefficients

Coefficients of variations (CV) were lower for organic carbon normalized solid-water distribution coefficients (K_{OC}; CV=53%) as compared to solid-water distribution coefficients (K_d; CV=140%). Therefore, and consistent with the input parameter guidance, the mean K_{oc} (137 L/kg-OC) was used to estimate flupyradifurone concentrations with PRZM-GW and the SWCC, and the median K_{oc} (109 L/kg-oc) was used to estimate groundwater concentrations with

[11] http://www.epa.gov/oppefed1/models/water/input_parameter_guidance.htm (accessed April 11, 2014)
[12] http://www.epa.gov/oppfead1/international/naftatwg/guidance/degradation-kin.pdf (accessed April 11, 2014)
[13] http://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPP-2013-0676 (accessed April 11, 2014)

SCI-GROW.

Aerobic Soil Metabolism

The aerobic soil metabolism input value used in PRZM-GW and the SWCC was calculated as the 90 percent upper confidence limit on the mean of ten representative half-life values. The aerobic soil metabolism input value used in SCI-GROW was the median of the same representative half-life values. Consistent with the input parameter guidance, the representative half-life for PRZM-GW was adjusted to a temperature of 25ºC (USEPA and Health Canada, 2012). Temperature adjustments were not completed for inputs to the SWCC; however, the temperature that the studies were conducted at were input into the SWCC. The temperature simulation option was not selected.

Aerobic Aquatic Metabolism

The aerobic aquatic metabolism input value used in the SWCC was calculated as the 90 percent upper confidence limit on the mean of two representative half-life values. The temperatures that the studies were conducted at were inputs for the SWCC. Temperature adjustments for aerobic and anaerobic aquatic metabolism are automatically simulated in the SWCC.

Anaerobic Aquatic Metabolism

The anaerobic aquatic metabolism input value used in the SWCC was calculated as the 90 percent upper confidence limit on the mean of two representative half-life values for residues of parent alone; stability was assumed for residues of parent plus unextracted residues. The temperatures that the studies were conducted at were inputs for the SWCC. Temperature adjustments for aerobic and anaerobic aquatic metabolism are automatically simulated in the SWCC.

Scenarios and Application Dates Chosen for SWCC modeling

Scenarios are used to specify soil, climatic, and agronomic inputs in PRZM (a component of the SWCC), and are intended to represent runoff-vulnerable soil conditions that result in high-end water concentrations associated with a particular crop and pesticide within a geographic region. Each PRZM scenario is specific to a location. Soil and agronomic data specific to the location are built into the scenario, and a specific meteorological station providing 30 years of daily weather values is associated with the location. **Table 13** identifies the use sites associated with each PRZM scenario. For foliar and soil applications to agricultural crops, the date of application was chosen as the day when the crop was present on the field, and during a period of generally high rainfall as it is expected that flupyradifurone may be used when the crop is on the field and during periods of high rainfall. Crop-specific management practices were used for modeling, including maximum proposed application rates, maximum proposed numbers of applications per year, minimum proposed re-application intervals, and the first application date for each crop. For the seed treatment use, the application date (*i.e.*, the planting date) was chosen as two weeks before crop emergence. The incorporation depth was based on information on the label.

Table 13. Use site group, associated crops, and PRZM scenarios used to calculate EDWC for the use site group

Use Site	Crops Associated with Use Site	Crop Cycles per year[1]	Scenarios
Crop Group 15: Cereal Grains (except Rice)	Barley; buckwheat; corn; millet, pearl; millet, proso; oats; popcorn; rye; sorghum (milo); teosinte; triticale; wheat	--	IAcornSTD ILcornSTD INcornSTD KSsorghumSTD MNCornSTD MScornSTD NCcornESTD NEcornESTD NDwheatSTD OHcornSTD PAcornSTD
Cotton	Cotton	--	CAcottonWirrigSTD MScottonSTD NCcottonSTD
Peanut	peanut	--	NCpeanutSTD
Root Vegetables (except Sugarbeet)	Arracacha; arrowroot; artichoke, Chinese; artichoke, Jerusalem; beet, garden; beet, sugar; burdock, edible; canna, edible; carrot; cassava, bitter and sweet; celeriac; chayote (root); chervil, turnip-rooted; chicory; chufa; dasheen (taro); ginger; ginseng; horseradish; leren; parsley, turnip-rooted; parsnip; potato; radish; radish, oriental; rutabaga; salsify; salsify, black; salsify, Spanish; skirret; sweet potato; tanier; turmeric; turnip; yam bean; yam, true.	3-5 cc/yr in CA for radish 1cc/yr for carrot 3-4 cc/yr for turnip greens 1-2 cc/yr rutabaga 1-2 cc/yr national for red beet Rotated with other crops	FlcarrotSTD IDpotatowirrigSTD MEpotatoSTD MIasparagusSTDv2 MNsugarbeetSTD ORmintSTD NCSweetPotatoSTD
Tuberous and Corm Vegetables	Arracacha; arrowroot; artichoke, Chinese; artichoke, Jerusalem; canna, edible; cassava, bitter and sweet; chayote (root); chufa; dasheen (taro); ginger; leren; potato; sweet potato; tanier; turmeric; yam bean; yam, true	--	IDNpotato_WirrigSTD MEpotatoSTD NCsweetpotatoSTD
Leafy Vegetables (except *Brassica*)	Amaranth (Chinese spinach); arugula (roquette); cardoon; celery; celery, Chinese; celtuce; chervil; chrysanthemum, edible-leaved; chrysanthemum, garland; corn salad; cress, garden; cress, upland; dandelion; dock (sorrel); endive (escarole); fennel, Florence; lettuce, head and leaf; orach; parsley; purslane, garden; purslane, winter; radicchio (red chicory); rhubarb; spinach; spinach, New Zealand; spinach, vine; Swiss chard	2 cc/yr in NC and CA for lettuce 1-3 cc/yr national for spinach Rotated with cole crops	FLcucumberSTD FLtomatoSTD_v2 CAlettuceSTD FLcabbageSTD
Brassica (Cole) Leafy Vegetables	Broccoli; broccoli, Chinese (gai lon); broccoli raab (rapini); Brussels sprouts; cabbage;Chinese (bok choy); cabbage, Chinese (napa); cabbage, Chinese mustard(gai choy); cauliflower; cavalo broccolo; collards; kale; kohlrabi; mizuna; mustard greens; mustard spinach; rape greens	2 cc/yr in NC and CA for cole crops Rotated with leafy vegetables	
Legume Vegetables (Succulent or Dried)	Bean (Lupinus) (includes grain lupin, sweet lupin, white lupin, and white sweet lupin); bean (Phaseolus) (includes field bean, kidney bean, lima bean, navy bean, pinto bean, runner bean,	Beans: 1-3 cc/yr national. 1 cc/yr (processing), 1-3 cc/yr (fresh market) for snap beans. 1 cc/yr in CA - due to pest	MIbeansSTD ORsnbeansSTD

Use Site	Crops Associated with Use Site	Crop Cycles per year[1]	Scenarios
	snap bean, tepary bean, wax bean); bean (Vigna) (includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean, yardlong bean); broad bean (fava); chickpea (garbanzo); guar; jackbean; lablab bean; lentil; pea (Pisum) (includes dwarf pea, edible-podded pea, English pea, field pea, garden pea, green pea, snowpea, sugar snap pea); pigeon pea; soybean; soybean (immature seed); sword bean	problems, succulent beans are typically not planted back to back. Snap beans have a fall crop & a spring crop in desert areas. Up to 3 fresh snap bean seasons listed for FL GA.	
Fruiting Vegetables (except cucurbits)	Eggplant; groundcherry (Physalis spp); pepino; pepper (includes bell pepper, chili pepper, cooking pepper, pimento, sweet pepper); tomatillo; tomato	1-3 cc/yr national for peppers. 3 cc/yr in FL for bell peppers grow in some areas all times, up to 3 seasons 1 cc/yr national. Production in Regions 1, 2, 3, 5, 10	CAtomatowirrigSTD FLtomatoSTD_V2 PAtomatoSTD FLpeppersSTD
Cucurbit Vegetables	Chayote (fruit); Chinese waxgourd (Chinese preserving melon); citron melon; cucumber; gherkin; gourd, edible (includes hyotan, cucuzza, hechima, Chinese okra); Momordica spp (includes balsam apple, balsam pear, bittermelon, Chinese cucumber); muskmelon (includes cantaloupe); pumpkin; squash, summer; squash, winter (includes butternut squash, calabaza, hubbard squash, acorn squash, spaghetti squash); watermelon	These crops are often rotated in the same field with Solanaceous crops (*e.g.*, tomatoes, peppers) in the southeastern US. In northern regions (north of NC) 1 crop per year is probably standard, with no such rotation.	FLcucumberSTD NJmelonSTD MImelonSTD MOmelonSTD
Hop	Hop	--	ORhopsSTD
Citrus Fruit	Calamondin; citrus citron; citrus hybrids (includes chironja, tangelo, tangor); grapefruit; kumquat; lemon; lime; mandarin (tangerine); orange, sour; orange, sweet; pummelo; Satsuma mandarin	--	Cacitrus_WirrigSTD FLcitrusSTD
Pome Fruit	Apple; azarole; crabapple; loquat; mayhaw; medlar; pear; pear, Asian; quince; quince, Chinese; quince, Japanese; tejocote; cultivars, varieties, and/or hybrids of these	--	NCappleSTD ORappleSTD PAappleSTD CAfruit_WirrigSTD
Bushberry	Blueberry, highbush and lowbush; currant; elderberry; gooseberry; huckleberry	--	OrberriesOP NYgrapesSTD
Low Growing Berry (excluding Cranberry)	Bearberry; bilberry; blueberry, lowbush; cloudberry; lingonberry; muntries; partridgeberry; strawberry; cultivars, varieties, and/or hybrids of these	--	Flstrawberry_WirrigST D ORberriesSTD
Small Fruit Vine Climbing (except Fuzzy Kiwifruit)	Amur river grape; gooseberry; grape; kiwifruit, fuzzy; kiwifruit, hardy; maypop; schisandra berry; cultivars, varieties, and/or hybrids of these	--	ORberriesOP NYGrapesSTD
		--	Cagrapes_wirrigSTD
Tree Nut	African nut-tree; almond; beechnut; Brazil nut; Brazilian pine; bunya; bur oak; butternut; Cajou nut; candlenut; cashew; chestnut; chinquapin; coconut; coquito nut; dika nut; ginkgo; Guiana chestnut; hazelnut (filbert); heartnut; hickory nut; Japanese horse-chestnut; macadamia nut;		CAalmond_WirrigSTD ORfilbertSTD GApecanSTD

Use Site	Crops Associated with Use Site	Crop Cycles per year[1]	Scenarios
	mongongo nut; monkey-pot; monkey puzzle nut; Okari nut; Pachira nut; peach palm nut; pecan; pequi; Pili nut; pine nut; pistachio; Sapucaia nut; tropical almond; walnut, black; walnut, English; yellowhorn; cultivars, varieties, and/or hybrids of these		
Prickly Pear/Cactus pear	Prickly pear	--	CAcitrus_WirrigSTD
Nongrass Animal Feeds (Forage, Fodder, Straw, Hay)	Alfalfa; bean, velvet; clover (Trifolium , Melilotus); kudzu; lespedeza; lupin; sainfoin; trefoil; vetch; vetch, crown; vetch, milk	--	CArangelandhayRLF_V2 NCalfalfaOP PAalfalfaOP TXalfalfaOP ILalfalfaNMC MNalfalfaOP
Soybean Seeds	Soybean	--	MSsoybeanSTD

[1] Information provided by BEAD in support of diazinon

Currently approved standard PRZM crop scenarios were used in modeling when available. Low growing berries include both berries grown on the ground (*i.e.*, strawberries) and berries grown on shrubs (*i.e.*, blackberries). The ORberriesOP and the Flstrawberry_WirrigSTD scenarios were used to represent the low growing berry subgroup. The ORberriesOP scenario (this scenario was developed for the organophosphate (OP) cumulative assessment) was prepared for use on blackberries, and is representative of berries grown on shrubs. Flupyradifurone is not an OP class chemical; however, the OP berry scenario is the only scenario available for this type of crop. The Root Vegetables Crop Group includes the following: garden beet, burdock, carrot, celeriac, turnip-root chervil, chicory, ginseng, horseradish, turnip rooted parsley, parsnip, radish, Oriental radish, rutabega, salsify, black salsify, Spanish salsify, skirret, and turnip. The following scenarios were chosen for this crop group: FlcarrotSTD, IDpotatowirrigSTD, MEpotatoSTD, MIasparagusSTDv2, and ORmint. The asparagus and sugarbeet scenarios were chosen to be representative of use on ginseng. ORmintSTD was chosen to be representative of use on parsley. To represent use on turnip greens, the FlcarrotSTD scenario and the MEpotatoSTD were chosen. There are currently no standard scenarios that are available to represent nongrass animal feeds. Therefore, the following scenarios were used to be representative of this crop group: CArangelandhayRLF_V2, NcalfalfaOP, PaalfalfaOP, TxalfalfaOP, ILalfalfaNMC, MnalfalfaOP.

Unlike EFED's standard crop scenarios, the OP-cumulative scenarios were not developed specifically to represent high-end exposure (*i.e.*, vulnerable) sites. Instead, these scenarios were developed by first identifying areas of high combined use of the entire OP class of chemicals that coincided with drinking water intakes that draw from surface water sources. Within these high OP-use areas, major crop uses were identified and scenarios were developed to represent high runoff-prone soils known to support the crops in these areas. In some instances, these scenarios may represent the major growing area for a particular crop. In other instances, the major crop area may be elsewhere, and the scenario in the high OP-use area may represent a "fringe" area of the crop in question. It has not been determined how the vulnerability of a crop scenario developed for the OP cumulative assessment compares to a standard scenario developed for the same crop; therefore, the OP scenarios may represent either greater or lesser vulnerability than standard scenarios. Because the OP scenarios focused on areas that coincided with drinking water intakes, their suitability as high-end vulnerable scenarios for ecological exposure assessments is less certain. The California red legged frog (*Rana draytonii*) scenarios were developed in support of risk assessments conducted to evaluate potential risks to this listed species in California. These scenarios have similar issues as the scenarios developed for the OP assessments, except that they were not chosen based on proximity to drinking water intakes, but rather to evaluate specific uses of pesticides in California. They may not be representative of vulnerable areas across the United States. The CArowcropRLF, CAcolecropRLF, CA-strawberry-noplastic, and CAwinegrapesRLF were used with the appropriate crop groups in this assessment. The scenarios ending in NMC were developed to support the N-methyl carbamate risk assessments.

Multiple Crop Cycles Per Year

The number of seasons per year was not specified on the proposed label and, depending on the crop, flupyradifurone could be used for multiple seasons per year on one site. Therefore, simulations were run assuming one, two, three four, and five seasons per year to characterize the uncertainty associated with multiple crops grown and treated with flupyradifurone on the same site in a year. This multiple crop cycle per year analysis was conducted with only one PRZM scenario, and provides a conservative estimate of the possible resulting exposure. The range of 1-in-10 year peak, 21-day, and 60-day EECs across the crops where multiple crop cycles per year may occur is relatively small (13 to 20 µg/L). Estimating EECs for one PRZM scenario (*i.e*., FLcarrotSTD to represent use on radishes) should provide a reasonable estimate of the possible values that may be observed for all crops where multiple crop cycles per year may occur. Radishes may be harvested three to four weeks after planting and they may have as many as five crop cycles per year in Florida (USDA, 2008). Therefore, root vegetables were modeled with five crop cycles per year. To do this, the FLcarrotSTD scenario was modified. It was assumed that the dates of emergence, maturation, and harvest occurred over October through March, the full growing season for radishes (USDA, 2008). Application dates were assumed to occur at the beginning of each month for five months. The runoff routine was modified to reflect a curve number (shown by CN in the SWCC) and USLE crop factor (shown by C in the SWCC) when the crop was present and when the crop was not present. The curve numbers of 87 was used to represent when the crop was present and a curve number of 91 was used to represent when the crop was not present. The average USLE crop factor was calculated from the original scenario during when the crop was present (0.774) and when the crop was not present (0.632). The updated scenario was saved as FLcarSTD5cc.SCN.

For modeling multiple crop cycles per year for groundwater, the scenarios were not altered as the presence of the crop has little influence on groundwater EECs. The number of applications was simply doubled or tripled as appropriate, to derive a better understanding of potential exposure.

Table 14. Summary of scenario alterations of the Flcarrot scenario for the multiple crop cycle per year analysis

Growth Descriptors on the Crop/land tab (Day – Month)		
Emerge	Mature	Harvest
01-10	15-10	01-03

Application Date (Day-Month)				
First application	Second Application			
01-10	09-10			
01-11	09-11			
01-12	09-12			
01-01	09-01			
01-02	09-02			
Runoff				
Day	Month	CN	C	N
16	10	87	0.774	0.011
1	3	91	0.632	0.011

Table 15. Proposed uses with possible multiple crop cycles per year[1]

Crop Group	Crop cycles per year
Root Vegetables (except Sugarbeet)	1-5
Leafy Vegetables (except *Brassica*)	1-3
Brassica (Cole) Leafy Vegetables	1-2
Legume Vegetables (Succulent or Dried)	1-3
Fruiting Vegetables (except cucurbits)	1-3
Cucurbit Vegetables	1-3

[1] Based on information provided by BEAD in support of diazinon

Tables summarizing input parameters

Table 16. SCI-GROW (v2.3) input parameter values for total residues of flupyradifurone plus unextracted residues (abbreviated as "FLU-UN") and for flupyradifurone alone (abbreviated as "FLU")[1]

Parameter	Residues	Value	Source	Comments
Application Rate (lbs residue/acre)	FLU-UN FLU	See **Table 23**	Proposed label	Maximum application rate for active ingredient
# of Applications				--
K_{oc} (mL/g)	FLU FLU-UN	109	MRIDs 48843662, 48843663, and 48843664	Median of 10 K_{OC} values. There is not a three-fold difference in observed values.
Aerobic Soil Metabolism Half-life (days)	FLU-UN	349	MRIDs 48843674, 48843676, 48843677, 48843679, 48843681, 48843683	Median of 10 values. There is a five-fold difference between the lowest (75 days) and highest representative half-lives (484 days) for FLU. There is not a 5-fold difference for TTR-UN. No temperature conversion was completed.
	FLU	186		

FLU-UN: Value for total residues of flupyradifurone plus unextracted residues.
FLU: Value for total residues of flupyradifurone.

Table 17. Tier I PRZM-GW input parameters

Parameter (units)	Residues	Input Value	Data Source	Comments
Application Rate (kg residue/ha)	FLU-UN FLU	See Table 23	Proposed label	Maximum application rate for flupyradifurone.
Number of Applications	FLU-UN FLU			--
Application Date(s)	FLU-UN FLU			The following were considered when determining the date of applications:

				timing of crop in scenario, a timing of rainfall in scenario, and application type.
Applications Occur Every	FLU-UN FLU	1/year and from year 1 to the last year		--
Application Method	FLU-UN FLU	Above canopy (2) Soil (1) seed treatment		--
Hydrolysis Half-life (days)	FLU-UN FLU	Stable (0)	MRID 48843667	--
Soil Metabolism Half-life at 25°C (days)	FLU-UN	371	MRIDs 48843674, 48843676, 48843677, 48843679, 48843681, 48843683	The 90 percent upper confidence bound on the mean of ten representative half-life values. Half-life values adjusted from 20°C to 25°C according to input parameter guidance.
	FLU	124		
K_{oc} (L/kg-OC)	FLU-UN FLU	137	MRIDs 48843662, 48843663, 48843664	Mean of ten K_{OC} values for flupyradifurone.

FLU-UN: Value for total residues of flupyradifurone plus unextracted residues.
FLU: Value for total residues of flupyradifurone.

Table 18. Input values used for Tier II surface water modeling with SWCC

Parameter (units)	Residue	Value (s)	Source	Comments
Organic-carbon Normalized Soil-water Distribution Coefficient (K_{OC} (L/kg-$_{OC}$))	FLU-UN FLU	137	MRIDs 48843662, 48843663, 48843664	Mean of ten K_{OC} values for flupyradifurone. EECs were also explored by assuming the KOC value was twice 2x 137 to determine the impact of a data gap on sediment sorption data.
Water Column Metabolism Half-life or Aerobic Aquatic Metabolism Half-life (days) and Reference Temperature	FLU-UN	1118 at 20°C	MRID 48843690, 48843692	Represents the 90 percent upper confidence bound on the mean of two representative half-life values.
	FLU	2979 at 20°C		
Benthic Metabolism Half-life or Anaerobic Aquatic Metabolism Half-life (days) and Reference Temperature	FLU-UN	Stable (0)	MRID 48843689	One available value was stable. The other value was 2470.
	FLU	3643 at 20°C		Represents the 90 percent upper confidence bound on the mean (1208) of two representative half-life values.
Aqueous Photolysis Half-life @ pH 7 (days) and Reference Latitude	FLU-UN FLU	2.5 at 40°N	MRID 48843669	The aqueous photolysis half-life input value was adjusted for continuous illumination as well as for latitude/season to reflect photolysis in summer sunlight at 40° N latitude
Hydrolysis Half-life (days)	FLU-UN FLU	Stable (0)	MRID: 46235726	--
Soil Half-life or Aerobic	FLU-UN	525 at 20°C	MRIDs	The 90 percent upper confidence

Parameter (units)	Residue	Value (s)	Source	Comments
Soil Metabolism Half-life (days) and Reference Temperature	FLU	265 at 20°C	48843674, 48843676, 48843677, 48843679, 48843681, 48843683	bound on the mean of ten half-life values. No temperature conversion was performed.
MWT or Molecular Weight (g/mol)	FLU-UN FLU	288.68	--	--
Vapor Pressure (Torr) at 25°C	FLU-UN FLU	1.3×10^{-8}	MRID 48843650	--
Solubility in Water @ 20 °C, pH not reported (mg/L)	FLU-UN FLU	3200	MRID 48843644	20°C and pH 7
Foliar Half-life (days)	All	0 d-1	Default	--
Number of Applications	FLU-UN FLU	See **Table 22**	Proposed label	--
Dates	FLU-UN FLU		Assumed based on type of application	Absolute dates were used in modeling. For foliar applications, dates were chosen to occur in a month when the crop was present and a high average rainfall occurred. For seed treatment the date of application was chosen as 14 days before crop emergence. For those scenarios that resulted in the highest EECs (except the seed treatment use) using the above scenario, a batch analysis over the application window (when the crop was present) was completed to determine the maximum EEC that could reasonably occur. The batch analysis was ran every 2 to 3 days depending on the length of the batch run.
Amount	FLU-UN FLU		Proposed label	Maximum single application rate for the crop
Application method	FLU-UN FLU	Foliar for ground and aerial applications Incorporate for seed treatment	Proposed label	Incorporation depth was assumed to be 1.27 cm. Soybean seeds are typically planted at a depth of 1 to 2 inches (2.54 – 5.08 cm). However, the actual planting depth will vary. The minimum planting depth recommended was 0.5 inches (1.27 cm) (Staton, 2013). Runoff only occurs from the top 2 cm of soil (Carsel *et al.*, 1997).
Application Efficiency	FLU-UN FLU	Aerial: 0.95 Ground: 0.99 Airblast: 0.99 Seed Treatment: 1.0 Spray drift only exposure: 0	Input parameter guidance (USEPA, 2009)	--

Parameter (units)	Residue	Value (s)	Source	Comments
Drift	FLU-UN FLU	Aerial: 0.125 Ground:0.062 Airblast:0.042 Seed Treatment: 0 No drift:	Offsite transport guidance (USEPA, 2013b)	EECs were also explored for applications without drift (*e.g.*, this value was set to zero).
PRZM Scenario	All	See **Table 22**	--	Screening scenario that is expected to result in a high end EEC.

FLU-UN: Value for total residues of flupyradifurone plus unextracted residues.
FLU: Value for total residues of flupyradifurone.

3.3.2. Aquatic Modeling Results

The uses on agricultural crops allow for aerial, ground (including airblast), and seed treatment applications of a flowable material and EECs were estimated for all of these application methods. The applications directly to soil (including soil drench) were modeled as ground applications without spray drift. As noted previously, the maximum number of seasons per year was not specified on the proposed label and flupyradifurone could be used for multiple seasons per year on one site. Therefore, simulations were run assuming up to five seasons per year for a single crop and considered representative of other crops with multiple crop cycles per year. Standard simulations assume spray drift will occur, however some simulations were also run omitting spray drift, to explore the possibility of mitigating with spray drift buffers. Simulations were completed reflecting residues of flupyradifurone plus unextracted residues (FLU-UN) and flupyradifurone alone (FLU). Finally, EECs were also calculated based upon transport of flupyradifurone via spray drift alone (*i.e.*, with zero runoff); this EEC can be used to estimate exposure to the end-use product alone.

Estimated 1-in-10 year FLU-UN and FLU concentrations in surface water and groundwater that are used to calculate RQs are summarized in **Table 19**, **Table 22,** and **Table 23**. A complete summary of all modeling is available in **Appendix C**. Example output files for the SWCC are provided in **Appendix E** and groundwater modeling output files are available in **Appendix D**.

Surface Water

For surface water, the highest peak EEC was derived for the use on the crop group for nongrass animal feeds including forage, fodder, straw and hay (0.18 lbs ai/A, 2 applications, 7-day retreatment interval, foliar, and aerial application) where 1-in-10 year peak, 21-day, and 60-day average FLU EECs are 25.2, 24.0, and 22.1 µg/L and are not substantially different from one another in terms of the magnitude of residues in water. The corresponding peak and 21-day average sediment pore-water FLU concentrations are 17.2 µg/L and reflect that FLU may be found to occur in pore water and that residues are relatively constant over a long time frame. Time series simulation results show that EECs did not continuously increase over the 30-year simulations in the static water body used to simulate aquatic exposure. The effective water column half-life was 330.1 days and photolysis was the predominant driver of loss; losses attributed to photolysis would likely be accentuated in shallow, clear surface water though.

Eliminating spray drift from the scenarios that resulted in the highest EECs had a range of impacts on the calculated EEC. EECs calculated without spray drift were 38 to 93% of EECs calculated with spray drift. This is applicable to applications where spray drift may occur (ground and aerial applications); the applications with targeted applications to the root zone and the soil are not expected to have substantial spray drift. The variation in the contribution of spray drift to EECs is likely due to a variety of factors including how much rainfall occurs near the time of application. Values calculated without spray drift may be used to determine whether mitigation with a spray drift buffer could eliminate a risk concern.

Modeling two to five crop cycles per year increased EECs (peak, 21-day and 60-day) for radishes by 2 to 4 fold, compared with results based on a single crop cycle per year. While multiple crop cycles were only simulated for radish, they may also occur for other root vegetables (1 to 5 crop cycles per year), leafy vegetables (1-3 crop cycles per year), Brassica leafy vegetables (1 to 2 crop cycles per year), legume vegetables (1 to 3 crop cycles per year), fruiting vegetables (1 to 3 crop cycles per year), and cucurbit vegetables (1 to 3 crop cycles per year). Similar trends as those observed for radish are expected for the other crop groups where multiple crop cycles per year may occur. It is speculated that it is relatively rare for five crop cycles per year to be planted due to the possibility of increased pest pressures that may occur when planting the same crop back to back.

Table 19. Summary of EECs estimated for radishes assuming a different number of crop cycles per year

Number of crop cycles per year	EECs for parent in µg/L				
	Water Column			Pore Water	
	Peak	21-day average	60-day average	Peak	21-day average
1	18.9	18.3	16.6	13	12.9
2[a]	39.3	37.6	34	27.9	26.8
3[b]	43	41.7	38.4	32.1	30.8
4[c]	45.8	44.5	41.1	35.1	33.8
5[d]	63.8	62.1	62.1	56.2	55.9

[a] Simulation for two seasons per year. Applications occurred on 10/1, 10/9, 11/1, and 11/9. The modified FLcarrotSTD scenario was used for this simulation.
[b] Simulation with three seasons a year. Applications occurred on 10/1, 10/9, 11/1, 11/9, 12/1, and 12/9. The modified FLcarrotSTD scenario was used for this simulation.
[c] Simulation with four seasons a year. Applications occurred on 10/1, 10/9, 11/1, 11/9, 12/1, 12/9, 01/01, and 01/09. The modified FLcarrotSTD scenario was used for this simulation.
[d] Simulation with five seasons a year. Applications occurred on 10/1, 10/9, 11/1, 11/9, 12/1, 12/9, 01/01, 01/09, 02/01, and 02/09. The modified FLcarrotSTD scenario was used for this simulation.

Groundwater

PRZM-GW predicted the highest EECs for the foliar application at a rate of 0.18 lbs ai/A with two applications, and a 7-day retreatment interval. The maximum single-day concentration of FLU-UN residues was 96.0 µg/L, and the maximum post-breakthrough (long-term average after the chemical reached groundwater) concentration was 89.7 µg/L. The maximum single-day FLU-UN concentration in groundwater for other uses ranged from 30 to 109 µg/L. Post-breakthrough average concentrations for these uses ranged from 17 to 96 µg/L. The average simulation breakthrough time (*i.e.*, the time required, following application, for the pesticide to reach groundwater) in the PRZM-GW simulations ranged from 3.6 to 8.8 years. These results indicate that it could take years following initiation of the use of flupyradifurone before the compound reaches groundwater in meaningful quantities (although preferential flow could substantially shorten such times). Assuming two to three seasons per year resulted in EECs that, correspondingly, were approximately two to three times the magnitude of those estimated assuming only a single season per year. Specifying the number of crop seasons per year on the label would reduce uncertainty in the EECs.

Unextracted Residues

Unextracted residues were conservatively assumed to comprise residues of concern in most of the modeling, though the extent to which unextracted residues are actually parent flupyradifurone is not known. The scenarios that resulted in the highest EECs using half-lives based on inclusion of unextracted residues were therefore also modeled using half-lives calculated based on residues of parent alone, *i.e*., employing the less conservative assumption that none of the unextracted residues are parent compound. Model inputs corresponding to both sets of assumptions (*i.e*., half-lives for parent only, and for parent plus unextracted residues) are shown in **Table 20**. **Table 21** compares some results for FLU-UN and FLU. Not unexpectedly, the inclusion of unextracted residues in degradation half-life calculations impacts EECs, especially for simulations with the PRZM-GW model, wherein concentrations increased by approximately 64 to 66%. It should be noted that the amount of unextracted residues observed may be a result of the quality of the extraction procedure, rather than the propensity for a compound to sorb to soil and sediment. Thus, it is reasonable to assume that some unextracted residues will be mobile. By comparison, the impact on surface water EECs was relatively minor, with a change in EECs near or less than 1 μg/L, flupyradifurone only EECs were up to 6% higher than flupyradifurone plus unextracted EECs. Surface water EECs for FLU were all higher than those calculated for FLU-UN. This is because different degradation kinetic equations were selected to calculate the representative half-life for different residues, the representative half-lives are shown in **Table 20** and the reason for the counterintuitive results is discussed in detail in Section 3.2.2. The representative water column half-life for parent plus unextracted residues was 1118 days (3.1 years) and the corresponding value for parent alone was 2979 days (8.1 years).[14] The two values used to calculate the parent representative input value were very different (547 versus 1740) resulting in a high 90th percentile of the mean representative half-life values. Additionally, in one study the representative half-life from the parent alone was higher (1740 days, T_{IORE} value) than the half-life for parent plus unextracted residues (676 days, SFO model) in the same study.

Table 20. Comparison of representative model inputs for parent and parent plus unextracted residues

Input Parameter	Representative Half-life Used in Modeling (days)	
	Parent Alone	Parent Plus Unextracted Residues
Water column	2979	1118
Benthic	3643	Stable
Soil	265	525

[14] The DT_{90} in the aquatic microcosm studies was a maximum or 363 days, which is considerably lower than the simulated value. The modeled system is very different then the aquatic microcosm system, and the values are not expected to be similar.

Table 21. Comparison of EEC for residues of FLU-UN versus FLU

Model	Peak EEC			60-day EEC or Post Breakthrough Average		
	FLU-UN	FLU	% Difference	FLU-UN	FLU	% Difference
PRZM-GW	95.7	63.5	51%	89.4	57.7	55%
SWCC*	23.6	25.2	-6%	22.8	23.7	-4%

% Difference = (FLU-UN EEC- FLU EEC)/FLU EEC × 100
*TXalfalfaOP (09-05) scenario; see **Table 22**.

Table 22. Estimated concentrations of flupyradifurone plus unextracted residues (FLU-UN) and flupyradifurone alone (FLU) in surface water*

Use Site	Single App. Rate (kg ai/ha), # of App, MRI in days	App Type	Drift/ No Drift	Parent Only					Parent plus Unextracted Residues				
				Water Column			Pore Water		Water Column			Pore Water	
				Peak	21-day average	60-day average	Peak	21-day average	Peak	21-day average	60-day average	Peak	21-day average
Crop Group 15: Cereal Grains	0.18 (0.20), 2x, 7d	A	Drift	23.5	22.8	21.6	18.9	19.0	22.4	21.4	20.6	17.9	18
			No Drift	19.4	18.8	18	15.5	15.6	--	--	--	--	--
		F, G	Drift	22.2	21.6	20.5	17.9	17.9	--	--	--	--	--
			No Drift	20.2	19.6	18.8	16.2	16.3	--	--	--	--	--
Cotton	0.18 (0.20), 2x, 7d	F, A	Drift	19.6	19	18.1	15.9	15.9	19.1	18.4	17.5	15.4	15.4
			No Drift	16.2	15.6	15.1	13.3	13.3	--	--	--	--	--
		F, G	Drift	18.6	17.9	17.2	15.1	15.1	18.1	17.5	16.6	14.7	14.7
			No Drift	16.9	16.3	15.7	138	13.8	--	--	--	--	--
Peanut	0.18 (0.20), 2x, 7d	F, A	Drift	10.9	10.4	9.81	8.11	8.1	10.5	10	9.52	7.72	7.71
			No Drift	7.31	6.97	6.69	5.44	5.44	--	--	--	--	--
		F, G	Drift	10.9	10.4	10.1	8.46	8.47	9.09	8.62	8.36	6.67	6.66
			No Drift	9.13	8.95	8.59	7.14	7.15	--	--	--	--	--
Root Veg. (except Sugarbeet) and Tuberous and Corm Veg.	0.18 (0.20), 2x, 7d	F, A	Drift	18.9	18.3	16.6	13	12.9	18	17.5	15.8	12.3	12.2
			No Drift	16	15.3	13.8	10.7	10.6	--	--	--	--	--
		F, G	Drift	18.2	17.4	15.8	12.3	12.2	17.4	16.7	15.1	11.6	11.5
			No Drift	16.7	15.9	14.4	11.1	11	--	--	--	--	--
Legume Veg. (Succulent or Dried)	0.18 (0.20), 2x, 7d	F, A	Drift	16.8	16.1	15.3	15.1	15.2	16	15.3	14.3	14.2	14.3
			No Drift	12.3	11.8	11.7	11.6	11.7	15.9	15.1	13.7	10.4	10.4
		F, G	Drift	19.1	19.7	17.9	13.8	13.7	17.7	17	15.9	14.2	14.4
			No Drift	17.8	18.2	16.5	12.7	12.5	--	--	--	--	--
Fruiting Vegetables	0.18 (0.20), 2x, 7d	F, A	Drift	19.9	18.9	17.3	13.3	13.3	19.1	18.1	16.4	12.6	12.5
			No Drift	16.5	15.6	14.3	11	11	15.9	15.1	13.7	10.4	10.4
		F, G	Drift	19.8	20.5	18.7	14.5	14.4	18.7	19.6	17.8	13.7	13.5
			No Drift	17.1	17.5	15.8	12.1	12	16.3	16.9	15.1	11.5	11.4

Use Site	Single App. Rate (kg ai/ha), # of App, MRI in days	App Type	Drift/ No Drift	Parent Only					Parent plus Unextracted Residues				
				Water Column			Pore Water		Water Column			Pore Water	
				Peak	21-day average	60-day average	Peak	21-day average	Peak	21-day average	60-day average	Peak	21-day average
	0.40, 1x	S, G	No Drift	14.8	15.1	15.4	11.7	11.7	--	--	--	--	--
Cucurbit Vegetables	0.18 (0.20), 2x, 7d	F, A	Drift	19.8	20.5	18.7	14.5	14.4	18.7	19.6	17.8	13.7	13.5
			No Drift	17.1	17.5	15.8	12.1	12	16.3	16.9	15.1	11.5	11.4
		F, G	Drift	19.1	19.7	17.9	13.8	13.7	18.2	19	17.1	13	12.9
			No Drift	17.8	18.2	16.5	12.7	12.5	--	--	--	--	--
	0.37 (0.40), 1x	S, G	No Drift	16.9	17.6	18.8	13.8	13.2	--	--	--	--	--
Hops	0.14 (0.15), 1x	F, A	Drift	5.57	5.41	5.41	4.73	4.73	5.4	5.24	5.22	4.52	4.52
			No Drift	2.14	2.07	1.99	1.74	1.74	--	--	--	--	--
		F, G	Drift	3.98	3.89	3.84	3.32	3.32	3.85	3.75	3.67	3.16	3.16
			No Drift	2.29	2.22	2.11	1.84	1.84	--	--	--	--	--
Citrus Fruit	0.18 (0.20), 2x, 7d	F, A	Drift	24.4	25.1	23.7	18.1	17.8	22.8	23.6	22.8	17.2	17
			No Drift	22	22.5	20.8	15.8	15.5	20.6	21.3	20.1	15.1	14.9
			Drift Only, No Runoff	3.45	--	--	2.38	--	--	--	--	--	--
		F, AB	Drift	--	--	--	--	--	22.2	23	21.9	16.4	16.2
		F, G	Drift	22.6	23.3	22.3	16.8	16.6	--	--	--	--	--
	0.37 (0.40), 1x	S, G	No Drift	23.1	22.2	21.1	16.2	16	--	--	--	--	--
Pome Fruit	0.18 (0.20), 2x, 7d	F, A	Drift	12.5	11.8	10.9	9.34	9.36	12.2	11.5	10.5	8.98	9
			No Drift	8.73	8.26	7.59	6.4	6.39	--	--	--	--	--
		F, AB	Drift	10.5	9.99	9.19	7.72	7.72	10.2	9.6	8.87	7.37	7.37
		F, G	Drift	11	10.4	9.56	8.05	8.05	--	--	--	--	--
			No Drift	9.1	8.61	7.9	6.59	6.58	--	--	--	--	--
Bushberry	0.18 (0.20), 2x, 7d	F, A	Drift	9.65	9.43	9.67	9.88	10	9.3	9.05	9.11 +	9.38	9.52
			No Drift	6.06	6.04	6.2	6.46	6.56	--	--	--	--	--
		F, G	Drift	7.98	7.96	8.18	8.48	8.55	7.64	7.5	7.73 +	8.03	8.16
			No Drift	6.32	6.29	6.46	6.73	6.84	--	--	--	--	--
Low Growing Berry (excluding Cranberry)	0.18 (0.20), 2x, 7d	F, A	Drift	12.9	12.8	11.6	8.78	8.21	--	--	--	--	--
			No Drift	10.2	9.66	8.68	6.39	6.15	--	--	--	--	--
		F, G	Drift	14.3	16.2	15.4	9.38	9.23	--	--	--	--	--
			No Drift	10.6	10.1	9.04	6.66	6.41	--	--	--	--	--

Use Site	Single App. Rate (kg ai/ha), # of App, MRI in days	App Type	Drift/ No Drift	Parent Only					Parent plus Unextracted Residues				
				Water Column			Pore Water		Water Column			Pore Water	
				Peak	21-day average	60-day average	Peak	21-day average	Peak	21-day average	60-day average	Peak	21-day average
Small Fruit Vine Climbing (except Fuzzy Kiwifruit)	0.18 (0.20), 2x, 7d	F, A	Drift	9.65	9.43	9.67	9.88	10	8.26	7.97	7.63	6.59	6.6
			No Drift	6.06	6.04	6.2	6.46	6.56	5.71	5.72	5.89	6.2	6.3
		F, G	Drift	8.28	8.14	7.64	6.38	6.39	7.9	7.88	7.43	6.17	6.17
			No Drift	6.31	6.03	5.66	4.67	4.66	--	--	--	--	--
Tree Nut	0.18 (0.20), 2x, 7d	F, A	Drift	9.73	9.26	8.75	8.9	8.9	9.52	8.98	8.21	8.49	8.6
			No Drift	6.55	6.51	6.8	6.53	6.54	--	--	--	--	--
		F, G	Drift	6.82	6.54	6.15	4.98	4.97	--	--	--	--	--
Prickly Pear	0.18 (0.20), 2x, 7d	F, G	Drift	2.98	2.86	2.68	2.22	2.22	2.8	2.67	2.49	2.14	2.14
			No Drift	1.24	1.22	1.27	1.04	1.04	--	--	--	--	--
Nongrass Animal Feeds (Forage, Fodder, Straw, Hay)	0.18 (0.20), 2x, 7d	F, A	Drift	25.2	24	22.1	17.2	17.2	23.6	22.4	20.5	15.7	15.8
			No Drift	21.8	20.8	19.2	14.8	14.9	20.4	19.3	17.7	13.5	13.5
			Drift Only, No Runoff	3.55	--	--	2.47	--	--	--	--	--	--
		F, G	Drift	23.5	22.3	20.6	15.9	15.9	--	--	--	--	--
			No Drift	21.8	20.7	19.1	14.7	14.8	--	--	--	--	--
Soybean Seed Treatment	0.37 (0.40), 1x	S, G	No Drift	6.97	6.61	6.05	4.7	4.7	6.9	6.53	5.93	4.61	4.6

Abbreviations: App=Application; A=aerial application; AB=airblast application; Ave=average; Veg.=vegetables; MRI=Minimum retreatment interval
sNo Drift= Simulation without spray drift.
Drift Only, No Runoff= Simulation was completed assuming 0% application efficiency. This essentially estimates EECs that could result from spray drift alone. This value may be used to evaluate the toxicity of end-use products.
+* The 1 in 10 year 21-day average value reported is higher than the 1 in 10 year peak EECs. This may occur because the 21-day average calculation may include days from another year but at least one day is in the year of interest, while the calculation of the peak concentration is only based on values in that year.∞

Table 23. Estimated concentrations of flupyradifurone plus unextracted residues (FLU-UN) or flupyradifurone alone (values designated with an asterick) in groundwater source irrigation water

Use Site (Timing of App)	Single App. Rate lbs. ai/A (kg ai/ha)	# of App	Ret. Int. Days	App. Type	EEC for flupyradifurone plus unextracted residues EEC for flupyradifurone alone* (µg/L)				
					SCI-GROW	PRZM-GW			
					Peak	Scenario	Daily Peak	Post Breakthrough Average	Ave Breakthrough Time (Days)
Foliar Application (10 days post emergence)	0.18 (0.20)	2	7	F, A	2.10 1.09*	WI	95.7 63.5* 190a 284b	89.4 57.7* 178a 26b	4205
Soil Application (10 days post-emergence)	0.37 (0.40)	1	--	G	2.16	WI	96.0	89.6	4205

Use Site (Timing of App)	Single App. Rate lbs. ai/A (kg ai/ha)	# of App	Ret. Int. Days	App. Type	EEC for flupyradifurone plus unextracted residues EEC for flupyradifurone alone* (µg/L)				
					SCI-GROW	PRZM-GW			
					Peak	Scenario	Daily Peak	Post Breakthrough Average	Ave Breakthrough Time (Days)
Seed Treatment (14 days pre-emergence)	0.37 (0.40)	1	--	G	2.16 1.01* 4.31α	WI	**95.7** 63.1*	89.7 58.0*	4205

Abbreviations: App=Application; A=aerial application; AB=airblast application; NJ/DE=Delmarva Sweet Corn; NC=NC cotton; WI=Wisconsin Corn; GA=Georgia Peanuts; Ave.=average; Ret. Int.=retreatment interval
* Results are for residues of flupyradifurone alone. All other values reflect residues of flupyradifurone plus M47 plus M48 plus unextracted residues.
a Simulation for two seasons per year.
b Simulation with three seasons a year.

3.4. Terrestrial Exposure

Birds and Mammals

Terrestrial wildlife exposure estimates are typically calculated for birds and mammals, emphasizing a dietary exposure route for uptake of pesticide active ingredients. Avian exposures are considered surrogates for exposures to terrestrial-phase amphibians and reptiles. For exposure to terrestrial organisms, such as birds and mammals, pesticide residues on food items are estimated, based on the assumption that organisms are exposed to pesticide residues in a given exposure use pattern. For flupyradifurone, application methods for the registered uses include foliar spray and soil drench. Non-target terrestrial organisms may also be exposed to flupyradifurone via treated seeds. For terrestrial animals, the T-REX model (Version 1.5.1)[15] is used to calculate dietary- and dose-based EECs of flupyradifurone for mammals and birds feeding on the site of application. Input values for T-REX include the maximum single application rates, number of applications, and retreatment interval for a given use and are located in **Table 24**. In this assessment, EFED uses a default foliar dissipation half-life of 35 days as an input for terrestrial exposure modeling in T-REX.

Upper-bound Kenega nomogram values based on Hoerger and Kenega (1972) as modified by Fletcher *et al*. (1994) are used to derive EECs for flupyradifurone exposures to terrestrial mammals and birds based on dietary- and dose-based exposures from foliar applications of flupyradifurone (**Table 24).** A one-year time period is simulated. Consideration is given to different types of feeding strategies for mammals and birds, including herbivores, insectivores and granivores. For dose-based exposures, three weight classes of mammals (15, 35, and 1000 g) and birds (20, 100, and 1000 g) are considered. T-REX is also used to calculate dose-based EECs of flupyradifurone for birds and mammals that consume treated seeds. Seeding rates and the maximum application rate based on the proposed label are used to calculate dose-based EECs and the mass of flupyradifurone per unit area (mg ai/ft^2) available for consumption by birds and mammals (**Table 25)**. For more information on estimating exposure to terrestrial organisms from seed treatments, please see the T-REX User's Guide[16].

[15] http://www.epa.gov/oppefed1/models/terrestrial/
[16] http://www.epa.gov/oppefed1/models/terrestrial/trex/t_rex_user_guide.htm

Table 24. Terrestrial EECs as food residues for animals exposed to flupyradifurone as a result of the proposed foliar uses.

Food Type	Dietary Based (mg/kg diet) (mammals and birds)	Dose Based (mg/kg bw) (birds)			Dose Based (mg/kg bw) (mammals)		
	All Size Classes	Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Foliar: Cereal Grains (except Rice), Tuberous and Corm Vegetables, Leafy Vegetables (except *Brassica*), *Brassica* (Cole) Leafy Vegetables, Fruiting Vegetables, Cucurbits, Bushberries (0.18 lbs ai/A; 2 applications; 7-day interval)							
Short grass	80.81	92.03	52.48	23.50	77.04	53.25	12.35
Tall grass	37.04	42.18	24.05	10.77	35.31	24.41	5.66
Broadleaf plants/small insects	45.45	51.77	29.52	13.22	43.34	29.95	6.94
Fruits/pods/(seeds, dietary only)	5.05	5.75	3.28	1.47	4.82	3.33	0.77
Arthropods	31.65	36.05	20.55	9.20	30.18	20.86	4.84
Seeds (granivore)	N/A	1.28	0.73	0.33	1.07	0.74	0.17
Foliar: Cotton, Nongrass Animal Feeds, Peanut, Root Vegetables (except Sugarbeet), Legume Vegetables, Citrus, Pome Fruit, Low Growing Berries, Small Fruit Vine Climbing (0.18 lbs ai/A; 2 applications; 10-day interval)							
Short grass	78.64	89.56	51.07	22.87	74.98	51.82	12.01
Tall grass	36.04	41.05	23.41	10.48	34.36	23.75	5.51
Broadleaf plants/small insects	44.23	50.38	28.73	12.86	42.17	29.15	6.76
Fruits/pods/(seeds, dietary only)	4.91	5.60	3.19	1.43	4.69	3.24	0.75
Arthropods	30.80	35.08	20.00	8.96	29.37	20.30	4.71
Seeds (granivore)	N/A	1.24	0.71	0.32	1.04	0.72	0.17
Foliar: Tree Nut, Prickly Pear/Cactus Pear (0.18 lbs ai/A; 2 applications; 14-day interval)							
Short grass	75.94	86.49	49.32	22.08	72.40	50.04	11.60
Tall grass	34.81	39.64	22.60	10.12	33.18	22.93	5.32
Broadleaf plants/small insects	42.72	48.65	27.74	12.42	40.73	28.15	6.53
Fruits/pods/(seeds, dietary only)	4.75	5.41	3.08	1.38	4.53	3.13	0.73
Arthropods	29.74	33.87	19.32	8.65	28.36	19.60	4.54
Seeds (granivore)	N/A	1.20	0.68	0.31	1.01	0.69	0.16
Foliar: Hop (0.14 lbs ai/A; 1 application)							
Short grass	33.60	38.27	21.82	9.77	32.04	22.14	5.13
Tall grass	15.40	17.54	10.00	4.48	14.68	10.15	2.35
Broadleaf plants/small insects	18.90	21.53	12.27	5.50	18.02	12.45	2.89
Fruits/pods/(seeds, dietary only)	2.10	2.39	1.36	0.61	2.00	1.38	0.32
Arthropods	13.16	14.99	8.55	3.83	12.55	8.67	2.01

Food Type	Dietary Based (mg/kg diet) (mammals and birds)	Dose Based (mg/kg bw) (birds)			Dose Based (mg/kg bw) (mammals)		
	All Size Classes	Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Seeds (granivore)	N/A	0.53	0.30	0.14	0.44	0.31	0.07
Soil/Drench/Chemigation: Fruiting Vegetables, Cucurbits, Citrus, Small Vine Climbing Fruit, Soybean Seeds (0.37 lbs ai/A; 1 application)							
Short grass	88.80	101.13	57.67	25.82	84.66	58.51	13.57
Tall grass	40.70	46.35	26.43	11.83	38.80	26.82	6.22
Broadleaf plants/small insects	49.95	56.89	32.44	14.52	47.62	32.91	7.63
Fruits/pods/(seeds, dietary only)	5.55	6.32	3.60	1.61	5.29	3.66	0.85
Arthropods	34.78	39.61	22.59	10.11	33.16	22.92	5.31
Seeds (granivore)	N/A	1.40	0.80	0.36	1.18	0.81	0.19
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 2 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)							
Short grass	122.05	139.00	79.27	35.49	116.37	80.42	18.65
Tall grass	55.94	63.71	36.33	16.27	53.33	36.86	8.55
Broadleaf plants/small insects	68.65	78.19	44.59	19.96	65.46	45.24	10.49
Fruits/pods/(seeds, dietary only)	7.63	8.69	4.95	2.22	7.27	5.03	1.17
Arthropods	47.80	54.44	31.05	13.90	45.58	31.50	7.30
Seeds (granivore)	N/A	1.93	1.10	0.49	1.62	1.12	0.26
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 3 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)							
Short grass	146.02	166.30	94.83	42.46	139.21	96.22	22.31
Tall grass	66.92	76.22	43.46	19.46	63.81	44.10	10.22
Broadleaf plants/small insects	82.13	93.54	53.34	23.88	78.31	54.12	12.55
Fruits/pods/(seeds, dietary only)	9.13	10.39	5.93	2.65	8.70	6.01	1.39
Arthropods	57.19	65.13	37.14	16.63	54.53	37.68	8.74
Seeds (granivore)	N/A	2.31	1.32	0.59	1.93	1.34	0.31
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 4 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)							
Short grass	159.25	181.36	103.42	46.30	151.83	104.93	24.33
Tall grass	72.99	83.13	47.40	21.22	69.59	48.09	11.15
Broadleaf plants/small insects	89.58	102.02	58.17	26.05	85.40	59.03	13.69
Fruits/pods/(seeds, dietary only)	9.95	11.34	6.46	2.89	9.49	6.56	1.52
Arthropods	62.37	71.03	40.51	18.14	59.47	41.10	9.53
Seeds (granivore)	N/A	2.52	1.44	0.64	2.11	1.46	0.34

Food Type	Dietary Based (mg/kg diet) (mammals and birds)	Dose Based (mg/kg bw) (birds)			Dose Based (mg/kg bw) (mammals)		
	All Size Classes	Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 5 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)							
Short grass	166.55	189.68	108.17	48.43	158.79	109.75	25.45
Tall grass	76.34	86.94	49.58	22.20	72.78	50.30	11.66
Broadleaf plants/small insects	93.68	106.70	60.84	27.24	89.32	61.73	14.31
Fruits/pods/(seeds, dietary only)	10.41	11.86	6.76	3.03	9.92	6.86	1.59
Arthropods	65.23	74.29	42.36	18.97	62.19	42.98	9.97
Seeds (granivore)	N/A	2.63	1.50	0.67	2.21	1.52	0.35

N/A = Not applicable.

Table 25. Terrestrial dose-based EECs for the range of seed treatment uses proposed for flupyradifurone.

Use	App Rate (lbs ai/A)	Seed App Rate (mg ai/ kg seed)	Animal Size	Dose-Based EEC (mg ai/kg-bw/day)		Spatial EEC (available ai per unit area) (mg ai /ft^2)
				Birds	Mammals	
Soybeans	0.037[1]	450	Small	113.89	95.34	0.39
			Medium	64.94	65.89	
			Large	29.08	15.28	

App = Application

[1] Estimated based on proposed label rate of 0.068 mg ai/seed and assumption of 250,000 seeds planted per acre

[2] Based on proposed label rate of 45 g ai/100 kg seed

Honey bees

Potential risk to bees is assessed in this document according to the tiering process described in the *White Paper in Support of the Proposed Risk Assessment Process for Bees* submitted to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Scientific Advisory Panel (SAP) for review and comment in September 2012 (USEPA, 2012d). As part of the Tier I risk assessment, screening-level exposures are estimated in pollen and nectar using generic residue data generated from other chemicals as well as other plant parts as described in **Table 26** and **Table 27**. For dietary exposures resulting from foliar applications, it is assumed that pesticide residues on tall grass (from the Kenaga nomogram of T-REX) are a suitable surrogate for residues in pollen and nectar of flowers that are directly sprayed during application. For soil applications, pesticide concentrations in pollen and nectar are assumed to be consistent with chemical concentrations in the xylem of barley (calculated using the Briggs' model). For seed treatments, pesticide concentrations in pollen and nectar are based on concentrations in leaves and stems of treated plants (based on the European and Mediterranean Plant Protection Organization (EPPO) default value discussed in the White Paper), assumed to be 1 milligram per kilogram (mg/kg) or 1 part per million (ppm). More details on these methods are available in the White Paper (USEPA, 2012d) and in the T-REX User's Guide[17].

The Tier I method is intended to generate "reasonably conservative" estimates of pesticide exposure to honeybees which are then refined using empirical residue data from a variety of crops, which are available for flupyradifurone. The Tier I exposure method is intended to account for the major routes of pesticide exposure that are relevant to bees (*i.e*., through diet and contact). Exposure routes for bees differ based on application type. Under the approach used in this assessment, bees foraging in a field treated with a pesticide through foliar spray could potentially be exposed to the pesticide through direct spray, *i.e*., contact, as well through consuming flupyradifurone residues in pollen and nectar. For honeybees foraging in fields treated with a pesticide through direct application to soil (*e.g*., drip irrigation) or through seed treatments, direct spray onto bees is not expected. For these application methods, pesticide exposure through consumption of residues in nectar and pollen are expected to be the dominant routes. Foraging honeybees may also be exposed to pesticides via contact with dust from seed treatments or via consumption of water from surface water, puddles, dew droplet formation on leaves and guttation fluid; however, exposures via these routes are not quantified in this assessment.

Table 26. Summary of contact and dietary exposure estimates used for foliar application, soil treatment, and seed treatment uses of pesticides for honeybee Tier I risk assessment.

Measurement Endpoint	Exposure Route	Exposure Estimate[1]
Foliar Applications		
Individual Survival (adults)	Contact	APP*(2.7 μg ai/bee)
Individual Survival (adults)	Diet	APP*(110 μg a.i /g)*(0.292 g/day)
Brood size and success	Diet	APP*(110 μg a.i /g)*(0.124 g/day)
Soil Treatments		
Individual Survival (adults)	Diet	(Briggs EEC)*(0.292 g/day)

[17] http://www.epa.gov/oppefed1/models/terrestrial/trex/t_rex_user_guide.htm

Measurement Endpoint	Exposure Route	Exposure Estimate[1]
Brood size and success	Diet	(Briggs EEC)*(0.124 g/day)
Seed Treatments		
Individual Survival (adults)	Diet	(1 μg a.i /g)*(0.292 g/day)
Brood size and success	Diet	(1 μg a.i /g)*(0.124 g/day)

APP = application rate in lbs ai/A

[1]Based on food consumption rates for larvae (0.124 g/day) and adult (0.292 g/day) worker bees and concentration in pollen and nectar.

Table 27. Screening-level EECs for honeybees based on foliar, drench, and seed treatment applications

Use	Single Maximum Application Rate	Life-stage	Exposure Route	EEC (µg ai/bee/day)
Cereal Grains (except Rice), Tuberous and Corm Vegetables, Leafy Vegetables (except Brassica), Brassica (Cole) Leafy Vegetables, Fruiting Vegetables, Cucurbits, Bushberries, Cotton, Nongrass Animal Feeds, Peanut, Root Vegetables (except Sugarbeet), Legume Vegetables, Citrus, Pome Fruit, Low Growing Berries, Small Fruit Vine Climbing, Tree Nut, Prickly Pear/Cactus Pear	0.18 lbs ai/A	Adults	Contact	0.49
		Adults	Diet	5.78
		Brood	Diet	2.46
Hops	0.14 lbs ai/A	Adults	Contact	0.38
		Adults	Diet	4.50
		Brood	Diet	1.91
Soil/Drench/Chemigation: Fruiting Vegetables, Cucurbits, Citrus, Small Vine Climbing Fruit	0.37 lbs ai/A	Adults	Diet	0.02
		Brood	Diet	0.01
Soybean Seeds	0.365 lbs ai/A[1]	Adults	Diet	0.29
		Brood	Diet	0.12

[1] Based on maximum label rate per year for seed treatments.

In cases where RQs exceed the LOC for acute risk to insect pollinators, estimates of exposure are refined using measured pesticide concentrations in pollen and nectar of treated crops, and further calculated for other castes of bees using their respective food consumption rates. The most conservative (highest) exposure estimates for contact and/or dietary exposure routes are selected for the refined Tier I screening-level assessment. These exposure estimates are based on adult and larval bees with the highest food consumption rates among bees. This is accomplished using food consumption rates based on work described in the White Paper (USEPA, 2012d) and updated to reflect comments from the Scientific Advisory Panel (SAP).

A number of studies were conducted to evaluate residues of flupyradifurone and the degradate BYI 02960-difluoro-ethylamino-furanone (DFEAF) in flowers, pollen, and nectar after drench and foliar applications to different commodity crops that are potentially of use for refining exposure if initial screening-level risk estimates exceed LOCs (**Table 28**). Many of the foliar studies consisted of two applications of BYI 02960 SL 200 G: one pre-bloom application (early flowering) and a second at full flowering. In all studies, DFEAF residues were low (<0.1 mg/kg), and given the low acute toxicity of DFEAF to honeybees (LD_{50} >81.5 µg/bee), they are not characterized further in this assessment. For foliar applications, flower and nectar residues of flupyradifurone typically reached their maxima within a few days following the second (full bloom) application; pollen residues varied among studies, sometimes increasing until the end of the study (*e.g.*, citrus) and sometimes reaching a maximum in the few days following the second application, similar to flowers and nectar. These data may indicate that systemic translocation of residues in some plants may lead to residues in pollen in the weeks following application. Many of the studies used honeybee-collected pollen (dislodged from the legs of forager bees using pollen traps affixed to the front of colonies) and nectar (removed directly from the honey stomachs of forager bees) to evaluate residues in bee-relevant matrices. Studies generally did not measure residues during the interval between the first and second applications, which is a source of uncertainty; however, since applications were made just prior to full bloom and at full bloom, the residues in pollen and nectar are considered to represent those that were systemically distributed to pollen and nectar through uptake and translocation by the plant as well as those residues directly landing on the surface of pollen and nectar as a result of application.

Measured residues from a variety of pollinator-attractive crops indicate that the concentration of residues in pollen were higher than those in nectar by factors ranging from 3.5-106x. However, cotton was a noticeable exception where total residues in nectar were roughly 50-fold higher than in pollen. The maximum residue in pollen was measured in blueberries (67.6 mg ai/kg) following application at early bloom of 0.36 lbs ai/A followed by a second application at 0.37 lbs ai/A at bloom; however, these applications were mistakenly made at twice the proposed label rate for pre-bloom and bloom applications (0.18 lbs ai/A). The highest residues measured in nectar were from cotton (21.8 mg ai/L); however, these elevated residues were associated with extrafloral nectaries as opposed to peak residues in nectar (0.39 mg ai/L) derived from floral sources. In general, peak residues in nectar (other than for cotton) were less than 1.5 mg ai/L.

Although exposure to bees through residues in guttation fluid are not considered quantitatively in this assessment, data were also available on flupyradifurone residues in oilseed rape following bare soil treatments followed by the sowing of treated seeds. Residues on guttation fluid were measured following planting in autumn and again in the spring. Residues in the autumn ranged from 0.039-21 mg ai/L while those in the following spring ranged between 0.014-0.21 mg ai/L. Based on the available data, the exposure levels in spring were up to several orders of magnitude lower than in autumn indicating that residues were dissipating presumably due in part to growth dilution. Given that peak residues in nectar from cotton overlap with peak values measured in guttation fluid, this assessment is considered protective for this potential route of exposure. Furthermore, there is uncertainty regarding the extent to which bees avail themselves of guttation fluid since the fluid may not be attractive to a large number of bees during times of peak foraging activity.

Table 28. Empirical pollen, nectar, and flower residue data for applications of flupyradifurone formulations to different crops

No. of applications/rate per application	Test Substance	Flupyradifurone residues in mg ai/kg	Comments	MRID
Tomato (drench) 1 at 0.18 lbs ai/A (200 g ai/ha)[1]	BYI 02960 SL 200 G (17.2%)	Pollen (max): 0.107 Pollen (mean): 0.0839 Flowers (max): 0.315 Flowers (mean): 0.246 [Predicted: 19.8][4]	Pollen collected from bumble bees; pollen residues highest in first week after flower emergence.	48844521
Watermelon (drench) 3 at 0.134 (150 g ai/ha)	BYI 02960 SL 200 G (17.2%)	Pollen (max): 0.006 Nectar (max): <0.001 Flowers (max): 1.56 Plan Tissue (max): 54.3 [Predicted: 14.7][4]	Pollen and nectar collected from honeybees; 7 days between applications; applications; 1st application occurred just after transplanting	48844522
Watermelon (drench) 1 at 0.18 lbs ai/A (200 g ai/ha)[1]	BYI 02960 SL 200 G (17.2%)	Pollen (max): 0.002 Nectar (max): <0.001 Flowers (max): 0.056 Flowers (mean): 0.017 [Predicted: 19.8][4]	Pollen and nectar collected from honeybees; single application occurred just after transplanting	48844523
Citrus: orange (foliar) 2 at 0.18 lbs ai/A (205 g ai/ha)	BYI 02960 SL 200 G (17.05%)	Pollen, traps (max): 1.8 Pollen, legs (max): 1.3 Nectar[2] (max): 0.2 Blossoms (max): 2.0 [Predicted: 19.8][4]	Pollen and nectar collected from honeybees; 2nd application occurred when flowers were 10-30% open; the highest citrus blossom residues occurred 3 days after the 2nd application; the highest nectar residues occurred 1 day after the 2nd application; the highest pollen residues occurred near the time of last sampling (5-7 days after 2nd application), which is a source of uncertainty.	48844524
Citrus: orange (foliar) 1 at 0.365 lbs ai/A (410 g ai/ha)	BYI 02960 SL 200 G (17.05%)	Pollen, traps (max): 1.1 Pollen, legs (max): 0.48 Nectar[2] (max): 0.31 Blossoms (max): 5.1 [Predicted: 40.5][4]	Pollen and nectar collected from honeybees; application occurred when flowers were 10-30% open; the highest citrus blossom and nectar residues occurred 3 days after application; the highest pollen residues occurred at the last sampling (7 days after application), which is a source of uncertainty.	48844524
Melon (drench) 1 at 0.365 lbs ai/A (410 g ai/ha)	BYI 02960 SL 200 (17.05%)	Pollen (max): 0.50 Nectar[2] (max): 0.76 Blossoms (max): 0.38 [Predicted: 40.5][4]	Pollen and nectar collected from honeybees; application occurred after transplanting; the highest blossom, nectar, and pollen residues occurred 32, 26, and 28 days after application.	48844525
Melon (foliar)	BYI 02960 SL 200	Pollen (max): 1.5 Nectar[2] (max): 0.36	Pollen and nectar collected from honeybees; 1st application occurred when nine flowers on main	48844525

2 at 0.18 lbs ai/A (205 g ai/ha)	(17.05%)	Blossoms (max): 2.8 [Predicted: 19.8][4]	stem open and 2nd application occurred at initial onset of fruit; the highest blossom residues occurred 1 day after the 2nd application; the highest nectar residues occurred 1 day before the 2nd application, and the highest pollen residues occurred one day after the 1st application.	
Cotton (foliar) 2 at 0.18 lbs ai/A (205 g ai/ha)	BYI 02960 SL 200 (17.11%)	Pollen (max): 0.432 Nectar, total (max): 21.83 Nectar, floral (max): 0.386 Nectar, inner-bracteal (max): 12.2 Nectar, sub-bracteal (max): 15.9 Nectar, pink floral (max): 0.311 Blossoms (max): 12.1 [Predicted: 19.8][4]	1st application occurred at 20% flowering and the 2nd application at full flowering (10 day interval between applications); the highest blossom residues occurred 3 days after the 2nd application; the highest total nectar residues occurred 3 days after the 2nd application, and the highest pollen residues occurred on the day of the 2nd application; residues were not recorded during the period between the first and 2nd applications; all residues appear to have declined significantly by 14 days after the 2nd application	48844527
Blueberry (foliar) 1 at 0.36 lbs ai/A (404 g ai/ha) and 1 at 0.37 lbs ai/A (411 g ai/ha)	BYI 02960 SL 200 (16.9%)	Pollen (max): 67.6 Nectar[2] (max): 0.64 Blossoms (max): 6.49 [Predicted: 40.5][4]	Pollen and nectar collected from honeybees; 1st application occurred at 10% flowering and the 2nd application at full flowering (9 day interval between applications); the highest blossom and nectar residues occurred on day of 2nd application, and the highest pollen residues occurred one day after 2nd application; residues were not recorded during the period between the first and 2nd applications; all residues appear to have declined by at least one order of magnitude from the highest daily average by the end of the study (10 days after 2nd application). Note: this study was mistakenly carried out at twice the proposed pre-bloom and bloom application rates (0.18 lbs ai/A).	48844528
Apple (foliar) 2 at 0.18 lbs ai/A (205 g ai/ha)	BYI 02960 SL 200 (17.05%)	Pollen, trap (max): 22 Pollen, leg (max): 39 Nectar[2] (max): 1.5 Blossoms (max): 113 [Predicted: 19.8][4]	Pollen and nectar collected from honeybees; 1st application occurred when most flowers with petals forming a hollow ball and the 2nd application at full flowering to flowers fading (8 day interval between applications); the highest resides for all matrices were recorded 1 day after the 2nd application; residues were not recorded during the period between the first and 2nd applications	48844530
Apple (foliar)	BYI 02960 SL 200	Pollen (max): 8.3-26.2[3] Nectar (max): 0.3-1.2[3]	Three field trials were conducted in NY, OR, and WA states; pollen and nectar collected directly from	48844529

2 at 0.18 lbs ai/A (205 g ai/ha)	(16.9%)	Blossoms (max): 20.1-27.7[3] [Predicted: 19.8][4]	plants; 2nd application occurred at full flowering 7 to 12 days after 1st application; the highest blossom residues occurred 1 day after the 2nd application; the highest nectar residues occurred near the time of the 2nd application; the highest pollen residues was variable among field trials; residues were not recorded during the period between the first and 2nd applications	
Oil-seed rape (foliar) Bare soil application: 0.28 lbs ai/A (310 g ai/ha) Seed treatment: 9.9 g ai/kg seeds, 5.98 kg seed/ha	Bare soil application: BYI 02960 SL 200 G (16.9%) Seed treatment: BYI 02960 FS 480 G (39.9%)	Guttation liquid residues: Fall (2010, range): 0.039-11 mg ai/L Spring (2011, range): 0.014-0.21 mg ai/L	Study performed in Germany; bare soil treatment was made on same day as treated seeds were sown (and was followed by immediate mechanical incorporation); droplets of guttation liquid were collected from the surface of the treated winter oil-seed rape plants; residues were sampled in fall 2010 (after planting) and following spring (2011); generally, residues of BYI 02960 declined by about two orders of magnitude during the approximately 5-week autumn sampling period.	48844537
Oil-seed rape (foliar) Bare soil application: 0.28 lbs ai/A (311 g ai/ha) Seed treatment: 10.11 g ai/kg seeds, 6.89 kg seed/ha	Bare soil application: BYI 02960 SL 200 G (16.9%) Seed treatment: BYI 02960 FS 480 G (39.9%)	Guttation liquid residues: Fall (2010, range): 0.087-21 mg ai/L Spring (2011, range): 0.062-0.15 mg ai/L	Study performed in France; bare soil treatment was made on same day as treated seeds were sown (and was followed by immediate mechanical incorporation); droplets of guttation liquid were collected from the surface of the treated winter oil-seed rape plants; residues were sampled in fall 2010 (after planting) and following spring (2011); in the fall, residues of BYI 02960 declined by about two orders of magnitude during the approximately 5-week autumn sampling period, but residues increased during the spring 2011 sampling period; no explanation for the increases in spring residues was provided by the study authors.	48844538

Max = maximum residues (generally represented by the highest daily average residues during study)
[1]Application rate used in study is half of the maximum single drench (soil) application rate proposed.
[2]Nectar samples were collected from bee honey stomachs
[3]Values represent range of average daily maximum residues across three field trials (New York, Oregon, Washington)
[4]Generic predicted residues of flupyradifurone on bee matrices are based on **Table 26** and are calculated by multiplying the application rate (in lbs ai/A) by the estimated tall grass EEC of 110 mg/kg for applications at 1 lbs ai/A. Note: predicted residues are only based on a single spray application and do not account for multiple spray events.

Terrestrial and Semi-Aquatic Plants

TERRPLANT (Version 1.2.2)[18] is used to calculate EECs for non-target plants that inhabit dry and semi-aquatic areas. In this assessment, exposure to non-target plants is calculated based on the potential runoff and spray drift of foliar applications of flupyradifurone and potential runoff after soil and seed treatment applications (**Table 29**). Potential exposure resulting from spray drift is not calculated for chemigation and seed treatment applications because any spray drift is expected to be negligible. TERRPLANT does not account for particulate drift.

Table 29. EECs for non-target terrestrial and semi-aquatic plants based on proposed uses of flupyradifurone based on TERRPLANT.

Uses	Application Technique	Single Max. App. Rate (lbs ai/A)	EECs (lbs ai/A)		
			Semi-Aquatic Areas (Total)	Spray Drift	Dry Areas (Total)
Cereal Grains (except Rice), Tuberous and Corm Vegetables, Leafy Vegetables (except Brassica), Brassica (Cole) Leafy Vegetables, Fruiting Vegetables, Cucurbits, Bushberries, Cotton, Nongrass Animal Feeds, Peanut, Root Vegetables (except Sugarbeet), Legume Vegetables, Citrus, Pome Fruit, Low Growing Berries, Small Fruit Vine Climbing, Tree Nut, Prickly Pear/Cactus Pear	Foliar	0.18	0.1	0.009	0.018
Hops	Foliar	0.14	0.08	0.007	0.014
Fruiting Vegetables, Cucurbits, Citrus, Small Vine Climbing Fruit	Soil, Chemigation	0.37	0.19	N/A	0.019
Soybeans	Seed[1]	0.365	0.19	N/A	0.019

App = Application; N/A = Not applicable
[1] Incorporation was not accounted for in EECs since the label only specifies that seeds should be incorporated to at least 0.5 inches; TERRPLANT accounts for incorporation at >1 inch.

3.5. Ecological Effects Characterization

3.5.1. Ecotoxicity Data

Toxicity endpoints used in risk estimation and characterization for the proposed new uses of flupyradifurone are shown in **Table 30** through **Table 36**. In the current risk assessment, the most sensitive endpoints available from registrant-submitted toxicity studies classified as fully reliable (*i.e.*, acceptable) or reliable with restrictions (*i.e.*, supplemental) are the endpoints selected for quantitative use in risk estimation[19].

[18] http://www.epa.gov/oppefed1/models/terrestrial/
[19] Only studies classified as "Supplemental" for quantitative use are used for risk quotient calculations in EFED assessments; supplemental studies that are not deemed useful for quantifying risks are used for risk characterization purposes only.

3.3.1.1. Aquatic Organisms

Acute toxicity data for fish and aquatic invertebrates are summarized in **Table 30**.

Based on the available data, flupyradifurone technical grade active ingredient (TGAI) is slightly toxic to the rainbow trout (*Oncorhynchus mykiss*), fathead minnow (*Pimephales promelas*), sheepshead minnow (*Cyprindon variegatus*), and African clawed frog (*Xenopus laevis*) on an acute exposure basis. For all aquatic vertebrates (fish and aquatic-phase amphibians) tested, the acute 96-hr LC_{50} value exceeded the highest concentration tested, *i.e*, the acute toxicity estimates were non-definitive values at or close to the limit test concentration of 100 mg ai/L. Flupyradifurone is slightly toxic to *Daphnia magna* and the Eastern oyster (*Crassostrea virginica*) with non-definitive acute toxicity estimates; however, the compound is very highly toxic to non-biting midges (*Chironomus riparius*) and highly toxic to mysid shrimp (*Americamysis bahia*) on an acute exposure basis.

Several acute toxicity tests were also carried out with the flupyradifurone formulation BY02960 SL 200 G (17.1% ai) indicating that it is practically non-toxic to rainbow trout, common carp (*Cyprinus carpio*), and *D. magna* on an acute exposure basis. However, it should be noted that acute toxicity tests with the formulation were not carried out with mysid shrimp or chironomids, which are the most sensitive aquatic animals to flupyradifurone TGAI.

Acute toxicity was also evaluated for several transformation products of flupyradifurone for freshwater vertebrates and invertebrates (**Table 30**); none of these studies indicate that the degradates tested are more toxic than the parent compound. Based on toxicity tests using the most sensitive freshwater invertebrate, *C. riparius*, M47, M48, and 6-CNA degradates are less toxic than the parent compound by several orders of magnitude.

Chronic toxicity data for fish and aquatic invertebrates exposed to flupyradifurone are summarized in **Table 31**.

In a 35-day early life-stage toxicity test with fathead minnows exposed to flupyradifurone TGAI (MRID 48843714), fry survival in the lowest (0.62 mg ai/L) and highest (8.40 mg ai/L) treatment groups was significantly lower than the negative control group. The difference observed for the lowest treatment group was not considered to be biologically significant because of the lack of a dose-response relationship for fry survival. The reduction in fry survival in the highest treatment group as compared to the negative control was approximately 7%. There were no other statistically or biologically significant effects for other endpoints, which included hatchability, larvae survival, or growth (length and weight). Given that a slight reduction in fry survival was the only effect detected in this study, it is uncertain whether this test provides sufficient characterization of the effects of the chemical on fish early life stages. This uncertainty will be considered further in the Risk Description (**Section 4.2**) by determining whether the test was conducted at high enough concentrations relative to environmental exposure concentrations to alleviate potential chronic risk concerns for aquatic vertebrates.

In a 21-day chronic life-cycle study with *D. magna* (MRID 48843711), the NOAEC and LOAEC were 3.42 and 6.73 mg ai/L, respectively, based on reduced (4.8%) parental body length at test termination.

A 21-day chronic toxicity study with *D. magna* was also carried out with the transformation product, BYI 02960-succinamide (M48; MRID 48843712). The NOAEC and LOAEC were determined to be 46.3 and 106 mg/L, based on increased parental age of first offspring. Therefore, the BYI 02960-succinamide degradate appears to be less toxic to *D. magna* than the parent compound on a chronic exposure basis.

No chronic toxicity data are available for estuarine/marine fish. Furthermore, an acute-to-chronic ratio from freshwater fish cannot be used to derive a chronic toxicity endpoint for estuarine/marine fish because the available acute toxicity endpoints for freshwater fish are non-definitive (*i.e.*, greater than the highest concentration tested).

In a 28-day life cycle toxicity test with mysid shrimp (*A. bahia*; MRID 48843713), there was a statistically significant decrease ($p<0.05$) in reproduction of 60% in the 23.6 µg ai/L treatment group. The NOAEC and LOAEC for reproduction were determined to be 13.2 and 23.6 µg ai/L, respectively.

Several degradates were also evaluated in chronic toxicity tests with aquatic invertebrates (**Table 31**); none of these studies indicated that the transformation products are more toxic than the parent compound on a chronic exposure basis. For the succinamide degradate (M48), *D. magna* are an order of magnitude less sensitive as compared to the parent compound. Based on the chronic toxicity tests using *C. riparius*, the sodium difluoroacetate and 6-chloronicotinic acid degradates are less toxic than the parent compound by three orders of magnitude.

Toxicity endpoints for aquatic plants exposed to flupyradifurone and its formulations are shown in **Table 32**.

The freshwater vascular plant duckweed (*Lemna gibba*) was exposed to flupyradifurone TGAI (MRID 48843731) over a 7-day period; the EC_{50} regarding growth inhibition was determined to be >67.7 mg ai/L for both frond number and dry weight. The NOAEC was determined to be 34.2 and 67.7 mg ai/L for frond number and dry weight, respectively.

The effects of flupyradifurone TGAI (MRID 48843732) on the growth of the freshwater green alga, *Pseudokirchneriella subcapitata*, were tested; the 96-hour EC_{50} and NOAEC were determined to be >80 and 80 mg ai/L, respectively, based on nominal test concentrations. It should be noted that 80 mg ai/L was the highest concentration tested and was reported to be at the practical limit of solubility for flupyradifurone.

The effects of several transformation products of flupyradifurone (MRID 48843733 to 48843735) were also tested on green algae. Although none of the studies showed adverse effects at any of the concentrations tested, some degradates were not tested at high enough concentrations to demonstrate that they are less toxic than the parent compound. However, similar to the parent compound, all of the toxicity tests with green algae provided non-definitive endpoints in which the 72-hr EC_{50} value exceeds the highest concentration tested.

Table 30. Acute toxicity endpoints used in risk estimation and characterization for fish and aquatic invertebrates exposed to flupyradifurone.

Study Type	Species	Test Material	Endpoints[1,2] (mg ai/L) (Study Duration)	Toxicity Classification (MRID) (Study Classification)
Acute toxicity to freshwater vertebrates	Rainbow trout (*Oncorhynchus mykiss*)	TGAI (96.2%)	LC_{50} > 74.2 95% CI = N/A (limit test) (96 hour test)	Slightly toxic (488843705) (Fully Reliable)
		BYI 02960 SL 200 G (17.1%)	LC_{50} > 100 95% CI = N/A (96 hour test)	Practically non-toxic (48844510) (Fully Reliable)
		BYI 02960 Succinamide (M48) (97.8%)	LC_{50} > 114 95% CI = N/A (96 hour test)	Practically non-toxic (48843708) (Fully Reliable)
		Sodium Difluoroacetate (>99%)	LC_{50} > 10.35 (96 hour test)	Slightly toxic (48843709) (Fully Reliable)
	Fathead minnow (*Pimephales promelas*)	TGAI (96.2%)	LC_{50} > 70.5 95% CI = N/A (96 hour test)	Slightly toxic (48843706) (Fully Reliable)
	Common carp (*Cyprinus carpio*)	BYI 02960 SL 200 G (17.1%)	LC_{50} > 100 95% CI = N/A (limit test) (96 hour test)	Practically non-toxic (48844511) (Fully Reliable)
	African clawed frog (*Xenopus laevis*)	TGAI (96.2%)	LC_{50} > 74.2 95% CI = N/A (48 hour test)	Slightly toxic (48843737) (Reliable with Restrictions)
Acute toxicity to freshwater invertebrates	Water flea (*Daphnia magna*)	TGAI (96.2%)	EC_{50} > 77.6 95% CI = N/A (48 hour test)	Slightly toxic (48843701) (Fully Reliable)
		BYI 02960 SL 200 G (17.1%)	EC_{50} = 115 95% CI = 85-179 (48 hour test)	Practically non-toxic (48844509) (Fully Reliable)
		Sodium Difluoroacetate	EC_{50} > 10.2 (48 hour test)	Slightly toxic (48843702)

Study Type	Species	Test Material	Endpoints[1,2] (mg ai/L) (Study Duration)	Toxicity Classification (MRID) (Study Classification)
		(>99%)		(Fully Reliable)
		6-chloronicotinic acid (99.7%)	EC_{50} > 95.1 (48 hour test)	Slightly toxic (44988409) (Fully Reliable)
	Non-biting midge (*Chironomus riparius*)	TGAI (96.2%)	**EC_{50} = 0.0639** 95% CI = 0.0431 – 0.1113 Slope=4.1 (48 hour test)	Very highly toxic (48843738) (Reliable with Restrictions)
		BYI 02960 Succinamide (M48) (97.8%)	EC_{50} > 104.5 (48 hour test)	Practically non-toxic (48843739) (Reliable with Restrictions)
		BYI 02960 Azabicyclosuccinamide (M47) (48%)	EC_{50} > 114.5 (48 hour test)	Practically non-toxic (48843740) (Reliable with Restrictions)
	Non-biting midge (*Chironomus tentans*)	6-CNA (97%)	EC_{50} > 1 (96 hour test)	Practically non-toxic (44558901) (Reliable with Restrictions)
Acute toxicity to estuarine/marine fish	Sheepshead minnow (*Cyprinidon variegatus*)	TGAI (96.2%)	LC_{50} > 83.9 95% CI = N/A (96 hour test)	Slightly toxic (48843710) (Fully Reliable)
Acute toxicity to estuarine/marine crustaceans	Mysid shrimp (*Americamysis bahia*)	TGAI (96.2%)	**LC_{50} = 0.25** 95% CI = N/A Slope=4.2 (96 hour test)	Highly toxic (48843704) (Fully Reliable)
Toxicity to estuarine/marine mollusks – shell deposition	Eastern oyster (*Crassostrea virginica*)	TGAI (96.2%)	LC_{50} > 29 95% CI = N/A (96 hour test)	Slightly toxic (48843703) (Fully Reliable)

[1] **Bolded** values are the most sensitive endpoint(s) for a given taxonomic group and will be used in risk estimation.

Table 31. Chronic toxicity endpoints used in risk estimation and characterization for fish and aquatic invertebrates exposed to flupyradifurone.

Study Type	Species	Test Material	Endpoints[1] (mg ai/L)	Effects (MRID) (Study Classification)
Early life stage toxicity to freshwater fish	Fathead minnow (*Pimephales promelas*)	TGAI (96.2%)	**NOAEC = 4.41** LOAEC = 8.40	Fry survival (48843714) (Fully Reliable)
Chronic toxicity to freshwater invertebrates	Water flea (*Daphnia magna*)	TGAI (96.2%)	NOAEC = 3.42 LOAEC = 6.73	Reduced parental length; living neonates/adult; average offspring/surviving female (48843711) (Fully Reliable)
		BYI 02960 Succinamide (M48) (97.8%)	NOAEC = 46.3 LOAEC = 106	Increased parental age at first offspring emergence (48843712) (Fully Reliable)
	Non-biting midge (*Chironomus riparius*)	TGAI (96.2%)	**NOAEC = 0.0033[2]** LOAEC = 0.0085[2]	Emergence rate; development rate (48843741) (Reliable with Restrictions)
		BYI 02960 SL 200 G (17.1%)	NOAEC = 0.012 LOAEC = 0.024	Emergence rate; development rate (48844519) (Reliable with Restrictions)
		Sodium Difluoroacetate (>99%)	NOAEC = 105 LOAEC >105 (single concentration test)	No effects at single concentration tested (48843742) (Reliable with Restrictions)
		6-CNA (97%)	NOAEC = 102 LOAEC >102 (single concentration test)	No effects at single concentration tested (48843743) (Reliable with Restrictions)
Chronic toxicity to estuarine/marine crustaceans	Mysid shrimp (*Americamysis bahia*)	TGAI (96.2%)	**NOAEC = 0.0132** LOAEC = 0.0236	Mean number of young produced per reproductive day per female (48843713) (Reliable with Restrictions)

[1] **Bolded** values are the most sensitive endpoint(s) for a given taxonomic group and will be used in risk estimation.
[2] Time-weighted average pore water concentration at 0.01 and 0.02 mg ai/L nominal test levels for NOAEC and LOAEC, respectively.

Table 32. Toxicity endpoints used in risk estimation and characterization for aquatic plants exposed to flupyradifurone.

Study Type	Species	Test Material	Endpoints[1] (mg ai/L)	Effects (MRID) (Study Classification)
Toxicity to vascular aquatic plants	Duckweed (*Lemna gibba*)	TGAI (96.2%)	EC_{50} > 67.7 95% CI = N/A **NOAEC = 34.2**	Mean frond counts; mean cumulative biomass and mean growth rate based on frond number (48843731) (Reliable with Restrictions)
Toxicity to nonvascular aquatic plants	Green algae (*Pseudokirchneriella subcapitata*)	TGAI (96.2%)	EC_{50} > 80 95% CI = N/A NOAEC = 80 (96 hour test)	No effects up to highest concentration tested (48843732) (Fully Reliable)
		BYI 02960 SL 200 G (17.1%)	EC_{50} > 42.8 95% CI = N/A NOAEC = 42.8 (96 hour test)	No effects up to highest concentration tested (48844518) (Fully Reliable)
		Sodium Difluoroacetate (>99%)	EC_{50} > 10.2 95% CI = N/A NOAEC = 10.2 (72 hour test) (single concentration test)	No effects at single concentration tested (48843733) (Reliable with Restrictions)
		BYI 02960 Succinamide (M48) (97.8%)	EC_{50} > 11.4 95% CI = N/A NOAEC = 11.4 (72 hour test) (single concentration test)	No effects at single concentration tested (48843734) (Reliable with Restrictions)
		6-CNA (97%)	EC_{50} > 100 95% CI = N/A NOAEC = 100 (72 hour test)	No effects up to highest concentration tested (48843735) (Reliable with Restrictions)

[1] **Bolded** values are the most sensitive endpoint(s) for a given taxonomic group and will be used in risk estimation.

3.3.1.2. Terrestrial Organisms

Birds and Mammals: Acute

Acute toxicity data for birds, mammals, honeybees, and earthworms (*Eisenia foetida*) exposed to flupyradifurone are summarized in **Table 33**.

Based on the available data, flupyradifurone is moderately toxic to birds (bobwhite quail, *Colinus virginianus*; canary, *Serinus canaria*) on an acute oral exposure basis and slightly toxic to birds (bobwhite quail, *C. virginianus*; mallard duck, *Anas platyrhynchos*) on a subacute dietary exposure basis. Several of the acute oral and subacute dietary toxicity studies indicate effects on feed consumption, body weight, or body weight gain suggesting that the chemical can affect either the willingness of birds to consume diets containing elevated levels of flupyradifurone or to consume food (*i.e*., anorexia). In a 28-day acute oral toxicity test conducted with chickens (*Gallus gallus domesticus*) exposed to flupyradifurone TGAI (MRID 48843717), there was nearly complete cessation in feed consumption at the limit dose (2000 mg ai/kg bw), which was associated with reduced body weight in treated birds relative to controls throughout the study period. Similarly, in an acute oral toxicity study with chickens exposed to the BYI 02960 SL 200 G formulation (MRID 48844513), all dosed birds avoided food almost completely after treatment, but all five birds tested commenced feeding by test Day 7. In a bobwhite quail acute oral toxicity study (MRID 48843715), there was reduced body weight and body weight gain at concentrations ≥200 mg ai/kg bw. In avian subacute dietary studies (MRIDs 48843718, 48843719), there was reduced body weight and body weight gain in bobwhite quail and mallard ducks at dietary concentrations of ≥1133 and ≥2238 mg ai/kg diet, respectively, during the 5-day exposure period; however, there were no treatment-related mortalities in either study and there was some evidence of recovery at lower test concentrations during the 3-day post-exposure period. When corrected for percent active ingredient, flupyradifurone TGAI appears to be more toxic than the BYI 02960 SL 200 G formulation to bobwhite quail on an acute oral exposure basis. Although there is uncertainty regarding the potential effects of flupyradifurone on food consumption, it is important to note that these effects are not well characterized in the subacute dietary toxicity studies since the studies are not typically designed to support hypothesis testing.

Flupyradifurone is classified as practically nontoxic to mammals on an acute oral exposure basis. No mortality was observed at the limit dose (2000 mg/kg bw) in an acute oral toxicity study with the rat (*Rattus norvegicus*), which was the most sensitive mammalian species tested; therefore, the 96-hr LD_{50} is non-definitive, *i.e*., LD_{50}>2,000 mg ai/kg bw. The US EPA Office of Pesticide Programs Health Effects Division (HED) has concluded that flupyradifurone exhibits low acute toxicity to mammals by all exposure routes (EPA Toxicity Category III or IV) (USEPA, 2014).

Terrestrial Invertebrates: Acute

Flupyradifurone TGAI is practically non-toxic to young adult honeybees (*Apis mellifera*) on an acute contact basis; however, the compound is highly toxic to young adult bees on an acute oral exposure basis. In the acute contact toxicity test (MRID 48843722), some bees showed movement coordination problems or lethargy at the two highest concentrations (100 and 200 µg ai/bee) starting at 48 hours of exposure. In the acute oral toxicity test (MRID 48843722), behavioral abnormalities (*e.g.*, movement coordination problems and lethargy) were observed in bees at doses >0.34 µg ai/bee only within the first four hours of dosing. In addition, the acute oral test resulted in a steep dose response relationship in which 0 and 100 percent mortality were observed at 0.34 and 2.8 µg ai/bee, respectively.

Several formulations and transformation products of flupyradifurone were also tested on honeybees on acute contact and oral exposure bases (MRIDs 48844514, 48844515, and 48843723 to 48843727). The major formulation of flupyradifurone (BYI 02960 SL 200 G) was shown to be approximately eight times more toxic to honeybees than the TGAI on an acute contact exposure basis, but of similar toxicity to honeybees on an acute oral exposure basis. Acute contact and oral toxicity data were also generated for a mixture containing BYI 02960 SL 200 G (17.1%) + tebuconazole EW 250C G (17%) at a ratio of 1:7.5, respectively. Results indicate that the toxicity of BYI 02960 SL 200 G increased by 116-fold and 6.1-fold via the contact and oral exposure routes, respectively, and that the toxicity of the formulation containing tebuconazole increased by >22-fold via contact. The rationale for mixing the two formulations in the particular ratio tested was not provided. For all transformation products tested, the acute oral and contact LD_{50} values for all tests were non-definitive values and were greater than the highest dose tested, although some studies resulted in mortalities at the doses tested.

Table 33. Acute toxicity endpoints used in risk estimation and characterization for terrestrial animals exposed to flupyradifur

Study Type	Species	Test Material	Endpoints[1]	
Acute oral toxicity to birds	Bobwhite quail (*Colinus virginianus*)	TGAI (96.2%)	**LD_{50} = 232 mg ai/kg bw** 95% CI = 173-313 mg ai/kg bw Probit Slope=5.9	
		BYI 02960 SL 200 G (17.1%)	LD_{50} = 459 mg ai/kg bw 95% CI = 339-6616 mg ai/kg bw	
	Chicken (*Gallus gallus domesticus*)	TGAI (96.2%)	LD_{50} > 2000 mg/kg bw[4] (limit test)	
		BYI 02960 SL 200 (17.1%)	LD_{50} > 2000 mg/kg bw[4] (limit test)	
	Canary (*Serinus canaria*)	TGAI (96.2%)	LD_{50} = 330 mg ai/kg bw[3] 95% CI = 215-625 mg ai/kg bw Probit Slope=2.3	
Subacute dietary toxicity to birds	Bobwhite quail (*Colinus virginianus*)	TGAI (96.2%)	LC_{50} >4,876 mg ai/kg diet LD_{50} >470 mg/kg/day	
	Mallard duck (*Anas platyrhynchos*)	TGAI (96.2%)	LC_{50} >4,741 mg/kg diet LD_{50} >825 mg/kg/day	
Acute oral toxicity to mammals[5]	Norway rat (*Rattus norvegicus*)	TGAI (96.2%)	LD_{50} >2000 mg/kg bw	
Acute contact and oral toxicity to honeybees	Honey bee (*Apis mellifera*)	TGAI (99.5%)	**LD_{50} = 122.8 µg ai/bee (contact)** **LD_{50} = 1.2 µg ai/bee (oral)**	P
		BYI 02960 SL 200 G (17.0%)	LD_{50} = 15.7 µg ai/bee (contact) LD_{50} = 3.2 µg ai/bee (oral)	P

Study Type	Species	Test Material	Endpoints[1]	Toxicity Classification (MRID) (Study Classification)
		BYI 02960 FS480G	LD_{50} = 68.6 µg ai/bee (contact) LD_{50} = 3.4 µg ai/bee (oral)	Practically non-toxic (contact) Highly toxic (oral) (48844711) (Fully Reliable)
		BYI 02960 SL200G (17.0%) + Tebuconazole EW 250C G (25.4%)	LD_{50} = 1 µg ai/bee (contact) LD_{50} = 0.2 µg ai/bee (oral)	Highly toxic (contact) Highly toxic (oral) (4844515) (Fully Reliable)
		BYI0296 Difluoroethyl-amino-furanone (DFEAF) (99.2%)	LD_{50} > 100 µg ai/bee (contact) LD_{50} > 81.5 µg ai/bee (oral)	Practically non-toxic (contact) Practically non-toxic (oral) (48843723) (Fully Reliable)
		BYI 02960 Hydroxy (95.5%)	LD_{50} > 100 µg ai/bee (contact) LD_{50} > 105.3 µg ai/bee (oral)	Practically non-toxic (contact) Practically non-toxic (oral) (48843724) (Reliable with Restrictions)
		DFA (95.8%)	LD_{50} > 100 µg ai/bee (contact) LD_{50} > 107.9 µg ai/bee (oral)	Practically non-toxic (contact) Practically non-toxic (oral) (48843725) (Fully Reliable)
		6-CNA (98.8%)	LD_{50} > 100 µg ai/bee (contact) LD_{50} > 107.1 µg ai/bee (oral)	Practically non-toxic (contact) Practically non-toxic (oral) (48843726) (Fully Reliable)
		6-chloro-picolylalcohol (98.9%)	LD_{50} > 100 µg ai/bee (contact) LD_{50} > 106.7 µg ai/bee (oral)	Practically non-toxic (contact) Practically non-toxic (oral) (48843727) (Fully Reliable)
14-day toxicity to earthworms	Earthworm (*Eisenia foetida*)	TGAI (96.2%)	LC_{50} = 213.2 mg ai/kg soil NOAEC < 5 mg ai/kg soil LOAEC = 5 mg ai/kg soil	NA (48843746) (Reliable with Restrictions)
		BYI 02960 SL 200 G (17.1%)	LC_{50} = 709 mg ai/kg soil NOAEC < 100 mg ai/kg soil LOAEC = 100 mg ai/kg soil	NA (48844547) (Reliable with Restrictions)

Study Type	Species	Test Material	Endpoints[1]	Toxicity Classification (MRID) (Study Classification)
		DFA (95.8%)	LC_{50} > 1,000 mg ai/kg soil NOAEC = 31.3 mg ai/kg soil LOAEC = 62.5 mg ai/kg soil	NA (48843747) (Reliable with Restrictions)
		6-CNA (99.7%)	LC_{50} > 1,000 mg ai/kg soil NOAEC = 1,000 mg ai/kg soil LOAEC > 1,000 mg ai/kg soil	NA (48843748) (Reliable with Restrictions)

1 **Bolded** values are the most sensitive endpoint(s) for a given taxonomic group and will be used in risk estimation.
2 Dose-response slope data not available. The default value of 4.5 (with 95% confidence intervals of 2.0 and 9.0) is used to derive the probability of an individual effect (Urban and Cook 1986).
3 Uncertainty surrounding endpoint since 50% mortality was observed at the 175 mg ai/kb bw treatment level.
4 Almost complete reduction in food consumption in all dosed birds at limit dose (2000 mg ai/kg bw).
5 Mammalian toxicity data were reviewed by OPP Health Effects Division (USEPA) as part of the Global Joint Review for flupyradifurone.

Birds and Mammals: Chronic

Chronic laboratory toxicity data for birds and mammals exposed to flupyradifurone are shown in **Table 34**.

In an avian reproduction study with mallard ducks (MRID 48843721) exposed to flupyradifurone in the diet, there was neither mortality nor significant clinical symptoms or compound-related adverse effects observed at any treatment level over the 20-week test period up to the highest concentration tested (NOAEC = 845 mg ai/kg diet). There is some uncertainty surrounding this study since adverse growth effects were observed at concentrations >1175 mg ai/kg diet in the avian dietary study with mallard ducks, although no effects to parental growth were reported in the reproduction study. In addition, avian reproduction tests should typically capture a reproductive effect or test up 5,000 mg ai/kg-diet. This uncertainty will be further addressed in the Risk Description (**Section 4.2**).

In a 23-week avian reproduction study with the bobwhite quail (MRID 48843720), at the highest concentration tested (999 mg ai/kg-diet), there were statistically significant ($p<0.05$) effects on parental survival and female body weight gain (69% reduction), a biologically significant effect on female parental body weight (13% reduction), as well as effects to several reproductive parameters including regressed ovaries and/or fewer maturing follicles, the number of eggs laid (44% reduction) and the number of eggs set (47% reduction), the number of viable embryos (45% reduction) and the number of live embryos (44% reduction), number hatched (49% reduction), percent number hatched of eggs laid, percent number hatched of live embryos (8% reduction), initial hatchling body weight (14% reduction), and for 14-d survivor body weight (11% reduction) and 14-day survivors. Therefore, the NOAEC for both parental toxicity and reproduction endpoints is 302 mg ai/kg diet.

In mammals, reductions in body weight with associated decreases in body weight gains and sometimes food consumption were commonly seen in various studies and in all species of the test animals (rats, mice, dogs and rabbits) with repeated dosing.

In a rat 2-generation study evaluated by HED (MRID 48844119), the most sensitive effects were decreased body weights and body weight gains in F2 pups at 38.7 mg/kg/day, resulting in an offspring NOAEL of 7.7 mg/kg/day. Some reproductive effects, including decreased litter size, occurred at higher dietary concentrations (137 mg/kg/day), resulting in a reproductive NOAEL of 38.7 mg/kg/day.

Parental body weight gain and food consumption effects were also observed in the rat developmental toxicity study (MRID 48844116) at 150 mg/kg/day, resulting in a study NOAEL of 50 mg/kg/day. In addition, decreased body weight and body weight gain also occurred in rat and mice chronic carcinogenicity studies (MRIDs 48844122 and 48844123) at 81 and 224 mg/kg/day, respectively, resulting in NOAELs of 15.8 and 43, respectively. In a rabbit developmental toxicity study (MRID 48844117), there were reductions in both maternal and fetal body weights at 80 mg/kg/day, resulting in a NOAEL of 40 mg/kg/day.

HED analysis (USEPA, 2014) indicates that most major metabolites of flupyradifurone exhibit lower toxicity to mammals than the parent compound except for DFA. A 90-day oral feeding study with DFA in rats (MRID 48844153) resulted in a variety of effects to non-apical endpoints (*i.e.*, not directly relatable to survival, growth, or reproductive effects), including the production of black foci in the stomach, focal glandular erosion/necrosis, as well as slight decreases in hemoglobin, mean corpuscular volume, mean corpuscular hemoglobin, and hematocrit were also found. In addition to these effects, reduced body weight (10% on Week 13) and decreased food consumption occurred at doses of 66.2 and 78.8 mg/kg bw for males and females, respectively, resulting in NOAEL values of 12.7 and 15.6 mg/kg bw for males and females, respectively. It is noted that when comparing the NOAEL and LOAEL of this study to a similar 90-day oral study with the parent compound (MRID 48844111; NOAEL and LOAEL of 38 and 156 mg/kg bw, respectively), on a molar basis, the NOAELs and LOAELs of DFA and the parent are comparable, however, the effects are different. Furthermore, it is noted that in the rat metabolism study with flupyradifurone, DFA was formed and detected as approximately 6% of the administered dose. Since 90-day rat oral toxicity data are not typically used by EFED to quantify chronic effects to mammals, a comparison is made in the Risk Characterization between the estimated exposure of mammals to DFA following applications of flupyradifurone and the dose at which effects to apical endpoints were observed in the 90-day rat oral study with DFA.

Terrestrial Invertebrates: Chronic

Chronic laboratory toxicity data for honeybees exposed to flupyradifurone are shown in **Table 34**.

Several 10-day laboratory feeding studies with caged adult honeybees were performed for flupyradifurone TGAI (MRID 48843762) and for several degradates (MRIDs 48843763 to 48843767). In these studies, bees were exposed to sucrose solution containing one or more concentrations of the test substance continuously for 10 days and mortality and sublethal effects were observed. None of the studies showed prolonged (>1 day) treatment-related effects in any of the treatment groups. However, it should be noted that the 10-day study with the TGAI was carried out at 4.64 µg ai/bee over 10 days which corresponds to 0.464 µg ai/bee/day, which is only 2.5 times lower than the 48-hour oral LD_{50} for the TGAI (1.2 µg ai/bee), suggesting that a minimum threshold may be needed to result in mortality.

A 22-day *in vitro* laboratory toxicity test was carried out with honey bee larvae exposed to flupyradifurone TGAI (MRIDs 48843768). Individual larvae were exposed to the test substance on Days 4-6 of the test through artificial spiked diet at nominal concentrations of 150, 600, 2500 and 10,000 µg ai/kg diet. Five independent test runs were performed, all of which comply with the validity criteria as proposed by the INRA-method (January, 2008) for testing pesticide toxicity to honeybee brood in laboratory conditions. However, control mortality was generally high (range: 16.7 to 32.4% across test runs and may have affected the ability of the study to detect effects to mortality. No statistically significant effects ($p<0.05$) on mortality were detected up to Day 22 in any of the test runs. Therefore, the NOAEC for this test is >10,000 µg ai/kg-diet (0.44 µg ai/bee/day) indicating that the compound did not appear to affect larval development or adult emergence at the concentrations tested; however, the wide range of mortality rates in the control larvae is a source of uncertainty.

A foliage residue toxicity test (MRID 48843728) was carried out on honeybees exposed to plant foliage (alfalfa) treated with BYI 02960 200 SL (17.1% ai) after weathering for various time periods (3, 8, and 24 hours). Mortality and sublethal effects such as changes in behavior were evaluated. All foliage was treated at a nominal application rate of 0.18 lbs ai/A, which represents the single maximum foliar application rate in the proposed label for BYI 02960 200 SL formulation. Honeybees showed no treatment-related effects on behavior or survival when exposed for 24 hours to alfalfa foliage collected after any of the weathering intervals; therefore the RT_{25} for this study is <3 hours.

Additional non-guideline contact toxicity data on non-target terrestrial arthropods exposed to formulated flupyradifurone (BYI 02960 SL 200 G) are considered supplemental information in the current risk assessment and are summarized in **Table 35**. Species tested include the predatory mite (*Typhlodromus pyri)*, the parasitoid wasp (*Aphidius rhopalosiphi*), ladybird beetles (*Coccinella septempunctata*), rove beetles (*Aleochara bilineata*) and the flower bug (*Orius laevigatus*), all of which are routine OECD test species. Of these, the wasp was the most sensitive with median lethal rate (LR_{50}) equivalent to an application rate of 0.5 g ai/ha (0.0004 lbs ai/A). These studies are further characterized in the Risk Description (**Section 4.2**).

Terrestrial Plants

Toxicity data for terrestrial plants exposed to flupyradifurone formulation BYI 02960 SL 200 are shown in **Table 36**.

A 21-day vegetative vigor study (MRID 48843730) was carried out on eleven terrestrial plant species (seven dicotyledonous and four monocotyledonous species) sprayed once with a single application rate of BYI 02960 SL 200 of 0.365 lbs ai/A (410 g ai/ha). There were no adverse effects on survival in all the species tested. Slight phytotoxicity was observed in *Brassica napus* (oilseed rape), *Cucumis sativus* (cucumber), *Lycopersicon esculentum* (tomato) and *Zea mays* (corn). Inhibition in shoot length and shoot dry weight were below 25% in all the species tested. There was statistically significant ($p<0.05$) inhibition in shoot dry weight in *Fagopyrum esculentum* (buckwheat) and *B. napus*, with 12% and 7% reductions as compared to control plants.

A 21-day seedling emergence study (MRID 48843729) was carried out on eleven terrestrial plant species (seven dicotyledonous and four monocotyledonous species) sprayed once with a single application rate of BYI 02960 SL 200 of 0.365 lbs ai/A (410 g ai/ha). Effects on emergence, survival, and shoot length did not exceed 25% in any of the species tested; therefore an IC_{25} was not established. There were statistically significant ($p<0.05$) inhibitions in shoot length (13.8%) and shoot dry weight (19.7%) in *F. esculentum* (buckwheat). Slight phytotoxicity was observed in *L. esculentum* (tomato), *Avena sativa* (oat) and *Z. mays* (corn) and moderate effects were seen in *F. esculentum* and *Glycine max* (soybean).

Table 34. Chronic toxicity endpoints used in risk estimation and characterization for terrestrial animals exposed to flupyradifurone.

Study Type	Species	Test Material	Endpoints[1]	Effects (MRID) (Study Classification)
Avian reproduction	Bobwhite quail (*Colinus virginianus*)	TGAI (96.2%)	**NOAEC = 302 mg/kg diet** **NOAEL = 40 mg/kg bw/day** LOAEC = 999 mg/kg diet	Parental survival and body weight; multiple reproductive endpoints (48843720) (Fully Reliable)
	Mallard duck (*Anas platyrhynchos*)	TGAI (96.2%)	NOAEC = 845 mg/kg diet NOAEL = 83 mg/kg bw/day LOAEC = >845 mg/kg diet	No effects up to the highest level tested. (48843721) (Reliable with Restrictions)
Chronic toxicity to mammals[2] – two-generation reproduction	Norway rat (*Rattus norvegicus*)	TGAI (96.2%)	**NOAEL = 7.7 mg/kg bw/day** LOAEL = 38.7 mg/kg bw/day	Pup body weight and body weight gain (48844119) (Fully Reliable)
10-day honey bee laboratory feeding study	Honey bee (*Apis mellifera*)	TGAI (96.2%)	NOAEC = 10,000 µg ai/L NOAEC = 4.64 µg ai/bee LOAEC > 10,000 µg ai/L	No effects observed at highest concentration tested (48843762) (Reliable with Restrictions)
		BYI0296 Difluoroethyl-amino-furanone (99.2%)	NOAEC = 10,000 µg ai/L LOAEC > 10,000 µg ai/L (single concentration test)	No effects observed at single concentration tested (48843763) (Reliable with Restrictions)
		BYI 02960 Hydroxy (95.5%)	NOAEC = 10,000 µg ai/L LOAEC > 10,000 µg ai/L (single concentration test)	No effects observed at single concentration tested (48843764) (Reliable with Restrictions)
		DFA (95.8%)	NOAEC = 10,000 µg ai/L LOAEC > 10,000 µg ai/L (single concentration test)	No effects observed at single concentration tested (48843765) (Reliable with Restrictions)
		6-CNA (98.8%)	NOAEC = 10,000 µg ai/L LOAEC > 10,000 µg ai/L (single concentration test)	No effects observed at single concentration tested (48843766) (Reliable with Restrictions)
		6-chloro-picolylalcohol (98.9%)	NOAEC = 10,000 µg ai/L LOAEC > 10,000 µg ai/L (single concentration test)	No effects observed at single concentration tested (48843767)

Study Type	Species	Test Material	Endpoints[1]	Effects (MRID) (Study Classification)
				(Reliable with Restrictions)
Toxicity to honey bee larvae (*in vitro* test)	Honey bee (*Apis mellifera*)	TGAI (96.2%)	NOAEC = 10,000 µg ai/L NOAEC = 0.44 µg ai/larva LOAEC > 10,000 µg ai/L	No effects observed at highest concentration tested (48843768) (Reliable with Restrictions)
56-day toxicity to earthworms	Earthworm (*Eisenia foetida*)	BYI 02960 SL 200 G (17%)	NOAEC = 1.5 mg ai/kg soil LOAEC = 2.7 mg ai/kg soil	Reduced mean number of juveniles (47923827) (Reliable with Restrictions)
		DFA (95.8%)	NOAEC = 62 mg ai/kg soil LOAEC = 110 mg ai/kg soil	Reduced mean number of juveniles (48843750) (Reliable with Restrictions)
		6-CNA (98.8%)	NOAEC = 95 mg ai/kg soil LOAEC = 100 mg ai/kg soil	Reduced mean number of juveniles (48843751) (Reliable with Restrictions)

[1] **Bolded** values are the most sensitive endpoint(s) for a given taxonomic group and will be used in risk estimation.
[2] Mammalian toxicity data were reviewed by OPP Health Effects Division (USEPA) as part of the Global Joint Review for flupyradifurone (USEPA, 2014).

Table 35. Additional non-guideline toxicity data for hazard characterization of beneficial arthropods exposed to flupyradifurone.

Study Type	Species	Test Material	Endpoints (lbs ai/A)	Effects[1] (MRID) (Study Classification)
Toxicity to predatory mite	Predatory mite (*Typhlodromus pyri*)	BYI 02960 SL 200 (17.0%)	LR_{50} = 0.015 (17 g ai/ha) 95% CI: 0.012-0.019	Survival (48843745) (Reliable with Restrictions)

Study Type	Species	Test Material	Endpoints (lbs ai/A)	Effects[1] (MRID) (Study Classification)
	Predatory mite (*Typhlodromus pyri*)	BYI 02960 SL 200 (17.0%)	LR_{50} = 0.16 (177 g ai/ha) 95% CI: 0.13-0.18	Survival (48844540) (Reliable with Restrictions)
Toxicity to parasitoid wasp	Parasitoid wasp (*Aphidius rhopalosiphi*)	BYI 02960 SL 200 G (17.1%)	LR_{50} < 0.00045 (0.5 g ai/ha) (85% mortality at lowest concentration tested)	Survival (48843744) (Reliable with Restrictions)
		BYI 02960 SL 200 (17.0%)	LR_{50} = 0.0018 (2.02 g ai/ha) 95% CI: 0.0014-0.0023	Survival (48844539) (Reliable with Restrictions)
Toxicity to ladybird beetle	Ladybird beetle (*Coccinella septempunctata* L.)	BYI 02960 SL 200 (17.0%)	LR_{50} = 0.24 (274 g ai/ha) 95% CI: 0.17-0.29	Survival (48844541) (Reliable with Restrictions)
Toxicity to rove beetle	Rove beetle (*Aleochara bilineata*)	BYI 02960 SL 200 (17.0%)	ER_{50} = 0.26 (>300 g ai/ha)[1] 95% CI: NA	NA (48844542) (Reliable with Restrictions)

LR = Lethal Body Residues

[1] ER_{50} value depicts F1 reproduction endpoint.

Table 36. Toxicity endpoints used in risk estimation and characterization for terrestrial and semi-aquatic plants exposed to flupyradifurone.

Study Type	Test Material	Most Sensitive Species	Endpoints (lbs ai/A)	Effects (MRID) (Study Classification)
Terrestrial plant toxicity: Tier II seedling emergence	BYI 02960 SL 200	Monocot: all species tested	IC_{25} > 0.365 NOAEL = 0.365 LOAEL > 0.365	NA (48843729) (Reliable with Restrictions)
		Dicot: buckwheat	IC_{25} > 0.365 NOAEL < 0.365	Shoot dry weight and shoot length

Study Type	Test Material	Most Sensitive Species	Endpoints (lbs ai/A)	Effects (MRID) (Study Classification)
		(*Fagopyrum esculentum*)	LOAEL = 0.365	(48843729) (Reliable with Restrictions)
Terrestrial plant toxicity: Tier II vegetative vigor	BYI 02960 SL 200	Monocot: all species tested	IC_{25} > 0.365 NOAEL = 0.365 LOAEL > 0.365	NA (48843730) (Reliable with Restrictions)
		Dicot: buckwheat (*Fagopyrum esculentum*)	IC_{25} > 0.365 NOAEL < 0.365 LOAEL = 0.365	Shoot dry weight (48843730) (Reliable with Restrictions)

Terrestrial Invertebrate Semi-Field and Full-field Studies

Multiple higher-tiered honeybee effects studies were carried out including semi-field, full field, and colony feeding studies. The results of these studies are summarized in **Table 37** and are described in detail below.

Six semi-field studies were conducted on honeybees (MRIDs 48844531 to 48844536) in which nucleus colonies were enclosed in gauze tunnels and bees were allowed to forage on the bee-attractive plant, *Phacelia tanacetifolia*, which was sprayed with different applications of flupyradifurone. There was no consistent adverse effects observed across the studies aside from some increases in mortality and decreases in foraging activity immediately following applications, particularly at full bloom while bees were actively foraging. These affects often appeared transitory, and in some cases there was recovery from the effects on mortality by test termination. Generally, the low number of replicates (2 or 3) per treatment group in these studies may have limited the ability to statistically detect effects on mortality and possibly other sublethal endpoints even when they appeared to be biologically significant. In addition, several studies suffered from large variation in starting colony size which may have prevented detection of adverse effects to treatment groups as well as confounded the interpretation of mortality due to limited forage.

In Fall 2010, two honeybee field studies were conducted in Germany and France (MRIDs 48844516 and 48844517) in which bare soil was sprayed with approximately 0.28 lbs ai/A (310 g ai/ha) BYI 02960 SL 200 G (1st application) and oil-seed rape seeds treated with BYI 02960 FS 480 G at 0.01 lbs ai/lb seeds (10 g ai/kg seeds) were sown on the same day. This was followed up by two foliar applications the following spring (2011) with approximately 0.18 lbs ai/A (200 g ai/ha) BYI 02960 SL 200 G both at early flowering (2nd application) and full flowering (3rd application). In both studies, flupyradifurone residues in canola pollen, nectar, wax, and flower were measured. Honeybee colonies were kept in the vicinity of treated or untreated (control) oil-seed rape until the end of flowering upon which time they were moved to a different untreated area and observed through overwintering until spring 2012.

In both studies, the highest flupyradifurone residues in flowers, pollen and nectar (from foraging bees) occurred at the time of the second foliar application at full bloom. Maximum residues in comb pollen, nectar, and wax varied, but generally occurred one week to several months after the second application indicating that residues were translocated within the hives to varying extents. In the field study in Germany, the full bloom (3rd) application was made in May of 2011, and comb residues of pollen, nectar, and wax also peaked in May of 2011. In the field study in France, the full bloom (3rd) application was made in April of 2011, and comb residues of pollen, nectar, and wax reached their maximum levels in early May, June, and August of 2011, respectively. These results indicate some conflict in the timing and extent to which flupyradifurone may be translocated to hives under realistic field scenarios.

Neither study indicated any treatment-related adverse effects on mortality, flight intensity, behavior around the hives and within the treated crop throughout the entire field exposure period; and neither study indicated any treatment related adverse effects on honeybee health, colony development, colony strength (numbers of adult bees and brood [eggs, larvae, pupae]), colony health, brood development, food storage, colony weight), and overall colony vitality throughout the entire field exposure period and throughout the entire monitoring period until the end of overwintering in Spring 2012. However, in both studies, honeybees were clearly foraging on alternative food sources besides the oil-seed rape based on pollen analysis which may have affected the level of exposure during the study. Yet, residue analyses demonstrate that residues were brought back to the colonies and were translocated to the hives; therefore, there were multiple routes of exposure to both adult and in-hive bees even though the bees may not have foraged exclusively on the treated crops. In the field study conducted in Germany, there is an association between application of the test item during full flowering of the crop and during bee flight (3rd spray application) in terms of intensive grooming behavior and coordination problems in a small fraction of bees in the test item treatment group; however, based on the parameters measured in the study, these effects appear to have been transitory and did not appear to affect the overall performance of the colonies relative to controls.

In a honeybee colony feeding study (MRID 48843771), honeybees were exposed to flupyradifurone TGAI mixed in the diet (pollen and nectar). Colonies were enclosed in gauze tunnels during the late spring/early summer. In the first week, honeybees underwent acclimation (*i.e.*, no test item treatment) to the tunnels followed by 6 weeks of exposure to fortified diet (600, 2500, and 10000 µg ai/kg diet) or untreated control; there were 5 replicates per treatment and control. The enclosure contained perennial ryegrass that was regularly cut short to eliminate other potential food sources. After the exposure period, bees were removed from the tunnels and allowed to forage freely; colonies were monitored until the following spring which included overwintering; there were 3 test item treatment groups. Throughout the entire confined acclimation (1 week) and subsequent exposure period (6 weeks), honey bee colonies received *ad libitum* untreated sugar diet (*i.e.*, sugar syrup made of sucrose, glucose, and fructose for carbohydrate supply) and pollen diet (*i.e*., pollen mixed with sugar syrup, for protein supply). The pollen diet was provided inside the respective hives; whereas, the sugar diet was offered in Petri-dishes outside the hives. Both the sugar and pollen diets were replenished three times a week. The amount of pollen and sugar syrup consumed were evaluated by weighing over regular intervals.

The results of the colony feeding study indicate that concentrations up to and including 10,000 µg ai/kg diet did not result in adverse acute, short-term, or long-term effects on mortality, colony strength and development, brood development, food storage, honey bee behavior, and overall hive vitality and colony health, as well as on overwintering performance. There were occasional isolated incidences of increased worker mortality in the 2500 µg ai/kg diet group relative to the control during the confinement period, but this is well within the range of natural variability and therefore is not considered biologically significant. There were also occasional incidences of decreased flight intensity in the 600 and 2500 µg ai/kg diet groups as compared to controls during the confinement period, but this was considered of low biological significance since the total number of foraging honeybees and total average food consumption did not differ between treated and the control colonies during the confinement period. Moreover, measured food consumption was not reduced in the days following instances when statistically significant lower flight intensity was detected.

Generally, there were no adverse effects observed for colony strength during the entire course of the feeding study including exposure and post-exposure periods and overwintering. However, just before the colonies entered their overwintering period in October, the average number of honeybees per exposure group was 9083, 8484, 11083 and 7866 for control, 600, 2500, and 10000 µg ai/kg diet groups, respectively; while at the last colony assessment after overwintering (March), the average number of honeybees per exposure group was 6079, 4053, 4752 and 4174 for control, 600, 2500, and 10000 µg ai/kg diet groups, respectively. Although it appears that control colonies survived overwintering with higher numbers of adult bees, there was no statistical difference between treatment and control groups.

Although there were no treatment-related adverse effects detected in honey bee brood, it is clear that confinement in tunnels during the acclimation and exposure periods decreased the average number of brood cells in hives in both control and treatment groups possibly due to stress on the colonies. It should also be noted that the number of brood cells differed widely among groups during the evaluation periods before and after overwintering. In October, before overwintering, the average number of brood cells per exposure group was 1830, 2670, 1056 and 1920 for control, 600, 2500, and 10000 µg ai/kg diet groups, respectively; while, at the last colony assessment after overwintering (March), the average number of brood cells per exposure group was 6270, 3770, 6560 and 5328 for control, 600, 2500, and 10000 µg ai/kg diet groups, respectively. However, there was no statistical difference between treatment and control groups and the increase in brood in the spring indicates that each of the colonies maintained its queen and was able to successfully initiate brood production after overwintering.

No treatment related adverse effects were detected in nectar/honey and pollen storage. There was a substantial (approximately 40%) but not statistically significant decrease in honey storage in the 600 µg ai/kg diet relative to the control group following the 6-week exposure period, but this was attributed to disease-like symptoms in one particular colony which was subsequently removed from the study. At the last colony assessment after overwintering (March), the average number of cells containing pollen/bee bread per exposure group was 3950, 1650, 2792 and 2136 for control, 600, 2500, and 10000 µg ai/kg diet groups, respectively, indicating a difference in pollen storage between the lowest and highest treatment groups and the control group. However, there was no statistical difference between treatment and control groups for pollen storage throughout the study.

gher tiered honeybee semi-field and field studies for flupyradifurone.

Test Design	Effects Evaluated	Residue Measures	Study Results/ Conclusions	Study Deficiencies
ies				
Application to *Phacelia anacetifolia* at full flowering under confined conditions gauze tunnels); honeybees placed in tunnels 4 days before application and were emoved from tunnels 8 days after application and allowed o forage freely until end of est (27 days after exposure); enoxycarb (150 g ai/ha) and hiamethoxam (50 g ai/ha) used as toxic references; 3 eplicates per treatment except thiamethoxam, 2 eplicates) Study location: Germany)	Mortality, foraging activity, behavior , colony strength, brood and food development, hive vitality	Not measured	Foraging activity reduced slightly in 150 g ai/ha group after treatment, but recovery occurred after several hours; no effects on mortality of workers and pupae, extent of nectar and pollen stores, egg laying activity, larval and pupal abundance, colony strength, hive weight development and overall hive vitality in treatment groups.	Application rate below maximum proposed single foliar application rate for many crops (0.18 lbs ai/A); statistics were not performed on data and a measure of variability (standard deviation or standard error) was not included with the means for the various parameters.
Application to *Phacelia anacetifolia* at full flowering under confined conditions gauze tunnels); honeybees placed in tunnels 2 days before application and were emoved from tunnels 12 days after application and allowed to forage freely until end of test (28 days after exposure); 2 replicates per reatment; fenoxycarb (150 g i/ha) and thiamethoxam (50	Mortality, foraging activity, behavior , colony strength, brood and food development, hive vitality	Not measured	Foraging activity reduced slightly in 150 g ai/ha group after treatment, but recovery occurred after several hours; no effects on mortality of workers and pupae, extent of nectar and pollen stores, egg laying activity, larval and pupal abundance, colony strength, hive weight development and overall hive vitality in treatment groups.	Application rate below maximum proposed single foliar application rate for many crops (0.18 lbs ai/A); a measure of variability (standard deviation or standard error) was not included with the means for the various parameters.

Test Substance, Application Rate (MRID, Study Classification)	Test Design	Effects Evaluated	Residue Measures	Study Results/ Conclusions	Study Deficiencies
	references (Study location: Germany)				
BYI 02960 SL 200 G (17% ai) Foliar: 1 treatment group with 2 applications of 0.18 lbs ai/A (200 g ai/ha) (48844533, Reliable with Restrictions)	Application to *Phacelia tanacetifolia* at end of inflorescence emergence (1st application) and at full flowering (2nd application) 10 days later (at approximately 2 pm during active foraging); honeybees placed in gauze tunnels 6 days after 1st application and removed 11 days after 2nd application and allowed to forage freely until end of test; 3 replicates per treatment; dimethoate (400 g ai/ha) used as toxic references (Study location: Germany)	Mortality, foraging activity, behavior , colony strength, brood and food development, hive vitality; residues (flowers, pollen, nectar)	<u>Day of 2nd application</u> Flower: 7.5-17.3 mg/kg <u>7 days after 2nd application</u> Flower: 0.14-3.1 mg/kg Pollen (combs): 1.1-6.2 mg/kg Nectar (combs): ≤0.014 mg/kg	Some transient effects observed 1-2 days following 2nd (full-bloom) application; mortality in treatment group was statistically significantly increased relative to control following 2nd application for 1 day (mean number of dead bees was 4 and 18 for control and treatment groups, respectively); mean number of forager bees/m^2 reduced following 2nd application for 2 days relative to control. No observed lasting treatment-related adverse effects on adult bee mortality, flight intensity, behavior of bees on crop and around the colony, number of bees (colony strength), abundance of brood (sum of cells containing eggs, larvae and pupae), and development of food storage area (sum of cells containing nectar and pollen).	
BYI 02960 SL 200 G (17% ai) Foliar: 1 treatment group with 1	Application to *Phacelia tanacetifolia* on bare soil at day of sowing (1st application), at beginning of flowering (2nd application),	Mortality, foraging activity, behavior , colony strength, brood and food	<u>Day of 3rd application</u> Flower: 37.6 mg/kg <u>7 days after 3rd application</u>	Some treatment-related effects on mortality and flight intensity of foraging adult bees after 3rd (full-bloom) application; mean daily	Large disparity in colony population size between control and treatment groups at beginning of study confounds treatment-

Test Substance, Application Rate (MRID, Study Classification)	Test Design	Effects Evaluated	Residue Measures	Study Results/ Conclusions	Study Deficiencies
application of 0.28 lbs ai/A (300 g ai/ha) followed by 2 applications of 0.18 lbs ai/A (200 g ai/ha) (48844534, Reliable with Restrictions	and at full flowering (3rd application); 7 days between 2nd and 3rd application; honeybees placed in gauze tunnels 4 days after 2nd application and removed 7 days after 3rd application and allowed to forage freely until end of test; 3 replicates per treatment; dimethoate (400 g ai/ha) used as toxic references (Study location: Denmark)	development, hive vitality; residues (flowers, wax, nectar)	Flower: 0.199 mg/kg Pollen (combs): 3.0-8.1 mg/kg Nectar: 0.015-0.031 mg/kg	mortality of the test group was 5 times greater than the control during 7-day period after 3rd (full-bloom) application and was statistically significant; reductions in flight intensity occurred during some days after 3rd application, but on other days flight intensity in the treatment group was higher than controls.	related effects on mortality; treatment colonies >3 times larger at test set-up; in addition, too few replicates resulted in lack of statistical power to detect effects in mortality.
BYI 02960 SL 200 G (16.9% ai) Foliar: 1 treatment group with 1 application of 0.28 lbs ai/A (300 g ai/ha) followed by 2 applications of 0.18 lbs ai/A (200 g ai/ha) (48844535, Reliable with Restrictions	Application to *Phacelia tanacetifolia* on bare soil at day of sowing (1st application), at beginning of flowering (2nd application), and at full flowering (3rd application); 18 days between 2nd and 3rd application; honeybees placed in gauze tunnels 14 days after 2nd application and removed 7 days after 3rd application and allowed to forage freely until end of test; 3 replicates per treatment; dimethoate (400 g ai/ha) used as toxic references (Study location: Italy)	Mortality, flight intensity, behavior, condition of the colonies and development of bee brood, mean values of the different brood; residues (flowers, pollen, nectar)	Day of 3rd application Flower: 9.5-20 mg/kg 7 days after 3rd application Flower: 0.70-3.6 mg/kg Nectar: ≤0.003 mg/kg	Possible effects to mortality in treatment group during period before and after the 3rd (full-bloom) application, which was confounded by high mortality in control hives; there appeared to be eventual recovery from effects of mortality; decreased flight intensity of worker bees in treatment group was observed on day of 3rd application (following application).	Time between 2nd and 3rd applications (18 days) is longer than proposed label application intervals; consistently high mortality in control hives inhibited assessment of treatment-related effects; food scarcity due to large colony size may have led to higher than expected mortality in some colonies making it difficult to determine if mortality was treatment related (major deficiency); residues in pollen could not be measured due to lack of sample during confined exposure period

Test Substance, Application Rate (MRID, Study Classification)	Test Design	Effects Evaluated	Residue Measures	Study Results/ Conclusions	Study Deficiencies
BYI 02960 SL 200 G (16.9% ai) Foliar: 1 treatment group with 2 applications of 0.18 lbs ai/A (200 g ai/ha) (48844536, Reliable with Restrictions	Application to *Phacelia tanacetifolia* at end of inflorescence emergence (1st application) and at full flowering (2nd application) 10 days later; honeybees placed in gauze tunnels 5 days after 1st application and removed 7 days after 2nd application and allowed to forage freely until end of test; 3 replicates per treatment; dimethoate (400 g ai/ha) used as toxic references (Study location: Germany)	Mortality, flight intensity, behavior, condition of the colonies and development of bee brood, mean values of the different brood; residues (flowers, pollen, nectar	End of Study (27 days after 2nd application) Pollen: 0.002-0.004 mg/kg Nectar/honey: ≤0.017 Wax: 0.001-0.062 mg/kg	Reduced flight intensity was observed on the day of the 2nd application as well as on some further days during the confined exposure period	Residue samples were only collected in the test item treatment group at the end of the study when residues would have been diluted by pollen/nectar from other floral sources; too few replicates resulted in lack of statistical power to detect effects in mortality.
Full Field Studies					
BYI 02960 FS 480 G (39.9% ai) Seed treatment BYI 0296 SL 200 G (16.9% ai) Soil: 1 application at 0.28 lbs ai/A (310 g ai/ha) Foliar: 2 applications at 0.18 lbs ai/A (204 g ai/ha) (48844516,	In September 2010, winter oil-seed rape seeds were treated with BYI 02960 FS 480 G seed treatment (10 g ai/kg seed) and planted at 5.98 kg seed/ha; soil treated with 0.28 lbs ai/A foliar spray (1st application) prior to sowing (same day); subsequent applications of 0.18 lbs ai/A at early flowering (2nd application) and full flowering (3rd application) in spring 2011; 8 colonies per treatment group and control; bees were allowed to forage on treated/untreated crop and	Mortality, flight intensity, behavior, brood and food status; colony health and strength; residues (flowers, pollen, nectar, wax, soil)	Ranges (across study) Flowers (1.9-30.4 mg/kg) Pollen, combs: 0.3-3.9 mg/kg Pollen, bee bread: 0.004-2.0 mg/kg Pollen, forager bees: 0.2-14.3 mg/kg Nectar, combs: 0.4-1.3 mg/kg Nectar/honey: 0.05-1.4 mg/kg Nectar, forager bees: 0.3-4.1 mg/kg Wax, combs: 0.006-.15 mg/kg Wax: 0.005-0.17 mg/kg	Generally, no treatment-related adverse effects observed on mortality, flight intensity in the test field, behaviour of the honeybees around the hives and within the treated crop throughout the entire field exposure period, honeybee health, colony development (including colony strength, colony health, brood- and food development, weight development of the colonies), overall colony vitality; possible correlation between application of the test item during full flowering of the crop and during bee flight	Bees were clearly foraging on alternative food sources (non-oil-seed rape) based on pollen analysis which may have affected the level of exposure during the study

Test Substance, Application Rate (MRID, Study Classification)	Test Design	Effects Evaluated	Residue Measures	Study Results/ Conclusions	Study Deficiencies
Reliable with Restrictions	then moved to untreated area at end of flowering period (Study location: Germany)		Soil: 0.075 mg/kg The highest pollen and nectar (from forager bees) and flower residues were collected from samples following 2nd foliar application (full bloom); the highest average pollen, nectar, and wax residues occurred approximately in combs occurred approximately 1 week after the 2nd foliar application	(3rd spray application) in terms of intensive grooming behavior and coordination problems in a small fraction of bees in the test item treatment group.	
BYI 02960 FS 480 G (39.9% ai) Seed treatment BYI 0296 SL 200 G (16.9% ai) Soil: 1 application at 0.28 lbs ai/A (310.5 g ai/ha) Foliar: 2 applications at 0.19 lbs ai/A (208-212 g ai/ha) (48844517, Reliable with	In autumn 2010, winter oil-seed rape seeds were treated with BYI 02960 FS 480 G seed treatment (10 g ai/kg seed) and planted at 5.98 kg seed/ha; soil treated with 0.28 lbs ai/A foliar spray (1st application) prior to sowing (same day); subsequent applications of 0.18 lbs ai/A at early flowering (2nd application) and full flowering (3rd application) in spring 2011; 8 colonies per treatment group and control; bees were allowed to forage on treated/untreated crop and then moved to untreated area at end of flowering period	Mortality, flight intensity, behavior, brood and food status; colony health and strength; residues (flowers, pollen, nectar, wax, soil)	Ranges (across study) Flowers (0.08-36 mg/kg) Pollen, combs: 0.004-1.2 mg/kg Pollen, forager bees: 0.17-21 mg/kg Nectar, combs: 0.012-0.92 mg/kg Nectar, forager bees: ≤ 4.3 mg/kg Wax, combs: ≤ 0.039 mg/kg Soil: 0.061 mg/kg The highest pollen (from forager bees) and flower residues were collected from samples	Generally, no treatment-related adverse effects observed on mortality, flight intensity, behavior around the hives and within the treated crop throughout the entire field exposure period, honeybee health, colony development (including colony strength, colony health, brood development and food storage, colony weight), as well as on overall colony vitality throughout the entire field exposure period and throughout the entire monitoring period, until the end of overwintering in spring 2012.	Bees were clearly foraging on alternative food sources (non-oil-seed rape) based on pollen analysis which may have affected the level of exposure during the study

Test Substance, Application Rate (MRID, Study Classification)	Test Design	Effects Evaluated	Residue Measures	Study Results/ Conclusions	Study Deficiencies
Restrictions	(Study location: France)		following 2nd foliar application (full bloom); the highest average pollen, nectar, and wax residues in combs occurred approximately 1, 2, and 4 months, respectively, after 2nd foliar application indicating a build-up of residues in hives		
Colony Feeding Study					
BYI 02960 TGAI (96.2% ai) 3 treatment groups (spiked diet) of 600, 2500, and 10000 µg ai/kg diet (48843771, Reliable with Restrictions)	Honeybees exposed to flupyradifurone in gauze tunnels with fortified diet (both pollen and sugar syrup) for 42 days; afterward bees were allowed to forage freely and were monitored until following spring (through overwintering); 3 test item treatment groups (600, 2500, and 10000 µg ai/kg diet) plus untreated control; 5 replicates per treatment; tunnels erected over ryegrass regularly cut short inside tunnels; (Study location: Germany)	Mortality, foraging activity, behavior, colony and brood development, general health status, absolute number and percentages of different life-stage bees), number of comb cells with pollen/bee bread and nectar/honey supplies, presence of pests/pathogens, residues in spiked food supply	N/A	No observed adverse acute, short-term, and long-term effects on mortality, colony strength and development, brood development, food storage, honey bee behavior, and overall hive vitality and colony health, as well as on overwintering performance. Occasional significant effects on worker mortality and flight intensity during the confinement period, but not considered biologically significant.	Enclosure in tunnels caused stress to bees and brood were reduced by approximately 1/3 after being placed into tents; pollen was not stored during confinement and may have impaired development of brood and adult numbers.

3.5.1. Incident Reports

Flupyradifurone has no existing registrations in North America; therefore, this assessment assumes that there are no existing incident reports associated with flupyradifurone uses in the United States.

4. Risk Characterization

Toxicity data and exposure estimates for flupyradifurone are used to evaluate the potential for adverse ecological effects on non-target species. This screening-level assessment employs a deterministic risk estimation method, based on risk quotient (RQ) values, to provide a metric of potential risks (**Section 4.1**). The RQ provides a comparison of exposure estimates to toxicity endpoints (*i.e.*, the estimated exposure concentrations are divided by acute and chronic toxicit values, respectively). The resulting unitless RQ values are compared to the Agency's levels of concern (LOCs). The LOCs, when exceeded, are used by the Agency to indicate when the use a pesticide, as directed by the label, has the potential to cause adverse effects to non-target organisms. The potential for risk is characterized further in the Risk Description (**Section 4.2**) based on the risk estimation results and other relevant information about toxicity, ecosystems potentially at risk, and the environmental fate and transport characteristics of flupyradifurone. cases where an RQ value exceeds the risk to listed species LOC, the potential for risk to listed species is characterized in greater detail in **Section 5**.

4.1. Risk Estimation

4.1.1. Aquatic Organisms

RQ values are calculated for estimating acute and chronic risk to fish and aquatic invertebrate as well as risks to aquatic plants, where the submitted ecotoxicity data are sufficient to use in estimation. In this assessment, risk estimates for fish also apply for aquatic-phase amphibians for which fish serve as surrogates. Toxicity data for aquatic animals and plants reported in **Section 3.3.1.1** in terms of mg/L (ppm) are converted to µg/L (ppb) so that both exposure and toxicity are in similar units, *i.e*., µg/L.

Flupyradifurone is slightly to practically non-toxic to aquatic vertebrates (fish and aquatic-pha amphibians). Since acute toxicity values for freshwater and estuarine/marine fish are non-definitive (*i.e.*, greater than the highest concentration tested), RQ values could not be calculate However, estimated peak exposure concentrations in surface water for all proposed uses are several orders of magnitude lower than the highest concentration tested in available fish acute toxicity studies; therefore, the likelihood of acute mortality in freshwater or estuarine/marine f following exposure to flupyradifurone from any of the uses evaluated is presumed to be low.

Chronic RQ values for freshwater fish for all proposed uses are ≤0.01, and therefore do not exceed the chronic risk LOC (RQ≥1) for fish.

Acute and chronic RQ values were derived for freshwater and estuarine/marine invertebrates inhabiting both water column and benthic aquatic environments using surface water and sediment pore water EECs, respectively. For freshwater invertebrates inhabiting surface waters, all proposed uses exceed the acute risk to listed species LOC (RQ ≥0.05), while the acute risk to non-listed species LOC (RQ ≥0.5) is only exceeded for foliar application when there are ≥2 crop cycles per season. For estuarine/marine invertebrates inhabiting surface waters, most proposed uses exceed the acute risk to listed species LOC (RQ ≥0.05), but none exceed the LOC (RQ ≥0.5) for risk to non-listed species. Chronic RQ values for freshwater and estuarine/marine invertebrates inhabiting surface waters exceed the chronic risk LOC (RQ≥1) for the majority of uses. For a small number of uses, when the contribution of spray drift to exposure levels is removed or when ground spray is modeled as compared to aerial spray, acute risk to listed species and/or chronic LOCs are no longer exceeded for freshwater and/or estuarine/marine invertebrates.

For sediment-dwelling freshwater invertebrates, represented by non-biting midges, all proposed uses except for prickly pears exceed the acute risk to listed species and chronic risk LOCs (RQ ≥0.05 and ≥1, respectively), while the acute risk to non-listed species LOC (RQ ≥0.5) is only exceeded for foliar applications when there are ≥2 crop cycles per season (**Table 39**). For sediment-dwelling estuarine/marine invertebrates, represented by mysid shrimp, the majority of proposed uses exceed the acute risk to listed species LOC (RQ ≥0.05), and approximately half of the proposed uses exceed the chronic risk LOC (RQ ≥1), but none exceed the non-listed species LOC (RQ ≥0.5).

For both vascular aquatic plants and algae, risk to listed species RQ values are <0.01 and do not exceed the LOC (RQ≥1). Risk to non-listed species RQ values could not be calculated since available EC_{50} values are non-definitive (*i.e.*, greater than the highest concentrations tested); however, EC_{50} values for both duckweed and green algae are at least two orders of magnitude higher than peak surface water EECs. Therefore, the likelihood for adverse effects to aquatic plants from the proposed uses of flupyradifurone is considered low.

As the endpoints for flupyradifurone formulations are higher than those of the TGAI, RQ values are not calculated for aquatic organisms using spray drift-only EECs.

Further characterization of the potential for adverse effects to aquatic organisms, based on the available data, is provided as part of the Risk Description in **Section 4.2.1**.

Table 38. RQ values for aquatic invertebrates exposed to flupyradifurone TGAI in the water column.

Use Site	Single App. Rate lbs ai/A, # of App, MRI in days	App Type	Drift/ No Drift	Parent Only EEC in µg/L		RQ Values			
				Water Column		Freshwater Invertebrates		Estuarine/Marine Invertebrates	
				Peak	21-day	Acute LC_{50}= 63.9µg/L[1]	Chronic NOAEC= 3.3 µg/L[2]	Acute LC_{50}= 250 µg/L[3]	Chronic NOAEC= 13.2 µg/L[4]
Crop Group 15: Cereal Grains	0.18 (0.20), 2x, 7d	F, A	Drift	23.5	22.8	**0.37**	**6.91**	**0.09**	**1.73**
			No Drift	19.4	18.8	**0.30**	**5.70**	**0.08**	**1.42**
		F, G	Drift	22.2	21.6	**0.35**	**6.55**	**0.09**	**1.64**
			No Drift	20.2	19.6	**0.32**	**5.94**	**0.08**	**1.48**
Cotton	0.18 (0.20), 2x, 7d	F, A	Drift	19.6	19	**0.31**	**5.76**	**0.08**	**1.44**
			No Drift	16.2	15.6	**0.25**	**4.73**	**0.06**	**1.18**
		F, G	Drift	18.6	17.9	**0.29**	**5.42**	**0.07**	**1.36**
			No Drift	16.9	16.3	**0.26**	**4.94**	**0.07**	**1.23**
Peanut	0.18 (0.20), 2x, 7d	F, A	Drift	10.9	10.4	**0.17**	**3.15**	0.04	0.79
			No Drift	7.31	6.97	**0.11**	**2.11**	0.03	0.53
		F, G	Drift	10.9	10.4	**0.17**	**3.15**	0.04	0.79
			No Drift	9.13	8.95	**0.14**	**2.71**	0.04	0.68
Root Veg. (except Sugarbeet) and Tuberous and Corm Veg.	0.18 (0.20), 2x, 7d	F, A	Drift	18.9	18.3	**0.30**	**5.55**	**0.07**	**1.39**
			No Drift	16	15.3	**0.25**	**4.64**	**0.06**	**1.16**
		F, G	Drift	18.2	17.4	**0.28**	**5.27**	**0.07**	**1.32**
			No Drift	16.7	15.9	**0.26**	**4.82**	**0.06**	**1.20**
	2 crop cycles	A	Drift	39.3	37.6	**0.62**	**11.4**	**0.16**	**2.85**
	3 crop cycles			43.0	41.7	**0.67**	**12.6**	**0.17**	**3.16**
	4 crop cycles			45.8	44.5	**0.72**	**13.5**	**0.18**	**3.37**
	5 crop cycles			63.8	62.1	**1.0**	**18.8**	**0.26**	**4.7**
Legume Veg. (Succulent or Dried)	0.18 (0.20), 2x, 7d	F, A	Drift	16.8	16.1	**0.26**	**4.88**	**0.06**	**1.22**
			No Drift	12.3	11.8	**0.19**	**3.58**	**0.05**	0.89
		F, G	Drift	19.1	19.7	**0.30**	**5.97**	**0.08**	**1.49**
			No Drift	17.8	18.2	**0.28**	**5.52**	**0.07**	**1.38**
Fruiting Vegetables	0.18 (0.20), 2x, 7d	F, A	Drift	19.9	18.9	**0.31**	**5.73**	**0.08**	**1.43**
			No Drift	16.5	15.6	**0.26**	**4.73**	**0.06**	**1.18**
		F, G	Drift	19.8	20.5	**0.31**	**6.21**	**0.08**	**1.55**
			No Drift	17.1	17.5	**0.27**	**5.30**	**0.07**	**1.33**
	0.40, 1x	S, G	No Drift	14.8	15.1	**0.23**	**4.58**	**0.06**	**1.14**
Cucurbit Vegetables	0.18 (0.20), 2x, 7d	F, A	Drift	19.8	20.5	**0.31**	**6.21**	**0.08**	**1.55**
			No Drift	17.1	17.5	**0.27**	**5.30**	**0.07**	**1.33**
		F, G	Drift	19.1	19.7	**0.30**	**5.97**	**0.08**	**1.49**
			No Drift	17.8	18.2	**0.28**	**5.52**	**0.07**	**1.38**
	0.37 (0.40),	S, G	No Drift	16.9	17.6	**0.26**	**5.33**	**0.07**	**1.33**
Hops	0.14 (0.15), 1x	F, A	Drift	5.57	5.41	**0.09**	**1.64**	0.02	0.41
			No Drift	2.14	2.07	0.03	0.63	0.01	0.16
		F, G	Drift	3.98	3.89	**0.06**	**1.18**	0.02	0.29
			No Drift	2.29	2.22	0.04	0.67	0.01	0.17
Citrus Fruit	0.18 (0.20), 2x, 7d	F, A	Drift	24.4	25.1	**0.38**	**7.61**	**0.10**	**1.90**
			No Drift	22	22.5	**0.34**	**6.82**	**0.09**	**1.70**
			Drift Only,	3.45	--	**0.05**	--	--	--

Use Site	Single App. Rate lbs ai/A, # of App, MRI in days	App Type	Drift/ No Drift	Parent Only EEC in µg/L		RQ Values			
				Water Column		Freshwater Invertebrates		Estuarine/Marine Invertebrates	
				Peak	21-day	Acute LC_{50}= 63.9µg/L[1]	Chronic NOAEC= 3.3 µg/L[2]	Acute LC_{50}= 250 µg/L[3]	Chronic NOAEC= 13.2 µg/L[4]
			No Runoff						
		F, AB	Drift	22.2*	23*	**0.35***	**6.97**	**0.09***	**1.74***
		F, G	Drift	22.6	23.3	**0.35**	**7.06**	**0.09**	**1.77**
	0.37 (0.40),	S, G	No Drift	23.1	22.2	**0.36**	**6.73**	**0.09**	**1.68**
Pome Fruit	0.18 (0.20), 2x, 7d	F, A	Drift	12.5	11.8	**0.20**	**3.58**	**0.05**	0.89
			No Drift	8.73	8.26	**0.14**	**2.50**	0.03	0.63
		F, AB	Drift	10.5	9.99	**0.16**	**3.03**	0.04	0.76
		F, G	Drift	11	10.4	**0.17**	**3.15**	0.04	0.79
			No Drift	9.1	8.61	**0.14**	**2.61**	0.03	0.65
Bushberry	0.18 (0.20), 2x, 7d	F, A	Drift	9.65	9.43	**0.15**	**2.86**	0.04	0.71
			No Drift	6.06	6.04	**0.09**	**1.83**	0.02	0.46
		F, G	Drift	7.98	7.96	**0.12**	**2.41**	0.03	0.60
			No Drift	6.32	6.29	**0.10**	**1.91**	0.03	0.48
Low Growing Berry (excluding Cranberry)	0.18 (0.20), 2x, 7d	F, A	Drift	12.9	12.8	**0.20**	**3.88**	**0.05**	0.97
			No Drift	10.2	9.66	**0.16**	**2.93**	0.04	0.73
		F, G	Drift	14.3	16.2	**0.22**	**4.91**	**0.06**	**1.23**
			No Drift	10.6	10.1	**0.17**	**3.06**	0.04	0.77
Small Fruit Vine Climbing (except Fuzzy Kiwifruit)	0.18 (0.20), 2x, 7d	F, A	Drift	9.65	9.43	**0.15**	**2.86**	0.04	0.71
			No Drift	6.06	6.04	**0.09**	**1.83**	0.02	0.46
		F, G	Drift	8.28	8.14	**0.13**	**2.47**	0.03	0.62
			No Drift	6.31	6.03	**0.10**	**1.83**	0.02	0.46
Tree Nut	0.18 (0.20), 2x, 7d	F, A	Drift	9.73	9.26	**0.15**	**2.81**	0.04	0.70
			No Drift	6.55	6.51	**0.10**	**1.97**	0.03	0.49
		F, G	Drift	6.82	6.54	**0.11**	**1.98**	0.03	0.50
Prickly Pear	0.18 (0.20), 2x, 7d	F, G	Drift	2.98	2.86	**0.05**	0.87	0.01	0.22
			No Drift	1.24	1.22	0.02	0.37	<0.01	0.09
Nongrass Animal Feeds (Forage, Fodder, Straw, Hay)	0.18 (0.20), 2x, 7d	F, A	Drift	25.2	24	**0.39**	**7.27**	**0.10**	**1.82**
			No Drift	21.8	20.8	**0.34**	**6.30**	**0.08**	**1.58**
			Drift Only, No Runoff	3.55	--	**0.06**	--	--	--
		F, G	Drift	23.50	22.30	**0.37**	**6.76**	**0.09**	**1.69**
			No Drift	21.80	20.70	**0.34**	**6.27**	**0.08**	**1.57**
Soybean Seed Treatment	0.37 (0.40), 1x	S, G	No Drift	6.97	6.61	**0.11**	**2.00**	0.03	0.50

Bolded values exceed the Agency's Level of Concern (LOC) for acute risk to listed (RQ $\geq$ 0.05) and/or non-listed (RQ $\geq$ 0.5) aquatic invertebrates or chronic risk to aquatic invertebrates (RQ $\geq$ 1).

[1] Based on 48-hr LC_{50} of 63.9 µg/L for the non-biting midge (*Chironomous riparius*) (MRID 48843738).

[2] Based on time-weighted average measured flupyradifurone concentration in pore-water during a 28-day toxicity study for chironomids (NOAEC of 3.3 µg/L. Effects on emergence rate and developmental rate were observed at 8.5 µg/L (MRID 48843741).

[3] Based on 96-hr LC_{50} of 250 µg/L for the mysid shrimp (MRID 48843704).

[4] Based on the NOAEC of 13.2 µg/L for the mysid shrimp (MRID 48843713). Effects on mean number of young produced per reproductive day per female were observed at 23.6 µg/L.

* Based on residues of parent plus unextracted residues.

Table 39. RQ values for sediment-dwelling invertebrates exposed to flupyradifurone TGAI.

Use Site	Single App. Rate (kg ai/ha), # of App, MRI in days	App Type	Drift/ No Drift	Parent only EEC in µg/L		RQ Values			
				Pore Water		Freshwater Invertebrates		Estuarine/Marine Invertebrates	
				Peak	21-day	Acute LC_{50}= 63.9µg/L[1]	Chronic NOAEC= 3.3 µg/L[2]	Acute LC_{50}= 250 µg/L[3]	Chronic NOAEC= 13.2 µg/L[4]
Crop Group 15: Cereal Grains	0.18 (0.20), 2x, 7d	F, A	Drift	18.9	19	**0.30**	**5.76**	**0.08**	**1.44**
			No Drift	15.5	15.6	**0.24**	**4.73**	**0.06**	**1.18**
		F, G	Drift	17.9	17.9	**0.28**	**5.42**	**0.07**	**1.36**
			No Drift	16.2	16.3	**0.25**	**4.94**	**0.06**	**1.23**
Cotton	0.18 (0.20), 2x, 7d	F, A	Drift	15.9	15.9	**0.25**	**4.82**	**0.06**	**1.20**
			No Drift	13.3	13.3	**0.21**	**4.03**	**0.05**	**1.01**
		F, G	Drift	15.1	15.1	**0.24**	**4.58**	**0.06**	**1.14**
			No Drift	13.8	13.8	**0.22**	**4.18**	**0.06**	**1.05**
Peanut	0.18 (0.20), 2x, 7d	F, A	Drift	8.11	8.1	**0.13**	**2.45**	0.03	0.61
			No Drift	5.44	5.44	**0.09**	**1.65**	0.02	0.41
		F, G	Drift	8.46	8.47	**0.13**	**2.57**	0.03	0.64
			No Drift	7.14	7.15	**0.11**	**2.17**	0.03	0.54
Root Veg. (except Sugarbeet) and Tuberous and Corm Veg.	0.18 (0.20), 2x, 7d	F, A	Drift	13	12.9	**0.20**	**3.91**	**0.05**	0.98
			No Drift	10.7	10.6	**0.17**	**3.21**	0.04	0.80
		F, G	Drift	12.3	12.2	**0.19**	**3.70**	**0.05**	0.92
			No Drift	11.1	11	**0.17**	**3.33**	0.04	0.83
	2 crop cycles	F, A	Drift	27.9	26.8	**0.44**	**8.12**	**0.11**	**2.03**
	3 crop cycles			32.1	30.8	**0.50**	**9.33**	**0.13**	**2.33**
	4 crop cycles			35.1	33.8	**0.55**	**10.2**	**0.14**	**2.56**
	5 crop cycles			56.2	55.9	**0.88**	**16.9**	**0.22**	**4.23**
Legume Veg. (Succulent or Dried)	0.18 (0.20), 2x, 7d	F, A	Drift	15.1	15.2	**0.24**	**4.61**	**0.06**	**1.15**
			No Drift	11.6	11.7	**0.18**	**3.55**	**0.05**	0.89
		F, G	Drift	13.8	13.7	**0.22**	**4.15**	**0.06**	**1.04**
			No Drift	12.7	12.5	**0.20**	**3.79**	**0.05**	0.95
Fruiting Vegetables	0.18 (0.20), 2x, 7d	F, A	Drift	13.3	13.3	**0.21**	**4.03**	**0.05**	**1.01**
			No Drift	11	11	**0.17**	**3.33**	0.04	0.83
		F, G	Drift	14.5	14.4	**0.23**	**4.36**	**0.06**	**1.09**
			No Drift	12.1	12	**0.19**	**3.64**	**0.05**	0.91
	0.40, 1x	S, G	No Drift	11.7	11.7	**0.18**	**3.55**	**0.05**	0.89
Cucurbit Vegetables	0.18 (0.20), 2x, 7d	F, A	Drift	14.5	14.4	**0.23**	**4.36**	**0.06**	**1.09**
			No Drift	12.1	12	**0.19**	**3.64**	**0.05**	0.91
		F, G	Drift	13.8	13.7	**0.22**	**4.15**	**0.06**	**1.04**
			No Drift	12.7	12.5	**0.20**	**3.79**	**0.05**	0.95
	0.37 (0.40),	S, G	No Drift	13.8	13.2	**0.22**	**4.00**	**0.06**	**1.00**
Hops	0.14 (0.15), 1x	F, A	Drift	4.73	4.73	**0.07**	**1.43**	0.02	0.36
			No Drift	1.74	1.74	0.03	0.53	0.01	0.13
		F, G	Drift	3.32	3.32	**0.05**	**1.01**	0.01	0.25
			No Drift	1.84	1.84	0.03	0.56	0.01	0.14
Citrus Fruit	0.18 (0.20), 2x, 7d	F, A	Drift	18.1	17.8	**0.28**	**5.39**	**0.07**	**1.35**
			No Drift	15.8	15.5	**0.25**	**4.70**	**0.06**	**1.17**
			Drift	2.38	--	0.04	--	0.01	--
		F,	Drift	16.4	16.2	**0.26**	**4.91**	**0.07**	**1.23**
		F, G	Drift	16.8	16.6	**0.26**	**5.03**	**0.07**	**1.26**
	0.37 (0.40), 1x	S, G	No Drift	16.2	16	**0.25**	**4.85**	**0.06**	**1.21**

Use Site	Single App. Rate (kg ai/ha), # of App, MRI in days	App Type	Drift/ No Drift	Parent only EEC in µg/L		RQ Values			
				Pore Water		Freshwater Invertebrates		Estuarine/Marine Invertebrates	
				Peak	21-day	Acute LC_{50}= 63.9µg/L[1]	Chronic NOAEC= 3.3 µg/L[2]	Acute LC_{50}= 250 µg/L[3]	Chronic NOAEC= 13.2 µg/L[4]
Pome Fruit	0.18 (0.20), 2x, 7d	F, A	Drift	9.34	9.36	**0.15**	**2.84**	0.04	0.71
			No Drift	6.4	6.39	**0.10**	**1.94**	0.03	0.48
		F, AB	Drift	7.72*	7.72*	**0.12***	**2.34**	0.03*	0.58*
		F, G	Drift	8.05	8.05	**0.13**	**2.44**	0.03	0.61
			No Drift	6.59	6.58	**0.10**	**1.99**	0.03	0.50
Bushberry	0.18 (0.20), 2x, 7d	F, A	Drift	9.88	10	**0.15**	**3.03**	0.04	0.76
			No Drift	6.46	6.56	**0.10**	**1.99**	0.03	0.50
		F, G	Drift	8.48	8.55	**0.13**	**2.59**	0.03	0.65
			No Drift	6.73	6.84	**0.11**	**2.07**	0.03	0.52
Low Growing Berry (excluding Cranberry)	0.18 (0.20), 2x, 7d	F, A	Drift	8.78	8.21	**0.14**	**2.49**	0.04	0.62
			No Drift	6.39	6.15	**0.10**	**1.86**	0.03	0.47
		F, G	Drift	9.38	9.23	**0.15**	**2.80**	0.04	0.70
			No Drift	6.66	6.41	**0.10**	**1.94**	0.03	0.49
Small Fruit Vine Climbing (except Fuzzy Kiwifruit)	0.18 (0.20), 2x, 7d	F, A	Drift	9.88	10	**0.15**	**3.03**	0.04	0.76
			No Drift	6.46	6.56	**0.10**	**1.99**	0.03	0.50
		F, G	Drift	6.38	6.39	**0.10**	**1.94**	0.03	0.48
			No Drift	4.67	4.66	**0.07**	**1.41**	0.02	0.35
Tree Nut	0.18 (0.20), 2x, 7d	F, A	Drift	8.9	8.9	**0.14**	**2.70**	0.04	0.67
			No Drift	6.53	6.54	**0.10**	**1.98**	0.03	0.50
		F, G	Drift	4.98	4.97	**0.08**	**1.51**	0.02	0.38
Prickly Pear	0.18 (0.20), 2x, 7d	F, G	Drift	2.22	2.22	0.03	0.67	0.01	0.17
			No Drift	1.04	1.04	0.02	0.32	0.00	0.08
Nongrass Animal Feeds (Forage, Fodder, Straw, Hay)	0.18 (0.20), 2x, 7d	F, A	Drift	17.2	17.2	**0.27**	**5.21**	**0.07**	**1.30**
			No Drift	14.8	14.9	**0.23**	**4.52**	**0.06**	**1.13**
			Drift Only, No Runoff	2.47	--	0.04	--	0.01	--
		F, G	Drift	15.90	15.90	**0.25**	**4.82**	**0.06**	**1.20**
			No Drift	14.70	14.80	**0.23**	**4.48**	**0.06**	**1.12**
Soybean Seed Treatment	0.37 (0.40), 1x	S, G	No Drift	4.7	4.7	**0.07**	**1.42**	0.02	0.36

Bolded values exceed the Agency's Level of Concern (LOC) for acute risk to listed (RQ ≥ 0.05) and/or non-listed (RQ ≥ 0.5) aquatic invertebrates or chronic risk to aquatic invertebrates (RQ ≥ 1).

[1] Based on 48-hr LC_{50} of 63.9 µg/L for the non-biting midge (*Chironomous riparius*) (MRID 48843738).

[2] Based on time-weighted average measured flupyradifurone concentration in pore-water during a 28-day toxicity study for chironomids (NOAEC of 3.3 µg/L. Effects on emergence rate and developmental rate were observed at 8.5 µg/L (MRID 48843741).

[3] Based on 96-hr LC_{50} of 250 µg/L for the mysid shrimp (MRID 48843704).

[4] Based on the NOAEC of 13.2 µg/L for the mysid shrimp (MRID 48843713). Effects on mean number of young produced per reproductive day per female were observed at 23.6 µg/L.

4.1.2. Terrestrial Organisms

Terrestrial Vertebrates

In this assessment, RQ values are calculated for acute dose-based risk to birds and for chronic risk to birds and mammals. RQ values are not calculated for acute dietary-based risk to birds or acute risk to mammals because the toxicity endpoints needed for these calculations are non-definitive. Specifically, the LC_{50} and LD_{50} values for birds and mammals, respectively, were greater than the highest concentration/dose tested in each study.

For all foliar or drench uses of flupyradifurone evaluated, the acute dose-based RQ values for birds exceed the Agency's LOC for acute risk to listed (RQ≥0.1) species for three or more types of dietary items (**Table 40**). In addition, for all foliar or drench uses except for hops, the acute dose-based RQ values for birds exceed the Agency's LOC for acute risk to non-listed (RQ≥0.5) species for the smallest class of birds (20 g) feeding on short grass. The modeling of multiple crop cycles generally increases the number of dietary items for which the acute risk to non-listed species are exceeded. The chronic risk LOC (RQ≥1) is not exceeded for birds for any proposed use, including when multiple crop cycles are taken into account.

Chronic, dietary-based RQ values for mammals only exceed the chronic risk LOC (RQ≥1) for short grass when flupyradifurone is applied in two or more crop cycles. Conversely, dose-based chronic RQs exceed the chronic risk LOC for multiple dietary items and size classes for all proposed uses evaluated.

Table 40. Acute and chronic RQ values for birds exposed to flupyradifurone as a result of the proposed uses.

Food Type	Acute Dose Based RQs[1]			Chronic Dietary Based RQs[2]
	Small (15 g)	Medium (100 g)	Large (1000 g)	
Foliar: Cereal Grains (except Rice), Tuberous and Corm Vegetables, Leafy Vegetables (except Brassica), Brassica (Cole) Leafy Vegetables, Fruiting Vegetables, Cucurbits, Bushberries (0.18 lbs ai/A; 2 applications; 7-day interval)				
Short grass	**0.55**	**0.25**	0.08	0.27
Tall grass	**0.25**	**0.11**	0.04	0.12
Broadleaf plants/small insects	**0.31**	**0.14**	0.04	0.15
Fruits/pods/(seeds, dietary only)	0.03	0.02	<0.01	0.02
Arthropods	**0.22**	**0.10**	0.03	0.10
Seeds (granivore)	0.01	<0.01	<0.01	N/A
Foliar: Cotton, Non-grass Animal Feeds, Peanut, Root Vegetables (except Sugarbeet), Legume Vegetables, Citrus, Pome Fruit, Low Growing Berries, Small Fruit Vine Climbing (0.18 lbs ai/A; 2 applications; 10-day interval)				
Short grass	**0.54**	**0.24**	0.08	0.26
Tall grass	**0.25**	**0.11**	0.03	0.12
Broadleaf plants/small insects	**0.30**	**0.14**	0.04	0.15
Fruits/pods/(seeds, dietary only)	0.03	0.02	<0.01	0.02
Arthropods	**0.21**	0.09	0.03	0.10
Seeds (granivore)	0.01	<0.01	<0.01	N/A
Foliar: Tree Nut, Prickly Pear/Cactus Pear (0.18 lbs ai/A; 2 applications; 14-day interval)				
Short grass	**0.52**	**0.23**	0.07	0.25
Tall grass	**0.24**	**0.11**	0.03	0.12
Broadleaf plants/small insects	**0.29**	**0.13**	0.04	0.14

Food Type	Acute Dose Based RQs[1] Small (15 g)	Medium (100 g)	Large (1000 g)	Chronic Dietary Based RQs[2]
Fruits/pods/(seeds, dietary only)	0.03	0.01	<0.01	0.02
Arthropods	**0.20**	0.09	0.03	0.10
Seeds (granivore)	0.01	<0.01	<0.01	N/A
Foliar: Hop (0.14 lbs ai/A; 1 application)				
Short grass	**0.23**	**0.10**	0.03	0.11
Tall grass	**0.10**	0.05	0.01	0.05
Broadleaf plants/small insects	**0.13**	0.06	0.02	0.06
Fruits/pods/(seeds, dietary only)	0.01	0.01	<0.01	0.01
Arthropods	0.09	0.04	0.01	0.04
Seeds (granivore)	<0.01	<0.01	<0.01	N/A
Soil/Drench/Chemigation: Fruiting Vegetables, Cucurbits, Citrus, Small Vine Climbing Fruit, Soybean Seeds (0.37 lbs ai/A; 1 application)				
Short grass	**0.61**	**0.27**	0.09	0.29
Tall grass	**0.28**	**0.12**	0.04	0.13
Broadleaf plants/small insects	**0.34**	**0.15**	0.05	0.17
Fruits/pods/(seeds, dietary only)	0.04	0.02	0.01	0.02
Arthropods	**0.24**	**0.11**	0.03	0.12
Seeds (granivore)	0.01	<0.01	<0.01	
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 2 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)				
Short grass	**0.83**	**0.37**	**0.12**	0.40
Tall grass	**0.38**	**0.17**	0.05	0.19
Broadleaf plants/small insects	**0.47**	**0.21**	0.07	0.23
Fruits/pods/(seeds, dietary only)	0.05	0.02	0.01	0.03
Arthropods	**0.33**	**0.15**	0.05	0.16
Seeds (granivore)	0.01	0.01	<0.01	
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 3 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)				
Short grass	**0.99**	**0.45**	**0.14**	0.48
Tall grass	**0.46**	**0.20**	0.06	0.22
Broadleaf plants/small insects	**0.56**	**0.25**	0.08	0.27
Fruits/pods/(seeds, dietary only)	0.06	0.03	0.01	0.03
Arthropods	**0.39**	**0.17**	0.06	0.19
Seeds (granivore)	0.01	0.01	<0.01	
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 4 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)				
Short grass	**1.09**	**0.49**	**0.15**	0.53
Tall grass	**0.50**	**0.22**	0.07	0.24
Broadleaf plants/small insects	**0.61**	**0.27**	0.09	0.30
Fruits/pods/(seeds, dietary only)	0.07	0.03	0.01	0.03
Arthropods	**0.43**	**0.19**	0.06	0.21
Seeds (granivore)	0.02	0.01	<0.01	N/A
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 5 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)				
Short grass	**1.13**	**0.51**	**0.16**	0.55
Tall grass	**0.52**	**0.23**	0.07	0.25

Food Type	Acute Dose Based RQs[1]			Chronic Dietary Based RQs[2]
	Small (15 g)	Medium (100 g)	Large (1000 g)	
Broadleaf plants/small insects	**0.64**	**0.29**	0.09	0.31
Fruits/pods/(seeds, dietary only)	0.07	0.03	0.01	0.03
Arthropods	**0.44**	**0.20**	0.06	0.22
Seeds (granivore)	0.02	0.01	<0.01	N/A

N/A = Not applicable.
Bolded values exceed the Agency's Level of Concern (LOC) for acute risk to listed (RQ $\geq$ 0.1) and/or non-listed (RQ $\geq$ 0.5) birds or chronic risk to birds (RQ $\geq$ 1).
[1] Acute dose-based RQ values are based on the bobwhite quail LD_{50} value of 232 mg ai/kg bw.
[2] Chronic RQ values are based on the bobwhite quail NOAEC value of 302 mg ai/kg diet.

Table 41. Chronic dietary and dose-based RQ values for mammals exposed to flupyradifurone as a result of the proposed uses.

Food Type	Dietary Based RQs	Dose Based RQs		
		Small (15 g)	Medium (35 g)	Large (1000 g)
Foliar: Cereal Grains (except Rice), Tuberous and Corm Vegetables, Leafy Vegetables (except Brassica), Brassica (Cole) Leafy Vegetables, Fruiting Vegetables, Cucurbits, Bushberries (0.18 lbs ai/A; 2 applications; 7-day interval)				
Short grass	0.81	**4.55**	**3.89**	**2.08**
Tall grass	0.37	**2.09**	**1.78**	0.96
Broadleaf plants/small insects	0.45	**2.56**	**2.19**	**1.17**
Fruits/pods/(seeds, dietary only)	0.05	0.28	0.24	0.13
Arthropods	0.32	**1.78**	**1.52**	0.82
Seeds (granivore)	N/A	0.06	0.05	0.03
Foliar: Cotton, Non-grass Animal Feeds, Peanut, Root Vegetables (except Sugarbeet), Legume Vegetables, Citrus, Pome Fruit, Low Growing Berries, Small Fruit Vine Climbing (0.18 lbs ai/A; 2 applications; 10-day interval)				
Short grass	0.79	**4.43**	**3.78**	**2.03**
Tall grass	0.36	**2.03**	**1.73**	0.93
Broadleaf plants/small insects	0.44	**2.49**	**2.13**	**1.14**
Fruits/pods/(seeds, dietary only)	0.05	0.28	0.24	0.13
Arthropods	0.31	**1.74**	**1.48**	0.79
Seeds (granivore)	N/A	0.06	0.05	0.03
Foliar: Tree Nut, Prickly Pear/Cactus Pear (0.18 lbs ai/A; 2 applications; 14-day interval)				
Short grass	0.76	**4.28**	**3.65**	**1.96**
Tall grass	0.35	**1.96**	**1.67**	0.90
Broadleaf plants/small insects	0.43	**2.41**	**2.06**	**1.10**
Fruits/pods/(seeds, dietary only)	0.05	0.27	0.23	0.12
Arthropods	0.30	**1.68**	**1.43**	0.77
Seeds (granivore)	N/A	0.06	0.05	0.03
Foliar: Hop (0.14 lbs ai/A; 1 application)				
Short grass	0.34	**1.89**	**1.62**	0.87
Tall grass	0.15	0.87	0.74	0.40
Broadleaf plants/small insects	0.19	**1.06**	0.91	0.49
Fruits/pods/(seeds, dietary only)	0.02	0.12	0.10	0.05
Arthropods	0.13	0.74	0.63	0.34
Seeds (granivore)	N/A	0.03	0.02	0.01
Soil/Drench/Chemigation: Fruiting Vegetables, Cucurbits, Citrus, Small Vine Climbing Fruit, Soybean Seeds (0.37 lbs ai/A; 1 application)				
Short grass	0.89	**5.00**	**4.27**	**2.29**

Food Type	Dietary Based RQs	Dose Based RQs Small (15 g)	Medium (35 g)	Large (1000 g)
Tall grass	0.41	**2.29**	**1.96**	**1.05**
Broadleaf plants/small insects	0.50	**2.81**	**2.40**	**1.29**
Fruits/pods/(seeds, dietary only)	0.06	0.31	0.27	0.14
Arthropods	0.35	**1.96**	**1.67**	0.90
Seeds (granivore)	N/A	0.07	0.06	0.03
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 2 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)				
Short grass	**1.22**	**6.88**	**5.87**	**3.15**
Tall grass	0.56	**3.15**	**2.69**	**1.44**
Broadleaf plants/small insects	0.69	**3.87**	**3.30**	**1.77**
Fruits/pods/(seeds, dietary only)	0.08	0.43	0.37	0.20
Arthropods	0.48	**2.69**	**2.30**	**1.23**
Seeds (granivore)	N/A	0.10	0.08	0.04
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 3 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)				
Short grass	**1.46**	**8.23**	**7.03**	**3.77**
Tall grass	0.67	**3.77**	**3.22**	**1.73**
Broadleaf plants/small insects	0.82	**4.63**	**3.95**	**2.12**
Fruits/pods/(seeds, dietary only)	0.09	0.51	0.44	0.24
Arthropods	0.57	**3.22**	**2.75**	**1.48**
Seeds (granivore)	N/A	0.11	0.10	0.05
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 4 crop cycles 10-day interval between 2 applications per cycle; 20 day interval between cycles)				
Short grass	**1.59**	**8.97**	**7.66**	**4.11**
Tall grass	0.73	**4.11**	**3.51**	**1.88**
Broadleaf plants/small insects	0.90	**5.05**	**4.31**	**2.31**
Fruits/pods/(seeds, dietary only)	0.10	0.56	0.48	0.26
Arthropods	0.62	**3.51**	**3.00**	**1.61**
Seeds (granivore)	N/A	0.12	0.11	0.06
Foliar: Root Vegetables (0.18 lbs ai/A; 10 applications representing 5 crop cycles; 10-day interval between 2 applications per cycle; 20 day interval between cycles)				
Short grass	**1.67**	**9.38**	**8.01**	**4.30**
Tall grass	0.76	**4.30**	**3.67**	**1.97**
Broadleaf plants/small insects	0.94	**5.28**	**4.51**	**2.42**
Fruits/pods/(seeds, dietary only)	0.10	0.59	0.50	0.27
Arthropods	0.65	**3.68**	**3.14**	**1.68**
Seeds (granivore)	N/A	0.13	0.11	0.06

N/A = Not applicable.
Bolded values exceed the Agency's Level of Concern (LOC) for chronic risk to wild mammals (RQ $\geq$ 1).
[1] Chronic RQ values are based on the rat 2-generation NOAEC value of 7.7 mg ai/kg bw/day.

RQ values for acute risk to birds and chronic risk to birds and mammals based on the use of flupyradifurone on soybean seeds were calculated as follows:

Avian Acute RQ #1 = mg ai /kg-bw/day/LD_{50}
*Avian Acute RQ #2 = mg ai ft-2/(LD_{50}*bw)*
Avian Chronic RQ = mg/kg-seed/NOAEL

Mammalian Chronic RQ = mg ai/kg-bw/day/adjusted NOAEL

Just as for foliar uses, RQ values are not calculated for acute risk to mammals because the toxicity endpoint needed for these calculations is non-definitive.

The resulting RQ values for seed treatment uses on soybeans exceed the Agency's acute risk to listed (RQ≥0.1) and non-listed (RQ≥0.5) species LOCs for birds depending on the size class of birds (**Table 42**). The chronic LOC (RQ≥1) was exceeded for birds and mammals.

Table 42. Chronic dietary RQ values for mammals exposed to flupyradifurone following the proposed seed treatment uses.

Crop	Risk Quotients			
	Avian (20 g)			Mammalian (15 g)
	Acute (# 1)	Acute (# 2)	Chronic	Chronic
Soybean	**0.68**	**0.12**	**1.49**	**5.63**
	Avian (100 g)			Mammalian (35 g)
	Acute (# 1)	Acute (# 2)	Chronic	Chronic
Soybean	**0.31**	0.02	**1.49**	**4.81**
	Avian (1000 g)			Mammalian (1000 g)
	Acute (# 1)	Acute (# 2)	Chronic	Chronic
Soybean	**0.10**	<0.01	**1.49**	**2.58**

Acute RQ #1 = mg ai /kg-bw/day/LD_{50}
Acute RQ #2 = mg ai ft-2 /(LD_{50}*bw)
Avian Chronic RQ = mg kg-1 seed/NOAEL
Mammalian Chronic RQ = mg ai/kg-bw/day/adjusted NOAEL
Bolded values exceed the Agency's LOC for acute risk to listed (RQ ≥ 0.1) and/or non-listed (RQ ≥ 0.5) birds.

DFA is also considered a residue of concern for terrestrial organisms in this assessment since toxicity data indicate adverse effects at similar doses as compared to the parent compound based on 90-day rat oral toxicity data. However, a 2-generation rat study, which is typically used to estimate chronic risk to mammals, is not available for DFA. Therefore, for purposes of characterization, estimated exposure to DFA from applications of flupyradifurone are compared to the available 90-day rat oral toxicity data for DFA in this assessment. EECs for residues of DFA on terrestrial food items are determined by multiplying the application rate for the parent by the ratio of the molecular weight of DFA (96.03 g/mole) divided by the molecular weight of parent (288.68 g/mole). This is a conservative methodology of estimating possible DFA residues because not all of the parent is expected to degrade to DFA. Based on this approach, single spray applications at 0.14 lbs ai/A (hops), 0.18 lbs ai/A (most foliar uses), and 0.37 lbs ai/A (drench applications) would result in DFA application rates of 0.05, 0.06, and 0.12 lbs DFA/A, respectively. Upper-bound dose-based EECs for mammals based on these application rates as calculated in T-REX are presented in **Table** 43**.** When the available 90-day oral toxicity endpoint for body weight (12.70 mg/kg bw) is adjusted for 15, 35, and 1000 g body weight classes of mammals, the resulting adjusted NOAELs are 9.77, 22.58, and 27.91 mg/kg bw, respectively (**Table 43**). Based on comparison of estimated exposure and chronic effects to mammals for DFA, EECs range from several orders of magnitude lower to just below the adjusted NOAEL values. The ratio of exposure (EECs) and effects (NOAELs) only approach (but do not exceed) the chronic mammal LOC of 1.0 for the soil drench uses.

Table 43. Comparison of EECs (foliar and soil drench) and body-weight adjusted NOAELs for DFA (degradate).

Application Rate (Use)	EECs for Mammal (mg DFA/kg bw)		
	15 g	35 g	1000 g
0.05 (hops)	0.15-10.75	0.10-7.43	0.02-1.72
0.06 (most foliar uses)	0.19-13.73	0.13-9.49	0.03-2.20
0.12 (soil drench uses)	0.38-27.46	0.26-18.98	0.06-4.40
Bodyweight-adjusted NOAELs (mg/kg bw)	27.91	22.58	9.77

Honeybees

In this assessment, initial screening level acute and chronic RQs are calculated for honeybees using conservative contact and dietary exposure estimates (**Table 44**). On a dietary exposure basis, all proposed foliar uses exceed the acute risk and chronic risk LOCs of 0.4 and 1.0, respectively. Conversely, neither acute nor chronic LOCs are exceeded for foliar uses on a contact exposure basis or for soil drench and soybean seed treatment uses on an oral exposure basis.

Since LOCs are exceeded at the Tier I generic exposure level, a refinement step was subsequently conducted using empirical residue data from pollen and nectar from multiple crop types (**Table 45**). Refined EECs are generated based on measured residues using known food consumption rates for bees. When nectar residue data are available, EECs are calculated for foraging worker bees since this group consumes the largest amount of nectar. When pollen and nectar data are available, EECs are also calculated for nurse bees, since this group consumes substantial amounts of both pollen and nectar. EECs for worker and nurse bees were estimated as follows:

EECs for worker bees: *maximum daily nectar residue (µg/g) * forager worker bee nectar consumption rate (0.292 µg/day of nectar)*

EECs for nurse bees: *maximum daily nectar residue (µg/g) * nurse bee nectar consumption rate (0.167 µg/day of nectar) + maximum daily pollen residue (µg/g) * nurse bee pollen consumption rate (0.012 µg/day of pollen)*

EECs for larval worker bees: *maximum daily nectar residue (µg/g) * larval worker bee nectar consumption rate (0.12 µg/day of nectar) + maximum daily pollen residue (µg/g) * larval worker bee pollen consumption rate (0.0036 µg/day of pollen)*

EECs and resulting RQ values vary widely depending on matrix and crop type. In general, residues in whole flower blossoms were the highest and exceeded honeybee acute (RQ≥0.4) and chronic (RQ≥1) LOCs for multiple crop types. In addition both acute and chronic LOCs are exceeded for worker bees feeding on nectar and nurse bees feeding on pollen and nectar for at least one crop type for which residues were measured. There are only chronic risks of concern to larval worker bees based on cotton residues. LOCs are only exceeded based on residues measured following foliar applications of flupyradifurone, not drench applications.

Table 44. Screening level RQ values for insect pollinators.

Use	Single Maximum Application Rate	Life-stage	Exposure Route	Acute RQ	Chronic RQ
Cereal Grains (except Rice), Tuberous and Corm Vegetables, Leafy Vegetables (except Brassica), Brassica (Cole) Leafy Vegetables, Fruiting Vegetables, Cucurbits, Bushberries, Cotton, Nongrass Animal Feeds, Peanut, Root Vegetables (except Sugarbeet), Legume Vegetables, Citrus, Pome Fruit, Low Growing Berries, Small Fruit Vine Climbing, Tree Nut, Prickly Pear/Cactus Pear	0.18 lbs ai/A	Adults	Contact	<0.01[1]	ND
		Adults	Diet	**4.8**[2]	**12.5**[3]
		Brood	Diet	ND	**5.6**[4]
Hops	0.14 lbs ai/A	Adults	Contact	<0.01[1]	ND
		Adults	Diet	**3.8**[2]	**9.7**[3]
		Brood	Diet	ND	**4.3**[4]
Soil/Drench/Chemigation: Fruiting Vegetables, Cucurbits, Citrus, Small Vine Climbing Fruit, Soybean Seeds	0.37 lbs ai/A	Adults	Diet	0.01	0.04
		Brood	Diet	ND	0.02
Soybean Seeds	0.365 lbs ai/A	Adults	Diet	0.24[2]	0.63[3]
		Brood	Diet	ND	0.28[4]

ND = No Data Available

Bold values indicate that acute (RQ≥0.4) and/or chronic (RQ≥1) LOCs are exceeded

[1] LD_{50} = 122.8 µg ai/bee based on acute contact toxicity data for TGAI

[2] LD_{50} = 1.2 µg ai/bee based on acute oral toxicity data for TGAI

[3] NOAEC = 0.464 µg ai/bee/day based on 10-day chronic toxicity data for TGAI

[4] NOAEC = 0.44 µg ai/bee/day based on 21-day toxicity data for TGAI

Table 45. Refined Tier I RQ values for honeybees based on empirical residue data from pollen and nectar.

MRID	Crop	Number of Applications at Rate (lbs ai/A)	Application Type	Matrix	Maximum Residue (mg/kg)	Worker Bees (adult)			Worker Bees (larval)	
						Refined EEC (µg/bee/day)	Refined Acute RQ[4]	Refined Chronic RQ[5]	Refined EEC[2] (µg/bee/day)	Refined Chronic RQ[6]
48844521	Tomato	1 at 0.18	Drench	Pollen	0.107	0.05[1]	0.04	0.12	0.04	0.09
				Flower	0.315	0.09	0.08	0.20		
48844523	Watermelon	1 at 0.18	Drench	Pollen	0.002	<0.01[1]	<0.01	<0.01	<0.01	<0.01
				Nectar	0.001	<0.01	<0.01	<0.01		
				Flowers	0.017	<0.01	<0.01	0.01		
48844522	Watermelon	3 at 0.134	Drench	Pollen	0.006	<0.01[1]	<0.01	<0.01	<0.01	<0.01
				Nectar	0.001	<0.01	<0.01	<0.01		
				Flowers	1.56	0.46	0.38	0.98		
48844524	Citrus	2 at 0.18	Foliar	Pollen, Traps	1.8	0.06[1]	0.05	0.12	0.03	0.07
				Nectar	0.2	0.06	0.05	0.13		
				Blossoms	2	0.58	**0.49**	**1.26**		
48844524	Citrus	1 at 0.365	Foliar	Pollen, Traps	1.1	0.06[1]	0.05	0.14	0.04	0.09
				Nectar	0.31	0.09	0.08	0.20		
				Blossoms	5.1	1.49	**1.24**	**3.21**		
48844525	Melon	1 at 0.365	Drench	Pollen	0.5	0.13[1]	0.11	0.29	0.09	0.21
				Nectar	0.76	0.22	0.18	0.48		
				Blossoms	0.38	0.11	0.09	0.24		
48844525	Melon	2 at 0.18	Foliar	Pollen	1.5	0.08[1]	0.07	0.17	0.05	0.11
				Nectar	0.36	0.11	0.09	0.23		
				Blossoms	2.8	0.82	**0.68**	**1.76**		
48844527	Cotton	2 at 0.18	Foliar	Pollen	0.432	3.65[1]	**3.04**	**7.87**	2.62	**5.96**
				Nectar, Total	21.83	6.37	**5.31**	**13.74**		
				Nectar, Floral	0.386	0.11	0.09	0.24		
				Nectar, inner-bracteal	12.2	3.56	**2.97**	**7.68**		
				Nectar, sub-bracteal	15.9	4.64	**3.87**	**10.01**		
				Nectar, pink floral	0.311	0.09	0.08	0.20		
				Blossoms	12.1	3.53	**2.94**	**7.61**		
48844528	Blueberry	2 at 0.36[3]	Foliar	Pollen	67.6	0.92[1]	**0.77**	**1.98**	0.32	0.73
				Nectar	0.64	0.19	0.16	0.40		
				Blossoms	6.49	1.90	**1.58**	**4.08**		
48844529	Apple	2 at 0.18	Foliar	Pollen (Highest Trial Max)	26.2	0.51[1]	**0.43**	**1.11**	0.24	0.54
				Nectar (Highest Trial Max)	1.2	0.35	0.29	0.76		

MRID	Crop	Number of Applications at Rate (lbs ai/A)	Application Type	Matrix	Maximum Residue (mg/kg)	Worker Bees (adult)			Worker Bees (larval)	
						Refined EEC (µg/bee/day)	Refined Acute RQ[4]	Refined Chronic RQ[5]	Refined EEC[2] (µg/bee/day)	Refined Chronic RQ[6]
				Blossoms (Highest Trial Max)	27.7	8.09	**6.74**	**17.43**		
				Pollen (Lowest Trial Max)	8.3	0.15[1]	0.12	0.32	0.07	0.15
				Nectar (Lowest Trial Max)	0.3	0.09	0.07	0.19		
				Blossoms (Lowest Trial Max)	20.1	5.87	**4.89**	**12.65**		
48844530	Apple	2 at 0.18	Foliar	Pollen, Legs	39	0.72	**0.60**	**1.55**	0.32	0.73
				Nectar	1.5	0.44	0.37	0.94		
				Blossoms	113	33.00	**27.50**	**71.11**		

Bold values indicate that acute (RQ≥0.4) and/or chronic (RQ≥1) LOCs are exceeded

[1] Represents EECs for nurse bees; EECs were calculated for nurse bees based on a combination of pollen and nectar consumption rate of 0.012 and 0.167 g/day, respectively.

[2] EECs were calculated for larval bees based on a combination of pollen and nectar consumption rate of 0.0036 and 0.120 g/day, respectively.

[3] Twice the proposed application rate was accidentally used in this study; therefore residues are likely to be overestimated.

[4] LD_{50} = 1.2 µg ai/bee based on acute oral toxicity data for TGAI

[5] NOAEC = 0.464 µg ai/bee/day based on highest concentration tested in 10-day chronic toxicity data for TGAI

[6] NOAEC = 0.44 µg ai/bee/day based on highest concentrations tested in 21-day toxicity data for TGAI

The refined tier I RQs for honeybees indicates that foliar applications of flupyradifurone are the major concern at the screening level (**Table 45**). This analysis is based on the highest daily average flupyradifurone residue value recorded in each of the various crop residue studies. However, the highest daily average residue value does not necessarily reflect the potential for exposure over multiple days following application. In order to further characterize how changes in residues over time affect the potential for exposure and effects to actively foraging honeybees in the field, average daily residues measured over the time course of empirical residue studies is displayed relative to the acute risk LOC for honeybees (**Figure 6**). This analysis focused specifically on acute risk to honeybees foraging on nectar because the oral route is considered to be the most sensitive. The data indicate that residues for most crops were at their daily maximum immediately following the bloom application and declined thereafter. Residues taken from whole flowers are substantially higher than nectar residues obtained from flowers or honeybee stomachs. Moreover, flower residue data for most crops exceed the residue value at the LOC threshold for acute risk to honeybees (RQ≥0.4), while nectar-specific residues are below the LOC. One exception to this pattern is that extra-floral nectar in cotton is up to an order of magnitude higher than the LOC. Cotton is the only crop in which extra-floral nectar residues were evaluated. For some crops, residues that exceed the LOC following bloom declined below the LOC during the later days of the study. However, the majority of studies were not carried out long enough following the bloom application to interpret whether flower residue declines would be substantial enough to fall below the LOC.

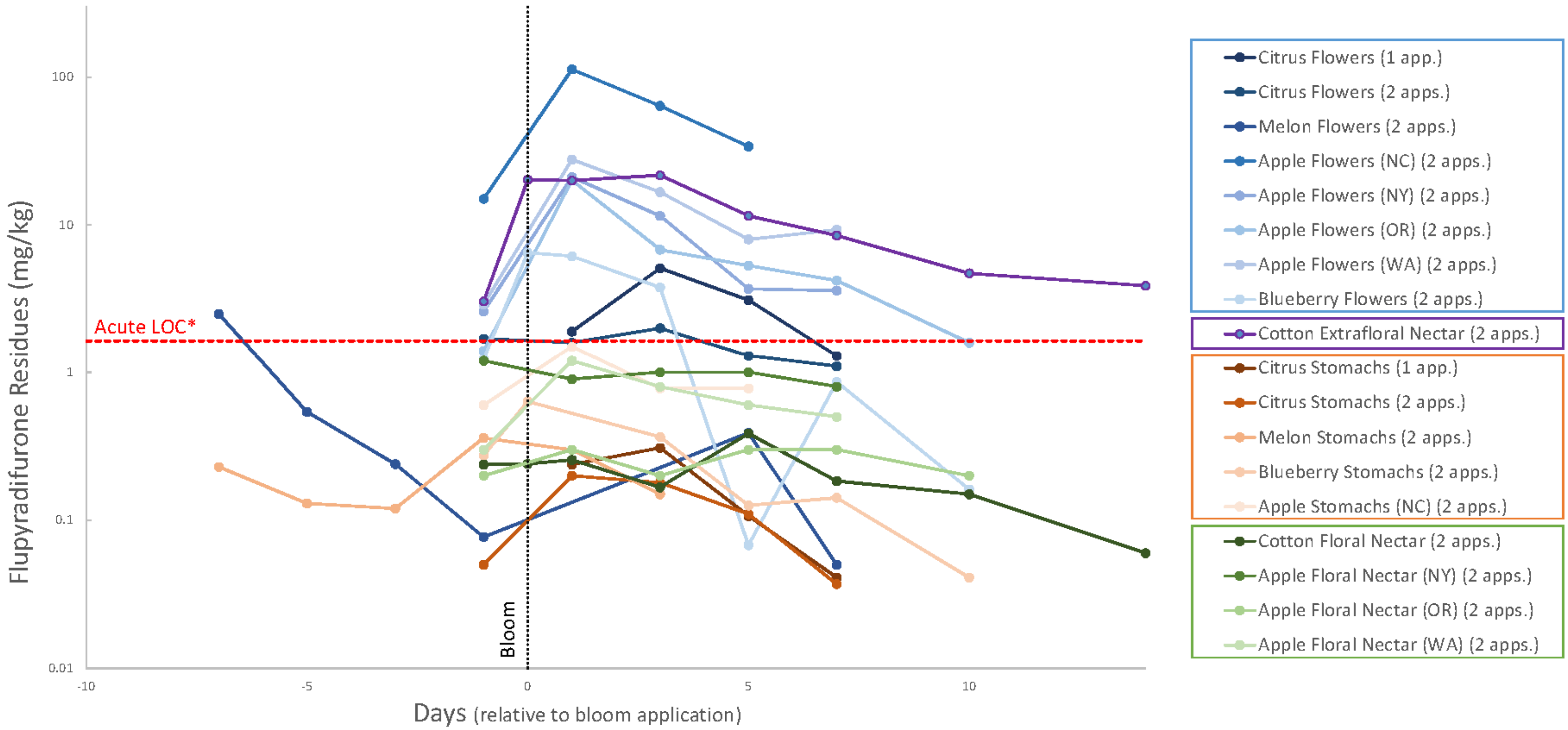


Figure 6. Measured flupyradifurone residues on various crops over time after foliar application.

Note: y-axis is plotted on log 10 scale.

*Acute LOC converted to residue value as follows: [1.2 µg ai/bee (acute oral toxicity endpoint) * 0.4 (Acute LOC for honeybees)] / 0.292 mg/L (nectar consumption rate for foraging worker bees) = **1.6 (residue value for acute LOC)**

Bloom = time-point (Day 0) in which bloom application was made. For studies with 1 application, only a bloom foliar application was made; for studies with 2 applications, the first application was at early bloom and the second application was at full bloom.

Apps=Applications; Stomachs = bee honey stomachs; NC = North Carolina; NY = New York; OR= Oregon; WA = Washington

Terrestrial Plants

For terrestrial plants, RQ values could only be calculated for listed monocots, since IC_{25} values from both seedling emergence and vegetative vigor studies were non-definitive (*i.e.*, greater than the single concentration tested: 0.365 lbs ai/A), and since NOAEC values for dicots from both seedling emergence and vegetative vigor studies were non-definitive (*i.e.*, significant effects were observed at the single concentration tested: 0.365 lbs ai/A). For listed monocots, RQ values for non-target plants are as follows: plants receiving spray drift are <0.1 across uses, plants occupying dry areas are <0.1 across uses, and plants occupying semi-aquatic areas range from 0.21 to 0.50 across uses; all RQs are below the risk to listed terrestrial plants LOC (RQ≥1). The implications of the lack of definitive terrestrial plant toxicity data on risk conclusions is discussed in the Risk Description (**Section 4.2**).

4.2. Risk Description and Conclusions

4.2.1. Aquatic Organisms

Flupyradifurone is characterized as persistent to very persistent and is expected to be mobile; therefore, it can move to surface water through run-off, erosion, and spray drift where it may be present in the water column for extended periods of time. Although a large portion of the compound is not expected to partition to sediment and/or bioaccumulate in aquatic organisms, the compound is likely to be present in sediment pore water as well as the water column. Therefore, exposure of aquatic organisms to flupyradifurone residues is considered likely from the proposed foliar, soil drench, and seed treatment uses. There is uncertainty regarding the magnitude of residues in water depending on the nature of unextracted residues. While the compound is estimated to persist in surface water/benthic sediments for extended periods, there is uncertainty regarding the extent to which this will occur and would likely depend on the extent to which water exchanges within the body of water as well as the extent to which sedimentation ultimately renders residues in sediment pore water no longer accessible. While flupyradifurone is resistant to hydrolysis and anaerobic metabolism, in clear, shallow waters, the compound can undergo relatively rapid aqueous photolysis and hasten its dissipation.

Based on available information, flupyradifurone is categorized as slightly to practically non-toxic to aquatic vertebrates and general exhibits low toxicity to fish and aquatic-phase amphibians; no acute or chronic risks of concern were identified for these groups in this assessment. Although acute RQ values were not calculated for freshwater and estuarine/marine fish because existing acute toxicity endpoints are non-definitive (*i.e.*, greater than the highest concentration tested), estimated peak exposure concentrations in surface water for all proposed uses are several orders of magnitude lower than the highest concentration tested in available fish acute toxicity studies. Therefore, the likelihood for adverse effects (*i.e.*, mortality and sublethal effects) from acute exposures is considered low.

Available freshwater fish chronic toxicity data on the fathead minnow do not provide sufficient information to characterize effects of flupyradifurone to early life stages since only slight effects on fry survival were observed at the lowest and highest test concentrations (only effects at the highest concentration were considered biologically significant). However, given that the NOAEC for the fathead minnow early life stage study (NOAEC=4.41 mg ai/L) is several orders of magnitude above modeled exposure values, the likelihood for adverse effects on fish (and aquatic-phase amphibians for which fish serve as surrogates) from chronic exposure to flupyradifurone from the proposed uses is considered low based on available data.

The likelihood for adverse effects to listed and non-listed vascular and nonvascular aquatic plants is also considered low. RQ values for non-listed species could not be calculated since available EC_{50} values are non-definitive (*i.e.*, greater than the highest concentrations tested); however, EC_{50} values for both duckweed and green algae are at least two orders of magnitude higher than peak surface water EECs.

Although flupyradifurone is characterized as only slightly toxic to the freshwater invertebrate, *D. magna*, on an acute exposure basis and resulted in a non-definitive toxicity value (EC_{50} >77.6 mg ai/L), the freshwater non-biting midge (*C. riparius*) is several orders of magnitude more sensitive (EC_{50} = 0.0639 mg ai/L); therefore, flupyradifurone is categorized as very highly toxic to freshwater invertebrates on an acute exposure basis. As noted earlier, even though flupyradifurone is not expected to preferentially partition into benthic sediments, the mobility of the compound and its potential persistence in surface water from the proposed uses represent a route of exposure to benthic invertebrates, including midges. Similarly, while flupyradifurone is categorized as only slightly toxic to the estuarine/marine Eastern oyster and resulted in a non-definitive endpoint (LC_{50} >29 mg ai/L), the compound is categorized as highly toxic to the mysid shrimp (*A. bahia*; LC_{50} = 0.25 mg ai/L). Based on the most sensitive endpoints, the major concern for aquatic organisms in this assessment is for freshwater and estuarine/marine invertebrates inhabiting both the water column and benthic environments. Acute risk to listed species and chronic risk LOCs for freshwater and estuarine/marine invertebrates were exceeded for the majority of proposed uses evaluated in this assessment. Since flupyradifurone is mobile and persistent in the aquatic environment, there is the potential for both short-term and long-term exposure and potential adverse effects to aquatic invertebrates with sensitivities similar to *C. riparius* and *A. bahia*. After the contribution of spray drift was removed from exposure estimates, many proposed uses still exceeded the acute risk to listed species and chronic risk LOCs. Therefore, the spatial proximity of foliar applications from a water body may not substantially change the likelihood for adverse effects to these aquatic invertebrates. While any buffer between an application and aquatic water body is expected to reduce exposure and risk, a methodology is not available to estimate the reduction in EECs due to transport in runoff because channelized runoff may occur. In this assessment, the influence of multiple crop cycles on aquatic invertebrates from multiple foliar applications of flupyradifurone was also considered. In general, the use of single crop cycle (2 applications at 0.18 lbs ai/A) did not lead to acute risks of concern to non-listed freshwater invertebrate species; conversely, multiple crop cycles (≥2) did lead to risks of concern to this group.

Transformation products and formulations of flupyradifurone resulted in higher (less sensitive) aquatic toxicity values as compared to flupyradifurone TGAI. Therefore, the potential for effects of the parent compound alone, rather that transformation products or other formulation ingredients, is considered to be the primary stressor in the aquatic assessment.

4.2.2. Terrestrial Organisms

As discussed earlier, flupyradifurone is expected to be persistent and mobile in the environment. Although the compound is stable to hydrolysis and soil photolysis, it can undergo relatively rapid aqueous photolysis (DT_{50}=2.5 days). Aerobic metabolism studies resulted in a range of DT_{50} values (37.5-3793 days) depending on the soils tested; however, the terrestrial field dissipation studies conducted resulted in dissipation half-lives (DT_{50}) ranging between 8.3-304 days. The extent to which DT_{50} values would be affected by foliar interception and/or uptake by plants is uncertain though since the dissipation studies were conducted on bare ground. For example, the crop canopy could reduce the amount of photolysis by reducing the amount of sunlight the compound is exposed to. The mobility of the compound also influences the extent to which the compound may represent a route of exposure and flupyradifurone is classified as moderately mobile to mobile and the extent to which the compound is subject to runoff/erosion/leaching will likely impact the extent of exposure to terrestrial organism. However, based on this screening-level assessment, exposure of terrestrial organisms is considered likely from the proposed uses of flupyradifurone.

Birds and Mammals

Flupyradifurone is categorized as being moderately to practically non-toxic to birds on an acute oral exposure basis and slightly to practically non-toxic to birds on a subacute dietary exposure basis, and toxicity endpoints exceeded the highest dietary exposure levels for both bobwhite quail (LD_{50}>4,876 mg ai/kg diet) and mallard ducks (LD_{50}>4,741 mg ai/kg diet). The subacute toxicity studies with birds did indicate that exposure to flupyradifurone affected the willingness of birds to consume the chemical in the diets provided. Flupyradifurone is also categorized as being practically non-toxic to mammals on an acute exposure basis and resulted in a non-definitive endpoint (LD_{50}>2,000 mg ai/kg bw) with no mortalities observed at the highest dose tested.

In this assessment, RQ values exceeded the acute risk to listed birds LOC for all of the proposed foliar and soil drench uses of flupyradifurone. In addition, RQ values exceeded the acute risk LOC for non-listed birds for all foliar or soil drench uses except for hops. The modeling of multiple crop cycles generally increased the number of dietary items for which the acute risk to non-listed species was exceeded. However, the extent to which multiple cropping seasons are applicable to various uses is uncertain.

RQ values were not calculated for acute dietary-based risk to birds or acute risk to mammals because the toxicity endpoints needed for these calculations (LC_{50}/LD_{50}) were determined to be greater than the highest dose tested in the submitted studies. Although flupyradifurone is classified as practically non-toxic to birds and mammals on subacute dietary and acute oral exposure bases, respectively, the nature and potential dose-response relationship of any effects of flupyradifurone at exposure levels above the highest concentrations/doses tested are unknown. For the proposed foliar and drench uses of flupyradifurone, the potential for acute risk to birds and mammals is characterized using the conservative assumption that the maximum concentrations/doses tested in the submitted oral toxicity studies (*i.e.*, 4,741 mg ai/kg diet for birds and 2,000 mg/kg bw for mammals) represent the toxicity endpoint. Employing these assumptions, the proposed foliar and drench uses of flupyradifurone are not expected to result in acute risk of mortality to listed or non-listed species of birds (and reptiles and terrestrial-phase amphibians for which birds serve as surrogates) or mammals because the resulting RQ values are all less than the Agency's acute risk LOC for non-listed species (RQ<0.5) and listed species (RQ<0.1).

As noted, several of the avian acute oral and subacute dietary toxicity studies indicated effects on feed consumption, body weight, or body weight gain. These effects occurred at doses ≥200 mg ai/kg and dietary concentrations ≥1133 mg ai/kg-diet. Given that the acute RQs calculated for birds in this assessment were based on median lethal doses in bobwhite quail at 232 mg ai/kg bw, observed sublethal effects to feed consumption and body weight in birds would not result in substantially more sensitive risk estimates for birds on an acute oral exposure basis. It is also possible that the reductions in food consumption by birds exposed to flupyradifurone in their diet may further limit exposure.

Although chronic toxicity studies with mallard ducks did not detect effects on survival, growth or reproduction at dietary concentrations up to 845 mg ai/kg diet, effects on growth were reported at dietary concentrations greater than 1,175 mg ai/kg diet in the subacute dietary exposure study. In a similar study with bobwhite quail, a range of effects considered to be both biologically and statistically significant were detected at dietary concentrations exceeding 302 mg ai/kg diet. Based on chronic exposure estimates though, both dose-based and dietary-based RQ values for birds are less than the chronic risk LOC for all of the uses evaluated.

In the chronic toxicity study with rats where animals were exposed over multiple generations to flupyradifurone residues in their diet, significant effects on food consumption and growth were reported at exposure levels ≥ 7.7 mg ai/kg bw/day. In this assessment, chronic dietary-based RQ values for mammals only exceeded the chronic risk LOC (RQ≥1) for short grass when flupyradifurone is applied as a foliar spray in two or more crop cycles. However, dose-based chronic RQs exceeded the chronic risk LOC for multiple dietary items and size classes for all proposed uses evaluated. Chronic dietary and dose-based RQ values in this assessment were calculated based on the NOAEC (100 mg ai/kg diet) and NOAEL (7.7 mg ai/kg bw) from the rat two-generation toxicity study (MRID 48844119). If the LOAEC (38.7 mg ai/kg bw) and LOAEL (500 mg ai/kg diet) from the same study were used to calculate RQs, the chronic risk LOC (RQ≥1) would not be exceeded for any proposed use or number of crop cycles based on dietary exposure, but would be exceeded for small (15 g) mammals feeding on short grass (RQ=1.0) following soil drench applications as well as for multiple dietary categories when flupyradifurone is applied as a foliar spray for ≥2 crop cycles. As noted previously though, the extent to which multiple cropping seasons are used for the various uses evaluated is uncertain.

The potential for risk to birds and mammals from proposed foliar and soil chemigation uses were evaluated in this assessment using the default foliar dissipation half-life of 35 days, since no additional data was available to determine the decline in flupyradifurone residues in dietary items. However, since LOCs for acute risk to listed (RQ≥0.05) and non-listed (RQ≥0.1) birds and chronic risk (RQ≥1) to mammals were exceeded in this assessment, the impact of different half-lives on RQs was examine for purposes of characterization (**Table 46**). Based on this analysis, at proposed foliar application rates, both acute risk to birds and chronic risk to mammal

LOCs are exceeded even when a half-life of 1 days is considered. In addition, the number of days that LOCs are exceeded is still approximately 2-3 weeks, even when half-lives as low as 7 days are considered for both foliar and soil drench uses. Therefore, potential risks of concern to birds and mammals from proposed foliar and soil drench uses would not be precluded based on refinements to the default foliar dissipation half-life.

Table 46. Impact of different foliar dissipation half-lives on terrestrial vertebrate RQs.

Use	Foliar Dissipation Half Life	Avian Acute Dose-Based RQs (Short Grass)	Number of Days LOC is Exceeded (Avian Acute)	Mammalian Chronic Dose-Based RQs (Short Grass)	Number of Days LOC is Exceeded (Mammal Chronic)
Foliar (0.18 lbs ai/A; 2 apps.; 7 day interval)	1	0.3	4	2.45	4
	7	0.44	22	3.65	21
	15	0.51	43	4.19	39
	35	0.55	56[1]	4.55	56[1]
Soil Drench (0.37 lbs ai/A; 1 app.)	1	0.61	3	5.00	3
	7		19		17
	15		39		35
	35		56[1]		56[1]

[1] The analysis is only carried out to a maximum of 56 days based on limitations in T-REX.

For the proposed seed treatment use on soybeans, RQ values exceed the LOC for acute risk to listed and non-listed birds and chronic risk to birds and mammals.

Honeybees and Terrestrial Invertebrates

Since flupyradifurone is proposed for use at bloom, a large number of studies were submitted to evaluate potential exposure and effects to bees. Exposure studies examined residue levels in pollen, nectar and whole flowers following applications at maximum proposed rates and subsequent to both soil and foliar applications at full bloom that would presumably reflect residues transported to these plant matrices through systemic uptake and through direct contact. Effects studies examined both acute and chronic effects to individual bees and also examined potential colony level effects over protracted periods including overwintering. Acute toxicity testing with young adult bees indicates that flupyradifurone is practically non-toxic to honeybees on an acute contact exposure basis; however, the compound is categorized as highly toxic to bees on an acute oral exposure basis. Repeated exposure of individual adult bees over 10 days to sucrose solutions containing up to 10 mg ai/L (equivalent to a dose of 0.464 µg ai/bee/day) did not result in an adverse effect; repeated exposure to bee larvae to flupyradifurone to diets containing 10 mg ai/L (equivalent to a dose of 0.44 µg ai/bee/day) did not result in an adverse effect on survival or adult emergence.

Based on initial screening-level exposure estimates (model-generated) and refined (measured residues in pollen and nectar), Tier I RQ values for bees exceeded the acute and chronic risk LOCs of 0.4 and 1.0, respectively, on an oral exposure basis, but no risks of concern were identified on an acute contact exposure basis. The screening-level analysis, therefore, indicates that the primary concern for bee pollinators is through the consumption of residues in their diet based on maximum residues detected in these diets rather than through contact. These risks of concern apply to both foraging worker bees, nurse bees, and developing eggs, larvae and pupae (*i.e.*, brood). It should be noted that LOCs were only exceeded based on residues measured following foliar applications of flupyradifurone, but not drench applications. In addition, risks of concern were not indicated for seed treatments based on generic screening-level exposure estimates. It should also be noted that the NOAEC values used to estimate chronic dietary risks to larval bees and young adult honeybees were based on the highest concentrations tested, since no adverse effects were observed in their respective studies; therefore, these endpoints and the resulting RQs are likely to be conservative. Overall, the results indicate that consideration of higher tiered honeybee studies are critical to evaluating potential adverse effects of flupyradifurone foliar applications at the colony or population level, as laid out in the SAP White Paper (USEPA, 2012d).

As discussed in the SAP White Paper (USEPA, 2012d) on assessing risks to bees, when the Tier I screen indicates a potential risk to individual bees, higher tier studies conducted with bee colonies should be used to qualitatively characterize potential risks to colonies. Based on available semi-field and field studies consisting of studies where flupyradifurone was fed directly to colonies or bees were allowed to forage on residues following multiple applications of the compound at the maximum label rate, including foliar applications at full bloom while bees were actively foraging, there were some transitory effects to honeybee mortality and foraging activity, particularly at periods following applications at full bloom. Based on the laboratory data on individual bees in combination with the colony-level studies, the available evidence suggests that foliar application during bloom during active foraging did not adversely affect the forager bees. This is consistent with the laboratory data indicating that the compound is practically non-toxic to bees on an acute contact exposure basis. The available data also indicate that the majority of flupyradifurone residues measured in plants were in pollen as opposed to nectar (although cotton is an exception) and forage bees do not tend to consume much pollen and the extent to which they will consume raw nectar likely depends on their energy needs since processed honey is a more concentrated form of carbohydrates for bees. The increase in bee mortality and behavioral effects reported following applications at bloom may reflect where sufficient quantities of nectar were consumed and would be consistent with the high toxicity of flupyradifurone to adult bees on an oral basis. In addition, there were some slight indications of effects to food storage and brood cells in the colony feeding study, but these effects were not statistically different from control colonies. Although the colony-level studies were limited in their ability to detect statistically significant effects owing to the few replicates used in the studies and/or high variability in measurement endpoints, the logistics of conducting such studies can be challenging; however, the methods used for the semi-field and full-field colony-level studies were consistent with methods described in the open literature and through European and Mediterranean Plant Protection Organization (EPPO) and adhered to the tiered testing process identified in the SAP White Paper.

The greatest area of uncertainty surrounding the potential risk to bee pollinators is for foliar applications at full bloom, which is proposed for a range of crops. Residue data for bee-relevant matrices (*i.e.,* pollen, nectar) from crop residue and field studies generally indicate that the highest residues occur immediately after foliar applications, especially at full bloom, when bees are most likely to be visiting the treated area. This is also the time period when transitory effects to mortality and foraging were identified in some of the higher tiered honeybee studies. Given the potential lack of statistical power due to low replication for many of the semi-field studies, it is not absolutely certain that higher-tiered studies were of sufficient quality to detect significant mortality events or other effects resulting from applications at bloom. Nevertheless, there is little evidence from the available studies that any of these transitory effects resulted in detectable effects to colony strength or overwintering success based on the full suite of studies provided.

One possible explanation for the lack of sustained effects to mortality observed in the higher tiered studies, even though the acute risk to honeybees LOC was exceeded at the refined Tier I screening level, is that there was much higher flupyradifurone residues observed in whole blossoms versus nectar-specific samples from flowers of honeybee stomachs in the crop residue studies. In all cases, floral nectar and honeybee stomach nectar residues were below the acute risk to honeybees LOC, while flower residues for most crops were above the LOC. These findings, combined with the observation that residues in bee matrices were typically highest immediately after the bloom application, suggest that floral nectar residues are much lower than whole flower residues because the nectar may be protected from direct spray. And since honeybees are foraging on nectar, the floral nectar and honeybee stomach nectar residues are more illustrative of exposure in the field. One uncertainty in this distinction between whole flowers versus nectar residues is that extra-floral nectar residues of flupyradifurone in cotton exceeded the LOC for multiple days and were much higher than honeybee stomach nectar residues recorded during the same study. This may indicate that extra-floral nectaries, which are also a food source for honeybees, may receive higher flupyradifurone residues either through direct spray or systemic translocation in the plant. Therefore, exposure via nectar may be higher in crops with extra-floral nectaries.

Many of the semi-field and field studies suffered from a range of deficiencies including unequal starting sizes of control and treatment colonies and lack of reporting of the variability associated with measurement endpoints. An additional source of uncertainty is the extent to which flupyradifurone residues will accumulate in flowering plants or in bee hives. Although submitted crop residue studies indicate that pollen, nectar, and flower residues were generally highest in the hours or several days following foliar applications, one study evaluating foliar application to citrus (MRID 48844524) did indicate that pollen residues continued to rise until around the last sampling date (5-7 days after application). This indicates that at least in certain flowering plants, pollen residues might continue to increase throughout the time period in which pollination is likely to occur. In addition, pollen, nectar, and wax residue data from one of the full field studies with flupyradifurone (MRIDs 48844517) indicate that average residues did not reach their maxima until up to several months after the pesticide was applied; however, these results directly conflict with those of a second field study in which pollen, nectar, and wax residues reached their peak during the same month as the application at full bloom (MRIDs 48844516). One possible cause for this discrepancy is the level in which bees from either study were foraging on treated versus untreated crop areas. Generally, there was not enough information on measured hive residues in the submitted package to determine if biologically relevant levels of flupyradifurone are expected to occur in the hive in the weeks, months, or seasons following foliar applications. However, effects measured at the colony level over a number of months including overwintering did not indicate any significant effects on flupyradifurone-treated bee colonies relative to untreated controls.

The semi-field and field honeybee studies utilized a range of application scenarios in terms of the adjuvant used, the application rate, the number of applications, and the retreatment interval between applications. Ostensibly, the most conservative scenario in terms of highest potential exposure occurred in the two field studies (MRIDs 48844516 and 48844517) in which oil-seed rape seeds were treated with BYI 02960 FS 480 G seed treatment, sown into soil treated with (0.28 lbs ai/A) BYI 02960 SL 200 G, and then plants were later treated with two foliar applications (0.18 lbs ai/A each) of BYI 02960 SL 200 G, including one application at full bloom. These studies generally did not indicate adverse effects related to a range of endpoints. However, as mentioned above, bees in these studies were foraging on alternative (non-treated) food sources based on pollen analysis which may have lowered the level of exposure (which would not be conservative), but is possible for bees under any application scenario.

As described previously in this assessment, the toxicity of formulated product BYI 02960 SL 200 G to young adult honeybees increases by 116-fold and 6.1-fold via the contact and oral exposure routes, respectively, when mixed with the tebuconazole formulation EW 250C G (17% tebuconazole). The rationale for mixing the two formulations in the particular ratio tested was not provided. But, it does suggest that the combination of the two actives can enhance the toxicity of flupyradifurone and that a similar effect may be possible when flupyradifurone is used in combination with other fungicides utilizing similar mechanistic pathways. Currently, the proposed label for Sivanto™ SL 200 indicates that the product should not be tank mixed with azole fungicides during bloom period.

Additional non-guideline toxicity data were submitted for terrestrial arthropods exposed to formulated flupyradifurone (BYI 02960 SL 200 G) that is useful for evaluating potential effects to non-target arthropods exposure through contact. In the majority of studies, survival effects were observed at concentrations lower than the proposed label application rate for flupyradifurone, in some cases several orders of magnitude lower. The lowest (most sensitive) toxicity endpoint reported for non-target arthropods was for survival effects to the parasitoid wasp. These data, which are only used for characterization purposes, indicate potential for effects of flupyradifurone to other non-target terrestrial arthropods.

Terrestrial Plants

Since definitive toxicity data were only available for monocotyledonous plants at the no effect level (*i.e.*, NOAEC), RQ values representing non-target terrestrial plants could only be calculated for listed monocots. If non-definitive toxicity data are used in risk estimation (*i.e.*, IC25 > 0.365 lbs ai/A and NOAEC < 0.365 lbs ai/A), RQ values for non-target dicot plants are as follows: plants receiving spray drift are < 0.1 across uses, plants occupying dry areas are <0.1 across uses, and plants occupying semi-aquatic areas range from 0.21 to 0.50 across uses, which are all below the LOC (RQ≥1) for risk to terrestrial plants. Given that only a single application rate was tested in both seedling emergence and vegetative vigor studies (*i.e*., the maximum seasonal rate of 0.365 lbs ai/A), and given that statistically significant effects in shoot dry weight and/or shoot length were observed for dicots in both studies, there is uncertainty regarding the potential for adverse effects to listed dicots. For foliar and chemigation applications of flupyradifurone, in order to exceed the LOC for listed dicots (RQ≥1) receiving spray drift, inhabiting dry areas, and inhabiting semi-aquatic areas, significant adverse effects on plants would have to occur at 0.009 (foliar only), 0.018, and 0.18 lbs ai/A, respectively. Given that inhibition to the most sensitive dicot endpoints at 0.365 lbs ai/A were <25% in seedling emergence and vegetative vigor studies, the potential for significant adverse effects at 0.18 lbs ai/A are possible, while significant effects at ≤0.018 appear unlikely. Therefore, the main uncertainty for terrestrial plants in this assessment applies to listed dicots inhabiting semi-aquatic areas.

Residues of flupyradifurone in surface or groundwater that is used for irrigation of plants are not expected to result in potential injury to terrestrial plants. Assuming an acre of land is irrigated with one inch of contaminated water, the 96 µg ai/L peak groundwater EEC is equivalent to an application rate of 0.022 lbs ai/A (**Appendix F**). The most sensitive of the available endpoints, the NOAEC and EC_{25} for cabbage from the vegetative vigor study is >0.410 kg/ha (equivalent to 0.37 lbs ai/A). The resulting non-definitive RQs are <0.07 (EEC/highest level tested = 0.0265 lbs ai/A /<0.37 lbs ai/A= 0.07). Both of these non-definitive RQs are far below the Agency's LOC of 1.0 for terrestrial plants. EECs would need to exceed 1,632 µg/L to have a risk concern to terrestrial plants (NOAEC × 1 conversion factor/226,625 lbs water per acre[20] = EEC; see **Appendix F** for explanation of the calculation).

4.2.3. Conclusions

The environmental fate assessment indicates that depending on soil conditions and weather, flupyradifurone may persist in soil and it may be transported through a range of dissipation routes (*i.e.*, runoff, erosion, leaching) to surface or groundwater, where the compound may also persist. Since this is a new chemical, monitoring data are not available to gauge the extent to which the compound will be mobile and/persist in the terrestrial and aquatic environments; however, available field dissipation studies conducted on bare ground indicate dissipation rates that are generally lower than what might be estimated through the combination of degradation pathways for which data are available.

On an acute exposure basis, flupyradifurone ranges from being slightly toxic to very highly toxic to aquatic invertebrates depending on the species tested. Based on the most sensitive species, the primary risks of concern in this assessment are for freshwater and estuarine/marine invertebrates inhabiting both the water column and benthic environments. Acute risk to listed species and chronic risk concerns for freshwater and estuarine/marine invertebrates were identified for the majority of proposed uses in this assessment. After the contribution of spray drift was removed from exposure estimates, many proposed uses still exceeded the acute risk to listed species and chronic risk LOCs. Therefore, the spatial proximity of foliar applications from a water body are not likely to substantially change the potential for risks of concern to aquatic organisms. In this assessment, the influence of multiple crop cycles on aquatic invertebrates from multiple foliar applications of flupyradifurone was also considered. In general, the use of single crop cycle (2 applications at 0.18 lbs ai/A) did not lead to acute risks of concern to non-listed freshwater invertebrates; however, multiple crop cycles (≥2) did lead to risks of concern to this group.

In this assessment, acute risks of concern to listed birds were identified for all proposed foliar and drench uses, as well as the seed treatment use of flupyradifurone. In addition, acute risks of

[20] One acre has 6,272,640 cubic inches of water on the field. The one acre field with one inch of water has 3,630 cubic ft of water (6,272,640 × 0.00058 cubic ft/cubic inch). The field has 27,156 gallons of water (3,630 cubic ft × 7.481 gallons/cubic ft). Therefore, one inch of water on the one acre field weighs 226,625 lbs (27,156 gallons × 8.3453 lbs/gallon of water).

concern to non-listed birds were identified for the seed treatment use and all foliar and soil drench uses, except for hops. The modeling of multiple crop cycles generally increased the number of dietary items for which the acute risk to non-listed species are exceeded. In addition, chronic risks of concern were identified for mammals for multiple dietary items and size classes for all proposed uses evaluated.

Flupyradifurone is proposed for use at full bloom and laboratory and field-based studies of individual bees as well as colonies were evaluated based on both conservative model-generated values as well as measured exposure values in pollen, nectar and flowers. Based on available semi-field and field studies of honey bee colonies, there were some transitory acute effects to honeybee mortality and foraging activity, particularly following applications at full-bloom while bees were actively foraging. In addition, there were some slight indications of effects to food storage and brood cells in a colony feeding study where exposure to the test material was more assured, but these effects were not statistically significant. Although many of the studies had limited numbers of replicates, which likely impacted the power of the studies to detect potential treatment effects, and variability in measurement endpoints was not well characterized, the methods used in the studies were consistent with those that have been used to identify effects of pesticides on colonies. The studies did evaluate the effects of multiple applications at the maximum proposed application rates and did demonstrate exposure through measured residues in pollen/nectar collected by bees as well as within the comb (bee bread, honey and wax). As such, the colony-level studies provided a means of examining both short- and long-term effects of exposure. Based on the available studies and acknowledging the uncertainties associated with them, there is no evidence that exposure to flupyradifurone under the conditions tested had any significant effect on colony strength, overwintering, or the capacity of the colony to successfully lay down brood in the Spring. Toxicity of residues on foliage studies with honey bees also suggest that contact toxicity is not a primary concern given that the RT_{25} is less than 3 hours for the compound; as such, the compound does not have an extended residual toxicity.

This assessment does not evaluate risk potential risk to non-target terrestrial invertebrates other than bees especially given that flupyradifurone is intended as an insecticide likely targeting sucking insect pests. However, in non-guideline toxicity studies submitted for terrestrial arthropods exposed to formulated flupyradifurone (BYI 02960 SL 200 G) via contact exposure, survival effects were observed at concentrations lower than the proposed maximum label application rate for flupyradifurone, in some cases several orders of magnitude lower. The lowest (most sensitive) toxicity endpoint reported for non-target arthropods was for survival effects to the parasitoid wasp. These data indicate that potential for effects of flupyradifurone to non-target terrestrial arthropods at or below proposed application rates.

5. Additional Description of Assumptions, Limitations, Uncertainties, Strengths

5.1. Label Uncertainties

Sivanto™ 200 SL

- The label should specify the formulation on the label.

- The label should specify a maximum number of applications for each crop. In the risk assessment, we estimated the maximum number of applications by dividing the maximum seasonal application rate by the maximum single application rate.
- Retreatment intervals are not specified for soil applications to fruiting vegetables, foliar applications to hops, and soil applications to the "small fruit climbing" group. While a minimum retreatment interval was not specified on the label for these use patterns, the maximum single application rate and the maximum seasonal rate were the same; therefore, a minimum retreatment interval was not needed in modeling and a single application was assumed to occur in the risk assessment.
- As the maximum application rates are provided on a seasonal basis, the label should specify the maximum number of seasons per year that the chemical may be applied to crops that have more than one growing cycle per year. Alternatively, the maximum application rates on a yearly basis could be provided. When multiple crop cycles per year were expected to be possible for a crop, risk was evaluated for a single crop cycle per year and for multiple crop cycles per year. Surface water EECS increased by two to four times, depending on the number of crop cycles per year assumed. In this assessment, the influence of multiple crop cycles on aquatic invertebrates from multiple foliar applications of flupyradifurone was considered. In general, the use of single crop cycle (2 applications at 0.18 lbs ai/A) did not lead to acute risks of concern to non-listed freshwater invertebrates; however, multiple crop cycles ($\geq$2) did lead to risks of concern for this group.

5.2. Aquatic Exposure

Fate data gaps are discussed in the data gaps Section 2.7.2. Additional uncertainties are discussed below.

5.2.1. Unextracted residues

Unextracted residues did occur in fate studies and it is uncertain whether those residues are residues of concern or not. Therefore, modeling was conducted with and without unextracted residues. The unextracted residues had an influence on the estimated groundwater EECs but had little impact on the surface water results. As there was not a risk concern identified due to exposure to residues in groundwater, additional data are not needed at this time to better understand the identity of the unextracted residues. The presence of the unextracted residues in the fate studies will not impact the risk conclusions at this time.

5.2.2. Soybean Seed Planting Depth and Application Rate

The depth of planting was assumed to be 0.5 inches, the minimum of the range of planting depths reported for soybean (see **Table 18**), and the minimum planting depth listed on the label. This will maximize the residues available for runoff as residues are only available for runoff in the top two centimeters of soil in PRZM (Carsel *et al.*, 1997). If the typical planting depth were assumed (1-2 inches or 2.54-5.08 cm), none of the residues would be available for runoff and the resulting EEC would be zero. Even when a one inch planting depth were used, it is likely that not all seed would be placed at the target depth, and a portion of residues would be available for runoff (the zero EEC would likely underestimate risk). Also, the maximum application rate allowed on the label for soybean seed treatment was used for modeling (0.365 lbs ai/Acre/season). The label also recommends a product rate of 0.068 mg ai/seed, assuming a seeding rate of 250,000 lbs seed per acre (USEPA, 2011) results in an application rate of 0.04 lbs ai/Acre (about ten times lower than the rate modeled). Using this estimated application rate would result in EECS about 10x lower than the EECs estimated for 0.365 lbs ai/Acre.

5.2.3. Model Input Values

Metabolism and physico-chemical properties of flupyradifurone are used as inputs into the aquatic models use to estimate concentrations of flupyradifurone in surface water and groundwater. Uncertainties associated with each of these individual components add to the overall uncertainty of the modeled concentrations. Metabolism input values are chosen to be conservative in simulating degradation, *e.g.*, by employing half-life values that err on the high side of the mean of the observed.

Laboratory studies indicated that flupyradifurone was stable hydrolysis in aerobic and anaerobic aquatic environments. The hydrolysis stability assumption was based on a study conducted for 5 days at 50^{o}C. Since hydrolysis is generally the only transformation pathway considered at soil depths greater than one meter, it can have a large impact on the PRZM-GW EECs (Baris *et al.*, 2013; USEPA, 2013a). A chemical may be assumed to be stable to hydrolysis based on minimal transformation in the guideline hydrolysis study (OCSPP 835.2120); however, reevaluation of the hydrolysis study may be completed if there is a risk concern. Currently EECs in groundwater do not result in a risk concern, and the assumption of stability for hydrolysis is not an influence on the risk conclusions for groundwater. As the aerobic aquatic metabolism value does show degradation, which is used to represent degradation in the water column in the surface water models, the assumption of stability for hydrolysis is not as much of a concern for surface water modeling.

Measured aerobic soil metabolism DT_{50} values had a wide range (38 to 401 days in 10 soils). Terrestrial field dissipation DT_{50} also had a wide range (8.3 to 310 days). The persistence of flupyradifurone is expected to vary widely in the different soils and environments where it is used. The representative model input aerobic soil metabolism half-life used in surface water modeling was 265 days for flupyradifurone alone, and 525 days for flupyradifurone plus unextracted residues. These values are considered conservative and thus generate conservative EECs. The cause of the variability in DT_{50} was not identified, as no examined variables were found to correlate with the differences in the aerobic soil metabolism.

Adsorption/desorption data are only available on ten soils. Typically, sorption data are also required for a sediment as well. It is uncertain whether the sorption coefficients used in modeling reflect sorption to benthic sediments. Sorption coefficients measured in sediment tend to be a factor of one to two times as great as those measured in soil (Allen-King *et al.*, 2002). To determine the possible impact that this data deficiency could have on risk conclusions, EECs were calculated assuming double the mean K_{oc} based sorption measured on soils. Acute and chronic EECs calculated assuming a 274 L/kg K_{oc} value were approximately 93% of EECs calculated based on a 137 L/kg K_{oc} value. This indicates that the lack of a sediment sorption coefficient is a minor source of uncertainty because it is likely to have a low impact on calculated RQs.

Freundlich sorption coefficients to soils indicate that the equilibrium concentration will influence the degree of sorption (1/n values range from 0.81 to 0.92). **Figure 7** shows this phenomenon well. For the Argissolo soil, K_{oc} values for the lowest equilibrium concentrations in water are approximately 670 L/kg-oc while the K_{oc} measured at higher equilibrium concentrations in water are 2.7 fold lower (246 L/kg-oc).

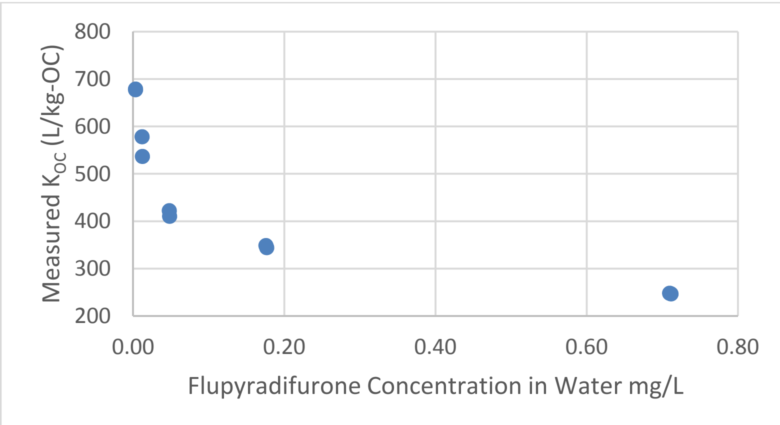


Figure 7. Relationship between the measured K_{oc} and the flupyradifurone equilibrium concentration in water in the Argissolo soil (1/n =0.81)

Sorption coefficients were measured over an appropriate range of equilibrium flupyradifurone concentrations (*e.g.*, equilibrium concentrations range from 3 – 953 µg/L and encompass the predicted EECs). While nonlinear sorption was not simulated in modeling, simulations were completed using the highest (779 L/kg-oc measured at 2.3 µg/L in the Gleissolo soil) and lowest (78.7 L/kg-oc measured at 506 µg/L in the Dollendorf II soil) measured K_{oc} measured at a single equilibrium concentration in water in the adsorption component of the batch equilibrium studies. EECs using the K_{oc} of 779 L/kg-oc are 63 to 70% of EECs simulated using a mean K_{oc}. EECs using the lowest K_{oc} of 78.7 L/kg-oc were essentially the same as the EECs simulated using the mean K_{oc}. This provides some information on the degree of uncertainty in the EECs due to variability that may be observed in sorption coefficients and due to assuming linear sorption rather than nonlinear sorption.

5.2.4. EPA Pond

The standard ecological water body scenario (EXAMS pond) used to calculate potential aquatic exposure to pesticides is intended to generate conservative exposure estimates, which avoid underestimating most aquatic concentrations. The standard scenario involves application of chemical to a 10-hectare field that drains to a 1-hectare, 2-meter deep (20,000 m^3) pond with no outlet. Exposure estimates generated using this pond are intended to generically represent exposures in vulnerable water bodies; however, there are water bodies that could at times be more vulnerable. Low-order streams may for example exhibit peak concentrations (*e.g.*, during storm flow runoff) that exceed those simulated in the EXAMS pond, but that pass quickly as pesticides are transported downstream. As watershed size increases, it becomes increasingly unlikely that the entire area is planted with a single crop that is all treated with a given pesticide.

5.2.5. Dilution of Sediment

The EXAMS model estimates of water concentration are based on an assumption that sediment mass in the benthic zone of the pond is fixed. In real farm ponds, eroded sediments from the watershed are presumably added on an ongoing basis. Over time, benthic sediments with sorbed pesticide may become buried by newer sediments settling out of the water column, rendering a fraction of the older sediment with sorbed pesticide less available for exchange with the water column.

5.2.6. A Well-Mixed Pond

Because the EXAMS model assumes instantaneous equilibrium and mixing, it does not consider the potential for higher short-term concentrations in the areas of the pond initially receiving pesticide runoff (*e.g.*, the shallow, near-shore areas of the pond) and drift (*e.g.*, the near-surface layer of the pond). Complete mixing is a convenient approximation. Concentrations immediately following introduction of runoff or drift will be higher in some areas of the pond than average concentrations based on the assumption of complete mixing throughout the water column. That such spatial inhomogeneities in concentration might persist at ecologically meaningful levels for longer than 1 day (*i.e.*, the limit of resolution of the model) seems unlikely, though perhaps plausible.

5.2.7. Lack of Averaging Time for Exposure

For an acute risk assessment, there is no averaging time for exposure, beyond that represented by the (daily) limit of resolution of the model. An "instantaneous" (daily mean) peak concentration, with a 1 in 10 year return frequency, is assumed. The use of the instantaneous peak assumes that 24 hour exposure is of sufficient duration to elicit acute effects comparable to those observed over more protracted exposure periods tested in the laboratory, typically 48 to 96 hours. In the absence of data regarding time-to-toxic event analyses and latent responses to instantaneous exposure, the degree to which risk may be overestimated cannot be quantified.

5.3. Terrestrial Exposure

Exposure from seed treatment uses is likely to be overestimated for scenarios where seeds are incorporated. Seed incorporation ≥ 1 inch would reduce the likelihood of runoff to non-target plants and surface water and would further reduce the likelihood of seed consumption by birds and mammals.

5.4. Effects Assessment Uncertainties

Effects uncertainties and data gaps are discussed in the data gaps **Sections 2.7.2** and **4.2**.

6. Federally Threatened and Endangered (Listed) Species of Concern

Consistent with the Agency's responsibility under the Endangered Species Act (ESA), the Agency evaluates risks to Federally-listed threatened and/or endangered (listed) species from registered uses of flupyradifurone. This assessment is conducted in accordance with the Overview Document (USEPA, 2004), provisions of the Endangered Species Act (ESA), and the Services' *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998).

6.1. Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by flupyradifurone use and not merely the immediate area where flupyradifurone is applied. At the initial screening-level, the risk assessment considers broadly described taxonomic groups and conservatively assumes that listed species within those broad groups are co-located with the pesticide treatment area. This means that terrestrial plants and wildlife are assumed to be located on or adjacent to the treated site and aquatic organisms are assumed to be located in a surface water body adjacent to the treated site. The assessment also assumes that the listed species are located within an assumed area, which has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area. **Section 6.2** of this risk assessment presents the proposed pesticide use sites that are used to establish initial co-location of species with treatment areas.

6.2. Taxonomic Groups Potentially at Risk

If the assumptions associated with the screening-level action area result in RQs that are below the listed species LOCs, a "no effect" determination conclusion is made with respect to listed species in that taxa, and no further refinement of the action area is necessary. Furthermore, RQs below the listed species LOCs for a given taxonomic group indicate no concern for indirect effects on listed species that depend upon the taxonomic group for which the RQ was calculated. However, in situations where the screening assumptions lead to RQs in excess of the listed species LOCs for a given taxonomic group, a potential for a "may affect" conclusion exists and may be associated with direct effects on listed species belonging to that taxonomic group or may extend to indirect effects upon listed species that depend upon that taxonomic group as a resource. In such cases, additional information on the biology of listed species, the locations of these species, and the locations of use sites could be considered to determine the extent to which screening assumptions regarding an action area apply to a particular listed organism. These subsequent refinement steps could consider how this information would impact the action area for a particular listed organism and may potentially include areas of exposure that are downwind and downstream of the pesticide use site.

Assessment endpoints, exposure pathways, the conceptual models addressing the proposed new flupyradifurone uses, and the associated exposure and effects analyses conducted for the flupyradifurone screening-level risk assessment are in **Sections 2** to **3**. The assessment endpoints used in the screening-level risk assessment include those defined operationally as reduced survival and reproductive impairment for both aquatic and terrestrial animal species and survival, reproduction, and growth of non-target aquatic and terrestrial plant species from exposure via spray drift and runoff. These assessment endpoints address the standard set forth in the Endangered Species Act requiring federal agencies to ensure that any action it authorizes does not appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species. Risk estimates (RQ values) integrating exposure and effects are calculated for broad-based taxonomic groups in the screening-level risk assessment and are presented in **Section 4.**

Both acute and chronic risk to listed species LOCs are considered in the screening-level risk assessment to identify direct and indirect effects to taxa of listed species. This section identifies direct and indirect effect concerns, by taxa, that are triggered by exceeding listed species LOCs in the screening-level risk assessment (**Table 47**).

Table 47. Potential effects to federally listed taxa associated with the proposed uses of flupyradifurone.

Listed Taxon	Direct Effects		Indirect Effects from Risk to Other Taxa	
	Yes/No	Acute/Chronic	Yes/No	Through ...
Terrestrial and semi-aquatic plants – monocots and dicots	Uncertain (dicots only)	NA	Yes	Acute effects on birds, terrestrial-phase amphibians, and chronic effects on mammals, when required for pollination or seed dispersal.
Birds	Yes	Acute (foliar, drench, seed treatment uses) Chronic (seed treatment only)	Yes	Chronic effects on mammals that serve as prey; acute effects on reptiles and amphibians that serve as prey.
Terrestrial-phase amphibians	Yes	Acute (foliar, drench, seed treatment uses) Chronic (seed treatment only)	Yes	Chronic effects on mammals which provide habitat (*e.g.*, burrows) and serve as prey.
Reptiles	Yes	Acute (foliar, drench, seed treatment uses) Chronic (seed treatment only)	Yes	Chronic effects on mammals that serve as prey; acute effects on birds, reptiles, and amphibians that serve as prey.
Mammals	Yes	Chronic (all uses)	Yes	Acute effects on birds, reptiles, and amphibians that serve as prey; chronic effects on mammals that serve as prey.
Aquatic plants	No	NA	Yes	Effects on aquatic invertebrates.
Freshwater fish	No	NA	Yes	Effects on aquatic invertebrates that serve as prey
Aquatic-phase amphibians	No	NA	Yes	Effects on aquatic invertebrates that serve as prey
Freshwater invertebrates	Yes	Acute (all uses) Chronic (most uses)[1]	Yes	Effects on other aquatic invertebrates that serve as prey
Mollusks	No	NA	Yes	Effects on other aquatic invertebrates that serve as prey
Marine/estuarine fish	No	NA	Yes	Effects on aquatic invertebrates that serve as prey
Marine/estuarine invertebrates	Yes	Acute (most uses)[1] Chronic (most uses)[1]	Yes	Effects on other aquatic invertebrates that serve as prey

[1] See **Table 38** and **Table 39** for list of specific uses that exceed listed species LOC for aquatic invertebrates

7. References

7.1. Literature Cited

Allen-King, R. M., Grathwohl, P., & Ball, W. P. 2002. New modeling paradigms for the sorption of hydrophobic organic chemicals to heterogenous carbonaceous matter in soils, sediments, and rocks. *Advances in Water Resources, 25*, 985-1016.

Armitage, J. M., & Gobas, F. A. P. C. 2007. A terrestrial food-chain bioaccumulation model for POPs. *Environmental Science and Technology, 41*, 4019-4025.

Baris, R., Barrett, M., Bohaty, R. F. H., Echeverria, M., Villaneuva, P., Wolf, J., et al. 2013. *Guidance for Using PRZM-GW in Drinking Water Exposure Assessments*. December 11, 2012. Environmental Fate and Effects Division. Office of Pesticide Programs. United States Environmental Protection Agency. Available at http://www.epa.gov/oppefed1/models/water/przm_gw/wqtt_przm_gw_guidance.htm (Accessed April 11, 2014).

Carsel, R. F., Imhoff, J. C., Hummel, P. R., Cheplick, J. M., & Donigian Jr., J. S. 1997. *PRZM-3, A Model for Predicting Pesticide and Nitrogen Fate in Crop Root and Unsaturated Soil Zones: Users Manual for Release 3.0*. Memorandum From to Environmental Research Laboratory. Office of Research and Development. United States Environmental Protection Agency.

FAO. 2000. Appendix 2. Parameters of pesticides that influence processes in the soil. In FAO Information Division Editorial Group (Ed.), *Pesticide Disposal Series 8. Assessing Soil Contamination. A Reference Manual*. Rome: Food & Agriculture Organization of the United Nations (FAO). Available at http://www.fao.org/DOCREP/003/X2570E/X2570E06.htm (Accessed July 10, 2009).

Fletcher, J. S., Nellessen, J. E., & Pfleeger, T. G. 1994. Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, an instrument for estimating pesticide residues on plants. *Environmental Toxicology and Chemistry, 13*(9), 1383-1391.

Gobas, F. A. P. C., Kelly, B. C., & Arnot, J. A. 2003. Quantitative structure activity relationships for predicting the bioaccumulation of POPs in terrestrial food-webs. *QSAR Comb. Sci, 22*, 329-336.

Hoerger, F., & Kenaga, E. E. 1972. Pesticide Residues on Plants: Correlation of Representative Data as a Basis for Estimation of their Magnitude in the Environment. In F. Coulston & F. Korte (Eds.), *Environmental Quality and Safety: Chemistry, Toxicology, and Technology* (Vol. 1, pp. 9-28). New York: Academic Press.

IRAC. 2012. *IRAC MoA Classification Scheme*. Version 7.2. April 2012. Insecticide Resistance Action Committee (IRAC). IRAC International Mode of Action Working Group. Available at http://www.irac-online.org/content/uploads/MoA-classification.pdf (Accessed January 10, 2012).

NAFTA. 2012. *Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media*. December 2012. NAFTA Technical Working Group on Pesticides. Available at http://www.epa.gov/oppfead1/international/naftatwg/guidance/degradation-kin.pdf (Accessed April 11, 2014).

SAP. 2009. *SAP Minutes No. 2009-01. A set of Scientific Issues Being Considered by the Environmental Protection Agency Regarding: Selected Issues Associated with the Risk*

Assessment Process for Pesticides with Persistent, Bioaccumulative, and Toxic Characteristics. October 28-31, 2008. January 29, 2009. FIFRA Scientific Advisory Panel. Office of Science Coordination and Policy. Available at http://www.epa.gov/scipoly/sap/meetings/2008/102808_mtg.htm (Accessed July 9, 2009).

Staton, M. 2013. *Michigan State University Extension. Planting soybean seed at the proper depth will produce more uniform stands and higher yields*. Available at http://msue.anr.msu.edu/news/soybean_planting_depth_matters (Accessed April 11. 2014).

USDA. 2008. *Crop Profile for Radish in Florida*. April 2008. United States Department of Agriculture. Available at http://www.ipmcenters.org/cropprofiles/docs/FLradish.pdf (Accessed April 25, 2014).

USEPA. 1998. *Guidelines for Ecological Risk Assessment*. EPA/630/R-95/002F. Risk Assessment Forum. Office of Research and Development. U.S. Environmental Protection Agency. Available at http://www.epa.gov/raf/publications/guidelines-ecological-risk-assessment.htm (Accessed November 7, 2012).

USEPA. 2004. *Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs*. Environmental Fate and Effects Division. Office of Pesticide Programs. U.S. Environmental Protection Agency. Available at http://www.epa.gov/espp/consultation/ecorisk-overview.pdf (Accessed June 19, 2009).

USEPA. 2006. *(P)RZM (E)XAMs Model Shell, Version 5.0*. November 15, 2006. Environmental Fate and Effects Division. Office of Pesticide Programs. Office of Chemical Safety and Pollution Prevention. United States Environmental Protection Agency. Available at http://www.epa.gov/oppefed1/models/water/pe5_user_manual.htm (Accessed April 18, 2013).

USEPA. 2008. *Fate, Transport, and Transformation Guidelines. OPPTS 835.6100 Terrestrial Field Dissipation*. EPA 712-C-08-020. October 2008. Office of Prevention, Pesticides, and Toxic Substances. Available at http://www.epa.gov/opptsfrs/publications/835_6100.pdf (Accessed July 30, 2009).

USEPA. 2009. *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides, Version 2.1*. Environmental Fate and Effects Division. Office of Pesticide Programs. U.S. Environmental Protection Agency. Available at http://www.epa.gov/oppefed1/models/water/input_parameter_guidance.htm (Accessed June 22, 2014).

USEPA. 2010. *Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in the Problem Formulation for Registration Review, Registration Review Risk Assessments, Listed Species Litigation Assessments, New Chemical Risk Assessments, and Other Relevant Risk Assessments*. January 25, 2010. Environmental Fate and Effects Division. Office of Chemical Safety and Pollution Prevention. U.S. Environmental Protection Agency. Available at http://www.epa.gov/pesticides/science/efed/policy_guidance/team_authors/endangered_species_reregistration_workgroup/esa_reporting_fate.htm (Accessed July 5, 2012).

USEPA. 2011. *Acres Planted per Day and Seeding Rates of Crops Grown in the United States*. March 24, 2011. Memorandum From J. Becker & S. Ratnayake to P. Deschamp & D. Spatz. Biological and Economic Analysis Division. Office of Pesticide Programs. Office of Chemical Safety and Pollution Prevention. United States Environmental

Protection Agency.
USEPA. 2012a. *Criteria Used by the PBT Profiler*. September 4, 2012. Office of Chemical Safety and Pollution Prevention. United States Environmental Protection Agency. Available at http://www.pbtprofiler.net/criteria.asp (Accessed September 7, 2012).
USEPA. 2012b. *Standard Operating Procedure for Using the NAFTA Guidance to Calculate Representative Half-life Values and Characterizing Pesticide Degradation*. November 30, 2012. Environmental Fate and Effects Division. Office of Pesticide Programs. U.S. Environmental Protection Agency. Available at http://www.epa.gov/oppefed1/ecorisk_ders/degradation_kinetics/NAFTA_Degradation_Kinetics.htm (Accessed December 16, 2013).
USEPA. 2012c. *User's Guide: T-REX version 1.5*. Memorandum From to Environmental Fate and Effects Division. Office of Pesticide Progams. Office of Chemical Safety and Pollution Prevention. United States Environmental Protection Agency. Available at http://www.epa.gov/oppefed1/models/terrestrial/trex/t_rex_user_guide.htm (Accessed April 29, 2013).
USEPA. 2012d. *White Paper in Support of the Proposed Risk Assessment Process for Bees. September 11-14, 2012*. September 11, 2012. U.S. Environmental Protection Agency. Pest Management Regulatory Agency. California Department of Pesticide Regulation. Available at http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2012-0543-0004 (Accessed June 22, 2014).
USEPA. 2013.D415161. *Data on Flupyradifurone and Its Environmental Transformation Products in Support of the ROCKS*. D415161. Memorandum From S. Glaberman & K. White to C. Olinger & E. Scollon. October 23, 2013. Environmental Fate and Effects Division. Office of Pesticide Programs. Office of Chemical Safety and Pollution Prevention. United States Environmental Protection Agency.
USEPA. 2013a. *Guidance for Using PRZM-GW in Drinking Water Exposure Assessments*. December 11, 2012. Environmental Fate and Effects Division. Office of Pesticide Programs. U.S. Environmental Protection Agency. Available at http://www.epa.gov/oppefed1/models/water/przm_gw/wqtt_przm_gw_guidance.htm (Accessed January 22, 2013).
USEPA. 2013b. *Guidance on Modeling Offsite Deposition of Pesticides Via Spray Drift for Ecological and Drinking Water Assessment*. Environmental Fate and Effects Division. Office of Pesticide Programs. Office of Chemical Safety and Pollution Prevention. U.S. Environmental Protection Agency. Available at http://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPP-2013-0676 (Accessed April 11, 2014).
USEPA. 2013.D408685. *Reduced Risk Analysis: Flupyradifurone Use on Pome Fruit, Citrus, Cotton, and Vegetables*. D408685. February 5, 2013. Environmental Fate and Effects Division. Office of Pesticide Programs. Office of Chemical Safety and Pollution Prevention.
USEPA. 2014. *Flupyradifurone: Human Health Risk Assessment for the First Food Use on: Root Vegetables Except Sugar Beet (Subgroup 1B), Tuberous and Corm Vegetables (Subgroup 1C), Bulb Vegetables (Group 3-07), Leafy Vegetables (Except Brassica) (Group 4), Taro Leaves, Turnip Tops; Head and Stem Brassica Vegetables (Subgroup 5A), Leafy Brassica Greens Vegetables (Subgroup 5B), Edible-Podded Legume Vegetables (Subgroup 6A), Succulent Shelled Pea and Bean (Subgroup 6B), Died*

Shelled Pea and Bean (except Soybean) (Subgroup 6C), Foliage of Legume Vegetables (except Soybean) (Subgroup 7A), Soybean (Seed), Fruiting Vegetables Except Cucurbits (Group 8-10), Cucurbit Vegetables (Group 9), Citrus Fruits (Group 10-10), Pome Fruits (Group 11-10), Bushberry (Subgroup 13-07B), Small Fruit Vine Climbing (Except Fuzzy Kiwifruit) (Subgroup 13-07F), Low Growing Berry (Subgroup 13-07G), Tree Nuts (Group 14-12), Cereal Grains Except Rice (Crop Group 15, Except Rice), Forage, Fodder and Straw of Cereal Grains (Crop Group 16), Nongrass Animal Feeds (Forage, Fodder, Straw and Hay) (Group 18), Cottonseed (Subgroup 20C), Coffee, Hops, Peanuts, Prickly Pear Cactus, and Pitaya. D407063. Health Effects Division. Office of Chemical Safety and Pollution Prevention. U.S. Environmental Protection Agency.

USEPA, & Health Canada. 2012. *Guidance for Selecting Input Parameters for Modeling Pesticide Concentrations in Groundwater Using the Pesticide Root Zone Model. Version 1.0*. October 15, 2012. Environmental Fate and Effects Division. Office of Pesticide Programs. United States Environmental Protection Agency. Environmental Assessment Directorate. Pesticide Management Regulatory Agency. Health Canada. Available at http://www.epa.gov/oppefed1/models/water/przm_gw/wqtt_przm_gw_input_guidance.pdf (Accessed January 29, 2014).

USEPA, & Health Canada. 2013. *Guidance for Selecting Input Parameters for Modeling Pesticide Concentrations in Groundwater Using the Pesticide Root Zone Model*. Version 1. October 15, 2012. Environmental Fate and Effects Division. Office of Pesticide Programs. U.S. Environmental Protection Agency. Available at http://www.epa.gov/oppefed1/models/water/przm_gw/wqtt_przm_gw_input_guidance.htm (Accessed February 28, 2013).

USFWS/NMFS. 1998. *Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act. Final Draft*. United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). Available at http://sero.nmfs.noaa.gov/pr/esa/pdf/Sec%207%20Handbook.pdf (Accessed November 7, 2012).

Submitted Fate Studies

830.7050 UV/Visible absorption

48843628	Peters, S. (2009) Spectral Data Set of BYI 02960 A.I: Reference Material. Project Number: 15/600/2439/OCR, M/345761/01/2. Unpublished study prepared by Bayer CropScience. 24p.

830.7370 Dissociation constants in water

48843634	Wiche, A.; Bogdoll, B. (2011) Flupyradifurone (BYI 02960), Pure Substance: Dissociation Constant in Water. Project Number: PA10/048/OCR, M/414102/01/2. Unpublished study prepared by Bayer CropScience AG. 17p.
48843635	Wiche, A.; Bogdoll, B. (2011) BCS-CC98193 (BYI 02960-DFEAF): Dissociation Constant in Water. Project Number: PA11/021/OCR, M/415757/01/2. Unpublished study prepared by Bayer CropScience AG. 18p.
48843636	Winkler, S. (2011) Difluoro Acetic Acid (BCS-AA56716): Determination of the Dissociation Constant in Water: Final Report. Project Number: 20100366/02, M/418626/01/2/OCR. Unpublished study prepared by Siemens AG. 19p.

48843637 Miya, K. (2001) Dissociation Constant of IC-0: Final Report. Project Number: NCAS/01/140/OCR, M/203097/01/2, RD/II01190. Unpublished study prepared by Nisso Chemical Analysis Service Co., Ltd. 16p.

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

48843640 Eyrich, U.; Ziemer, F. (2011) BCS-CR74729 (BYI 02960-succinamide): Partition Coefficient 1-Octanol / Water at pH 5, pH 7 and pH 9 (Shake Flask Method). Project Number: PA11/079/OCR, M/416883/01/2. Unpublished study prepared by Bayer CropScience AG. 32p.

48843641 Eyrich, U.; Ziemer, F. (2011) BCS - CU93236 (BYI 02960-azabicyclosuccinamide Na-salt): Partition Coefficient 1-Octanol / Water at pH 5, pH 7 and pH 9 (Shake Flask Method). Project Number: PA11/093/OCR, M/416656/01/2. Unpublished study prepared by Bayer CropScience AG. 33p.

48843642 Eyrich, U.; Ziemer, F. (2011) Difluoroacetic Acid (BCS-AA56716): Partition Coefficient 1-Octanol / Water at pH 5, pH 7 and pH 9 (Shake Flask Method). Project Number: PA10/043/OCR, M/416624/01/2. Unpublished study prepared by Bayer CropScience AG. 35p.

48843643 Higashida, S. (2001) Partition Coefficient (n-Octanol/Water) of IC-0. Project Number: NCAS/01/127/OCR, M/204285/01/2, C/017442. Unpublished study prepared by Nisso Chemical Analysis Service Co.,Ltd. 19p.

830.7840 Water solubility: Column elution method, shake flask method

48843644 Wiche, A.; Bogdoll, B. (2011) BYI 02960, Pure Substance: Solubility in Distilled Water (pH 7), at pH 4 and pH 9 (Flask Method). Project Number: PA09/003/OCR, M/409513/01/2. Unpublished study prepared by Bayer CropScience AG. 25p.

48843645 Bogdoll, B.; Strunk, B. (2011) BCS-CC98193 (BYI 02960-DFEAF): Water Solubility at pH 5, pH 7 and pH 9 (Flask Method). Project Number: PA11/018/OCR, M/415753/01/2. Unpublished study prepared by Bayer CropScience AG. 28p.

48843646 Wiche, A.; Ziemer, F. (2011) BCS-CR74729 (BYI 02960-succinamide): Water Solubility at pH 5, pH 7 and pH 9 (Flask Method). Project Number: PA11/078/OCR, M/416651/01/2. Unpublished study prepared by Bayer CropScience AG. 24p.

48843647 Ziemer, F.; Strunk, B. (2011) BSC-CU93236 (BYI 02960-azabicyclosuccinamide Na-salt): Water Solubility at pH 5, pH 7 and pH 9 (Flask Method). Project Number: PA11/094, M/417069/01/2/OCR. Unpublished study prepared by Bayer CropScience AG. 17p.

48843648 Bogdoll, B.; Strunk, B. (2011) Difluoroacetic Acid (BCS-AA56716): Miscibility with Distilled Water and Solubility in Water in a pH Range of 1.6 to 13. Project Number: PA10/042/OCR, M/418554/01/2. Unpublished study prepared by Bayer CropScience AG. 16p.

48843649 Miya, K. (2001) Solubility of IC-0 in Water. Project Number: NCAS/01/129/OCR, M/202871/01/2. Unpublished study prepared by Nisso Chemical Analysis Service Co.,Ltd. 19p.

830.7950 Vapor pressure

48843650 Smeykal, H. (2008) BYI 02960, Pure Substance: Vapour Pressure: Final Report. Project Number: 20080615/01/OCR, M/309853/01/3. Unpublished study prepared by Siemens AG. 14p.

48843651 Dornhagen, J. (2011) BCS-CC98193 (BYI 02960-DFEAF): Vapour Pressure: Final Report. Project Number: 20110091/01/OCR, M/420457/01/2. Unpublished study prepared by Siemens AG. 16p.

48843652 Smeykal, H. (2011) Difluoroacetic Acid (BCS-AA56716): Vapour Pressure: Final Report. Project Number: 20100366/01/OCR, M/418553/01/2. Unpublished study prepared by Siemens AG. 15p.

835.0001 Background for Environmental Fate, Transport, and Drift

48844234 Desmarteau, D.; Tang, J. (2012) Drinking Water Exposure Assessment for Flupyradifurone TC Resulting from Proposed Crop Uses in the United States. Project Number: MERVP089, M/435213/01/1. Unpublished study prepared by Bayer CropScience. 46p.

835.1230 Sediment and soil absorption/desorption for parent and degradates

48843662 Menke, U.; Telscher, M. (2008) [Pyridinylmethyl-(Carbon 14)]BYI 02960: Adsorption to and Desorption from Soils. Project Number: 1659/6/OCR, M/327492/01/2, M131/1659/6. Unpublished study prepared by Bayer CropScience. 80p.

48843663 Stroech, K. (2010) [Pyridinylmethyl-(carbon 14)]BYI 02960: Adsorption/Desorption on Two Soils. Project Number: MERVP017, M/363541/01/1. Unpublished study prepared by Bayer CropScience. 78p.

48843664 Tasso de Souza, T. (2012) Adsorption/Desorption of [Pyridine-2,6-(carbon 14)]-BYI 02960 in Brazilian Soils: Final Report. Project Number: 2301/AD/343/11, M/426755/02/3. Unpublished study prepared by Bioensaios Analises e Consultoria Ambiental Ltda. 66p.

48843665 Menke, U. (2011) [1-(carbon 14)]BYI 02960-DFA (BCS-AB60481): Adsorption to and Desorption from Five Soils. Project Number: M131/1964/5, MEF/10/538, M/413836/01/2. Unpublished study prepared by Bayer CropScience. 79p.

835.1240 Soil column leaching

48843666 Tasso de Souza, T. (2012) Mobility of [Pyridine-2,6-(carbon 14)]-BYI 02960 in Brazilian Soils - Soil Columns Leaching Method: Final Report. Project Number: 2301/LIX/344/11, M/424966/02/3. Unpublished study prepared by Bioensaios Analises e Consultoria Ambiental Ltda. 54p.

835.2120 Hydrolysis of parent and degradates as a function of pH at 25 C

48843667 Mislankar, S.; Woodard, D. (2011) BYI-02960: Hydrolytic Degradation. Project Number: MERVP019, M/398952/01/2. Unpublished study prepared by Bayer CropScience. 57p.

835.2210 Direct photolysis rate in water by sunlight

48843668 Heinemann, O. (2011) BYI 02960: Determination of the Quantum Yield and Assessment of the Environmental Half-Life of the Direct Photo-Degradation in Water. Project Number: MEF/11/554, M1432048/2, M/414756/01/2. Unpublished study prepared by Bayer CropScience. 44p.

835.2240 Direct photolysis rate of parent and degradates in water

48843669 Hall, L. (2012) Phototransformation of [(carbon 14)]BYI 02960 in Aqueous pH 7 Buffer. Project Number: MERVP042, MERVP042/1, M/418426/02/2. Unpublished study prepared by Bayer CropScience. 104p.

48843670 Hall, L. (2011) Phototransformation of [(carbon 14)]BYI 02960 in Natural Water. Project Number: MERVP020, M/415368/01/2. Unpublished study prepared by Bayer CropScience. 105p.

835.2370 Photodegradation of parent and degradates in air

48843671 Hellpointner, E. (2010) BYI02960: Calculation of the Chemical Half-Life in the Troposphere. Project Number: MEF/10/896, M/398741/01/2. Unpublished study prepared by Bayer CropScience. 18p.

835.2410 Photodegradation of parent and degradates in soil

48843672 Menke, U.; Unold, M. (2011) [Pyridinylmethyl-(carbon 14)]BYI 02960 and [Furanone-4-(carbon 14)]BYI 02960: Phototransformation on Soil. Project Number: MEF/10/351, M113/1808/2, M/405776/01/2. Unpublished study prepared by Bayer CropScience. 103p.

835.3180 Sediment/water microcosm biodegradation test

48843673 Bruns, E. (2012) Fate of BYI 02960 (tech.) in Outdoor Microcosm Ponds Simulating Actual Exposure Conditions in Agricultural Use. Project Number: EBRVP109, M/427167/01/2. Unpublished study prepared by Bayer CropScience. 75p.

835.4100 Aerobic soil metabolism

48843674 Menke, U. (2011) [Pyridinylmethyl-(carbon 14)]BYI 02960: Aerobic Soil Metabolism/Degradation and Time-Dependent Sorption in Soils. Project Number: MEF/07/334, M125/1634/2, M/414615/01/2. Unpublished study prepared by Bayer CropScience. 131p.

48843676 Menke, U. (2011) [Furanone-4-(carbon 14)]BYI 02960: Aerobic Soil Metabolism/Degradation. Project Number: MEF/10/804, M125/1758/9, M/411625/01/2. Unpublished study prepared by Bayer CropScience. 119p.

48843677 Ripperger, R. (2012) [Furanone -4-(carbon 14)]BYI 02960: Aerobic Soil Metabolism in Two US Soils. Project Number: MERVP037, MERVP037/2, M/405497/03/1. Unpublished study prepared by Bayer CropScience. 99p.

48843679 Menke, U.; Unold, M. (2011) [Ethyl-1-(carbon 14)]BYI 02960: Aerobic Soil Metabolism. Project Number: MEF/10/858, M125/1888/3, M/414981/01/1. Unpublished study prepared by Bayer CropScience. 121p.

48843681 Menke, U.; Unold, M. (2011) [Pyridine-2,6-(carbon 14)]BYI 02960: Aerobic Soil Metabolism. Project Number: MEF/10/880, M125/1952/5, M/411693/01/2. Unpublished study prepared by Bayer CropScience. 86p.

48843682 Shepherd, J. (2012) [Pyridine-2,6-(carbon 14)]BYI 02960: Aerobic Soil Metabolism in Two US Soils. Project Number: MERVP038, MERVP038/1, M/413425/02/1. Unpublished study prepared by Bayer CropScience. 112p.

48843683 Tasso de Souza, T. (2012) BYI 02960: Rate of Degradation of [Pyridine-2,6-(carbon 14)]-BYI 02960 in Brazilian Soils: Final Report. Project Number: 2301/BS120/342/11, M/432044/01/3. Unpublished study prepared by Bioensaios Analises e Consultoria Ambiental Ltda. 72p.

835.4200 Anaerobic soil metabolism

48843686 Menke, U.; Unold, M. (2012) [Furanone-4-(carbon 14)] and [Ethyl-1-(carbon 14)] and [Pyridine-2,6-(carbon 14)] BYI 02960: Anaerobic Soil Metabolism. Project Number: MEF/11/514, M126/1933/5, M/421504/01/2. Unpublished study prepared by Bayer CropScience. 129p.

48843687 Mislankar, S.; Woodard, D. (2012) [Pyridine-2,6 (carbon 14)]BYI 02960: Anaerobic Soil Metabolism. Project Number: MERVP094, M/421993/01/2. Unpublished study prepared by Bayer CropScience, Thorsten Leicher and Agvise, Inc. 90p.

48843688 Woodard, D. (2012) [Pyridine-2,6 (carbon 14)]BYI 02960: Anaerobic Soil Metabolism in Springfield, Nebraska (USA) Soil. Project Number: MERVL006, M/424987/01/2. Unpublished study prepared by Bayer CropScience, and Agvise, Inc. 66p.

835.4300 Aerobic aquatic metabolism

48843673 Bruns, E. (2012) Fate of BYI 02960 (tech.) in Outdoor Microcosm Ponds Simulating Actual Exposure Conditions in Agricultural Use. Project Number: EBRVP109, M/427167/01/2. Unpublished study prepared by Bayer CropScience. 75p.

48843689 Xu, T. (2012) [Pyridine-2,6-(carbon 14)]BYI 02960: Anaerobic Aquatic Metabolism in Two Water/Sediment Systems. Project Number: MERVP027, M/422616/01/2. Unpublished study prepared by Bayer CropScience. 75p.

48843690 Hellpointner, E.; Unold, M. (2012) [Pyridine-2,6-(carbon 14)]BYI 02960: Aerobic Aquatic Metabolism. Project Number: MEF/11/907, M1512007/6, M/422359/01/1. Unpublished study prepared by Bayer CropScience. 141p.

48843691 Hellpointner, E.; Unold, M. (2012) [1-(carbon 14)]BYI 02960-DFA (BCS-A B60481): Aerobic Aquatic Degradation. Project Number: MEF/11/996, M1512008/7, M/422371/01/1. Unpublished study prepared by Bayer CropScience. 128p.

48843692 Menke, U.; Unold, M. (2012) [Furanone-4-(carbon 14)] and [Ethyl-1-(carbon 14)]BYI 02960: Aerobic Aquatic Metabolism. Project Number: MEF/10/730, M1511908/5, M/426504/01/1. Unpublished study prepared by Bayer CropScience. 171p.

835.4400 Anaerobic aquatic metabolism

48843689 Xu, T. (2012) [Pyridine-2,6-(carbon 14)]BYI 02960: Anaerobic Aquatic Metabolism in Two Water/Sediment Systems. Project Number: MERVP027, M/422616/01/2. Unpublished study prepared by Bayer CropScience. 75p.

48843690 Hellpointner, E.; Unold, M. (2012) [Pyridine-2,6-(carbon 14)]BYI 02960: Aerobic Aquatic Metabolism. Project Number: MEF/11/907, M1512007/6, M/422359/01/1. Unpublished study prepared by Bayer CropScience. 141p.

48843691 Hellpointner, E.; Unold, M. (2012) [1-(carbon 14)]BYI 02960-DFA (BCS-A B60481): Aerobic Aquatic Degradation. Project Number: MEF/11/996, M1512008/7, M/422371/01/1. Unpublished study prepared by Bayer CropScience. 128p.

48843692 Menke, U.; Unold, M. (2012) [Furanone-4-(carbon 14)] and [Ethyl-1-(carbon 14)]BYI 02960: Aerobic Aquatic Metabolism. Project Number: MEF/10/730, M1511908/5, M/426504/01/1. Unpublished study prepared by Bayer CropScience. 171p.

835.6100 Terrestrial field dissipation

48843693 Lenz, M. (2012) Terrestrial Field Dissipation of BYI 02960 in California Soil. Project Number: MERVY001, M/432355/01/1. Unpublished study prepared by Bayer CropScience, Agvise Laboratories, Inc. and Research for Hire. 216p.

48843694 Lenz, M. (2012) Terrestrial Field Dissipation of BYI 02960 in Florida Soil. Project Number: MERVY002, M/432358/01/1. Unpublished study prepared by Bayer CropScience, Agvise Laboratories, Inc. and Southeast Ag Research, Inc. 214p.

48843695 Lenz, M. (2012) Terrestrial Field Dissipation of BYI 02960 in Idaho Soil. Project Number: MERVP028, M/432354/01/1. Unpublished study prepared by Bayer CropScience, Agvise Laboratories, Inc. and Miller Research, Inc. 225p.

48843696 Harbin, A. (2012) Terrestrial Field Dissipation of BYI 02960 200 SL in Three Canadian Soils. Project Number: MERVP055, M//432672/01/2. Unpublished study prepared by Bayer CropScience, Bayer CropScience, Atlantic AgriTech Inc. and Bayer CropScience Canada. 357p.

48843697 Heinemann, O. (2013) Determination of the Residues of BYI 02960 in/on Soil After Spraying of BYI 02960 SL 200 in the Field in Germany, Italy, Spain and the United Kingdom. Project Number: 09/2702, M/414245/01/2, MERVP012. Unpublished study prepared by Bayer CropScience. 274p.

835.6200 Aquatic field dissipation

48844235 Desmarteau, D.; Tang, J. (2012) Aquatic Ecological Exposure Assessment for Flupyradifurone TC Resulting from Proposed Crop Uses in the United States. Project Number: MERVP088, M/433353/01/2. Unpublished study prepared by Bayer CropScience. 40p.

860.1380 Storage stability data

48843840 Netzband, D.; Stoughton, S. (2012) Stability of BYI 02960 and its Metabolites 6-Chloronicotinic Acid (6-CNA) and Difluoroacetic Acid (DFA) in Soil During Frozen Storage, 2010 (Reported Through 381 Days of Storage). Project Number: RARVP070, M/428408/01/1. Unpublished study prepared by Bayer CropScience. 38p.

48843841 Timberlake, B.; Harbin, A. (2012) Storage Stability of BYI 02960, Difluoroacetic Acid, and Difluoroethyl-Amino-Furanone in Plant Matrices. Project Number: RARVP046, M/428412/01/1. Unpublished study prepared by Bayer CropScience. 223p.

48977401 Netzband, D.; Timberlake, B.; Harbin, A. (2012) Storage Stability of BYI 02960, Difluoroacetic Acid, and Difluoroethyl-amino-furanone in Plant Matrices (18-Month Data). Project Number: M/428412/02/1/OCR, RARVP046/1, RARVP046. Unpublished study prepared by Bayer CropScience LP. 266p.

Analytical Methods

48843836 Netzband, D. (2012) In House Laboratory Validation of an Analytical Method for the Determination of Residues of BYI 02960 and its Metabolites Difluoroacetic Acid, BYI 02960-Succinamide and BYI 02960-Azabicyclosuccinamide in Water Using LC/MS/MS. Project Number: RARVP010, M/433268/01/1. Unpublished study prepared by Bayer CropScience. 96p.

48844224 Nuesslein, F.; Hellpointner, E.; Thomas, J.; et al. (2012) Tier 2 Summary of the Analytical Methods and Validation for the Flupyradifurone TC. Project Number: 102000025488, M/435597/01/1. Unpublished study prepared by Bayer CropScience LP. 95p.

48843829 Brumhard, B.; Reineke, A. (2009) Analytical Method 01074 for the Determination of BYI 02960 in Soil Using LC/MS//MS. Project Number: 01074, MR/07/337, P601071824. Unpublished study prepared by Bayer CropScience AG. 45p.

48843830 Netzband, D. (2010) An Analytical Method for the Determination of Residues of BYI 02960, 6-Chloronicotinic Acid (6-CNA) and Difluoroacetic Acid (DFA) in Soil and Sediment Using LC/MS/MS. Project Number: RV/002/S10/01, M/401212/01/1. Unpublished study prepared by Bayer CropScience. 22p.

48843831 Netzband, D. (2011) An Analytical Method for the Determination of Residues of BYI 02960, 6-Chloronicotinic Acid (6-CNA) and Difluoroacetic Acid (DFA) in Soil and Sediment Using LC/MS/MS. Project Number: RV/002/S10/02, M/428409/01/1. Unpublished study prepared by Bayer CropScience. 27p.

48843834 Fargeix, G.; Rosati, D. (2012) Analytical Method (Number) 01213 for the Determination of Residues of BYI 02960 in Drinking and Surface Water By HPLC-MS/MS. Project Number: 01213, MR/12/022, 11/04. Unpublished study prepared by Aventis Cropscience, Centre de Recherche de La Dargoire. 50p.

48843835 Netzband, D. (2012) Analytical Method for the Determination of Residues of BYI 02960 and its Metabolites Difluoroacetic Acid, BYI 2960-Succinamide and BYI 2960- Azabicyclosuccinamide in Water Using LC/MS/MS. Project Number: RV/005/W12/01, M/435207/01/1. Unpublished study prepared by Bayer CropScience. 28p.

48843838 Heinz, N. (2011) BYI 02960: Analytical Method for Determination in Air. Project Number: P/2419/G, P605117520, RARVP011. Unpublished study prepared by PTRL Europe Gmbh. 35p.

48843827 Li, Y.; Moore, S. (2012) An Analytical Method for the Determination of Residues of BYI 02960 and its Metabolites BYI02960-Hydroxy, BYI 02960-Acetyl-AMCP, and Difluoroacetic Acid in Animal Matrices and Biota Using LC/MS/MS. Project Number: RV/004/A11/05, M/429871/01/1. Unpublished study prepared by Bayer CropScience. 64p.

Other Studies

48843656 Eyrich, U.; Bogdoll, B. (2011) Flupyradifurone (BYI 02960): Solubility in Organic Solvents. Project Number: PA09/005, M/414064/01/2/OCR. Unpublished study prepared by Bayer CropScience AG. 25p.

48843769 Leicher, T. (2011) BYI 02960: Effects on Soil Litter Degradation After Spray Application. Project Number: E/427/3905/0, EBRVP082, M/413408/01/3. Unpublished study prepared by Bayer CropScience. 62p.

Submitted Effects Studies

Banman, C. S.; Lam, C. V.; Acute toxicity of BYI 02960 to Daphnia magna under static conditions; Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP032; Document No.: M-357476-01-1; October 14, 2009; Pages: 42 850.1010 **MRID** 48843701

Bruns, E.; Acute toxicity of BCS-AB60481 to the waterflea Daphnia magna in a static laboratory test system - limit test-; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP079; Document No.: M-409326-01-3; June 10, 2011; Pages: 51 850.1010 **MRID** 48843702

Gallagher, S. P.; Kendall, T. Z.; Krueger, H. O.; BYI 02960: A 96-hour shell deposition test with the eastern oyster (Crassostrea virginica); Wildlife International Ltd., Easton, MD, USA; Report No.: EBRVP023; Document No.: M-361668-01-1; December 01, 2009; Pages: 62 850.1025 **MRID** 48843703

Gallagher, S. P.; Kendall, T. Z.; Krueger, H.O.; BYI 02960: A 96-hour static acute toxicity test with the saltwater mysid (Americamysis bahia); Wildlife International Ltd., Easton, MD, USA; Report No.: 149A-236; Document No.: M-364620-01-1; December 08, 2009; Pages: 59 850.1035 **MRID** 48843704

Matlock, D.: Lam, C. V.; Acute toxicity of BYI 02960 technical to the rainbow trout (Oncorhynchus mykiss) under static conditions; Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP041; Document No.: M-390611-01-1; September 27, 2010; Pages: 44 850.1075 **MRID** 48843705

Matlock, D.; Lam, C. V.; Acute toxicity of BYI 02960 technical to the fathead minnow (Pimephales promelas) under static conditions; Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP035; Document No.: M-392560-01-1; October 21, 2010; Pages: 45 850.1075 **MRID** 48843706

Bruns, E.; Acute toxicity of BYI 02960 (tech.) to fish (Cyprinus carpio) under static conditions (limit test); Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP186; Document No.: M-420407-01-3; December 19, 2011; Pages: 58 850.1075 **MRID** 48843707

Bruns, E.; Acute toxicity of BYI 02960 succinamide (tech.) to fish (Oncorhynchus mykiss) under static conditions (limit test); Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP203; Document No.: M-414293-01-3; September 21, 2011; Pages: 49 850.1075 **MRID** 48843708

Bruns, E.; Acute toxicity of sodium difluoro acetate (BCS AB60481, tech.) to fish (Oncorhynchus mykiss) under static conditions (limit test); Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP080; Document No.: M-413889-01-3; September 12, 2011; Pages: 53 850.1075 **MRID** 48843709

Banman, C. S.; Lam, C. V.; Acute toxicity of BYI 02960 technical to the sheepshead minnow (Cyprinodon variegatus) under static conditions; Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP034; Document No.: M-357479-01-1; October 14, 2009; Pages: 44 850.1075 **MRID** 48843710

Riebschlaeger, T.; Effects of BYI 02960 (techn.) on development and reproductive output of the waterflea Daphnia magna in a static-renewal laboratory test system; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP209; Document No.: M-414066-01-2; September 15, 2011; Pages: 89 850.1300 **MRID** 48843711

Riebschlaeger, T.; Influence of BYI02960-succinamide (tech.) on development and reproductive output of the waterflea Daphnia magna in a static-renewal laboratory test system; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP185; Document No.: M-424700-01-2; February 10, 2012; Pages: 83 850.1300 **MRID** 48843712

Claude, M. B.; Kendall, T. Z.; Krueger, H. O.; BYI 02960: A flow-through life-cycle toxicity test with the saltwater mysid (Americanysis bahia); Wildlife International Ltd., Easton, MD, USA; Report No.: EBRVP038; Document No.: M-420783-01-2; September 08, 2011; Pages: 125 850.1350 **MRID** 48843713

Matlock, D.; Lam, C. V.; Early life stage toxicity of BYI 02960 technical to the Fathead minnow (Pimephales promelas) under flow-through conditions; Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP033; Document No.: M-409339-01-1; June 14, 2011; Pages: 106 850.1400 **MRID** 48843714

Fredricks, T. B.; Stoughton, T. L.; Toxicity of BYI 02960 technical during an acute oral LD50 with the northern bobwhite quail (Colinus virginianus); Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP022; Document No.: M-386036-01-1; July 14, 2010; Pages: 40 **MRID** 48843715

Christ, M. T.; Fredricks, T. B.; Toxicity of BYI 02960 technical during an acute oral LD50 with the canary (Serinus canaria); Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP036; Document No.: M-408514-01-1; May 25, 2011; Pages: 45 **MRID** 48843716

Barfknecht, R.; Wilkens, S.; Acute oral toxicity of chicken (Gallus gallus domesticus) with BYI 2960 (tech.), according to OECD 223 - limit test-; Bayer CropScience AG, Monheim, Germany; Report No.: BAR/LD 141; Document No.: M-420519-01-3; December 19, 2011; Pages: 33 850.2100 **MRID** 48843717

Stoughton, T. L.; Lam, C. V.; Toxicity of BYI 02960 technical during an acute dietary LC50 with the northern bobwhite quail (Colinus virginianus; Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP021; Document No.: M-394535-01-1; November 10, 2010; Pages: 42 850.2200 **MRID** 48843718

Fredricks, T. B.; Lam, C. V.; Stoughton, T. L.; Toxicity of BYI 02960 technical during an acute dietary LC50 with the mallard duck (Anas platyrhynchos); Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP020; Document No.: M-388718-01-1; August 26, 2010; Pages: 41 850.2200 **MRID** 48843719

Stoughton, T. L.; Christ, M. T.; Lam, C. V.; Toxicity of BYI 02960 technical on reproduction to the northern bobwhite quail (Colinus virginianus); Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP019; Document No.: M-424704-01-2; February 09, 2012; Pages: 73 850.2300 **MRID** 48843720

Stoughton, T. L.; Christ, M. T.; Lam, C. V.; Toxicity of BYI 02960 technical on reproduction to the mallard duck (Anas platyrhynchos); Bayer CropScience LP, RTP, NC, USA; Report No.: EBRVP018-1; Document No.: M-412917-02-1; August 25, 2011; Pages: 64 850.2300 **MRID** 48843721

Schmitzer, S.; Revised final report no.: 1 - Effects of BYI 02960 (acute contact and oral) on honey bees (Apis mellifera L.) in the laboratory; IBACON GmbH, Rossdorf, Germany; Report No.: 41121035; Document No.: M-308904-02-2; August 20, 2008; Pages: 35 850.3020 **MRID** 48843722

Schmitzer, S.; Effects of BYI02960 - difluoroethyl - amino - furanone (acute contact and oral) on honey bees (Apis mellifera L.) in the laboratory; IBACON GmbH, Rossdorf, Germany; Report No.: 60291035; Document No.: M-398557-01-3; December 21, 2010; Pages: 34 850.3020 **MRID** 48843723

Schmitzer, S.; Effects of BYI 02960 - hydroxy (acute contact and oral) on honey bees (Apis mellifera L.) in the laboratory; IBACON GmbH, Rossdorf, Germany; Report No.: 63901035; Document No.: M-409606-01-3; June 15, 2011; Pages: 34 850.3020 **MRID** 48843724

Schmitzer, S.; Effects of difluoroacetic acid (acute contact and oral) on honey bees (Apis mellifera L.) in the laboratory; IBACON GmbH, Rossdorf, Germany; Report No.: 56331035; Document No.: M-367915-01-3; April 29, 2010; Pages: 34 850.3020 **MRID** 48843725

Schmitzer, S.; Effects of 6-chloronicotinic acid (acute contact and oral) on honey bees (Apis mellifera L.) in the laboratory; IBACON GmbH, Rossdorf, Germany; Report No.: EBRVL009; Document No.: M-395279-01-3; November 19, 2010; Pages: 34 850.3020 **MRID** 48843726

Schmitzer, S.; Effects of 6-chloro-picolylalcohol (acute contact and oral) on honey bees (Apis mellifera L.) in the laboratory; IBACON GmbH, Rossdorf, Germany; Report No.: 50911035; Document No.: M-361234-01-3; January 11, 2010; Pages: 31 850.3020 **MRID** 48843727

Porch, J. R.; Krueger, H. O.; BYI 02960 200 SL: A foliage residue toxicity study with the honeybee; Wildlife International Ltd., Easton, MD, USA; Report No.: EBRVP044; Document No.: M-413084-01-1; July 13, 2011; Pages: 38 850.3030 **MRID** 48843728

Gosch, H.; BYI 02960 SL 200 g/L - Effects on the seedling emergence and growth of eleven species of non-target terrestrial plants (Tier 1); Bayer CropScience AG, Frankfurt am Main, Germany; Report No.: SE10/001; Document No.: M-397727-01-2; December 14, 2010; Pages: 73 850.4100 **MRID** 48843729

Gosch, H.; BYI 02960 SL 200 g/L - Effects on the vegetative vigour of eleven species of non-target terrestrial plants (Tier 1); Bayer CropScience AG, Frankfurt am Main, Germany; Report No.: VV 10/002; Document No.: M-397734-01-2; December 14, 2010; Pages: 65 850.4150 **MRID** 48843730

Banman, C. S.; Alexander, T. M.; Lam, C. V.; Toxicity of BYI 02960 technical to duckweed (Lemna gibba G3) under static-renewal conditions; Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP043; Document No.: M-398376-01-1; December 21, 2010; Pages: 54 850.4400 **MRID** 48843731

Banman, C. S.; Lam, C. V.; Toxicity of BYI 02960 technical to the green alga Pseudokirchneriella subcapitata; Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP030; Document No.: M-397552-01-1; December 10, 2010; Pages: 55 850.5400 **MRID** 48843732

Bruns, E.; Pseudokirchneriella subcapitata growth inhibition test with BCS-AB60481 - limit test; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP077; Document No.: M-409118-01-3; June 10, 2011; Pages: 63 850.5400 **MRID** 48843733

Sobczyk, H.; Pseudokirchneriella subcapitata growth inhibition test with BYI 02960 - succinamide - limit test; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP184; Document No.: M-414090-01-3; September 23, 2011; Pages: 59 850.5400 **MRID** 48843734

Bruns, E.; Pseudokirchneriella subcapitata growth inhibition test with 6 - chloronicotinic acid; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP242; Document No.: M-424145-01-3; February 01, 2012; Pages: 100 850.5400 **MRID** 48843735

Caspers, N.; Activated sludge, respiration inhibition test with BYI 02960 (tech.); Currenta GmbH & Co. OHG, Leverkusen, Germany; Report No.: 2010/0089/01; Document No.: M-377311-01-2; June 21, 2010; Pages: 27 850.6800 **MRID** 48843736
Banman, C. S.; Lam, C. V.; Acute toxicity of BYI 02960 to Xenopus laevis under flow-through conditions; Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP187; Document No.: M-417822-01-1; November 18, 2011; Pages: 49 850.SUPP **MRID** 48843737

Bruns, E.; Acute toxicity of BYI 02960 (tech.) to larvae of Chironomus riparius in a 48 h static laboratory test system; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP026; Document No.: M-414739-01-3; September 26, 2011; Pages: 55 850.SUPP **MRID** 48843738

Bruns, E.; Acute toxicity of BYI 02960-succinamide to larvae of Chironomus riparius in a 48 h static laboratory test system; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP202; Document No.: M-417386-01-3; November 17, 2011; Pages: 52 850.SUPP **MRID** 48843739

Bruns, E.; Acute toxicity of BYI 02960-azabicyclosuccinamide (BCS-CS64875) to larvae of Chironomus riparius in a 48 h static laboratory test system; Bayer CropScience AG, Monheim, Germany; Report No.: M-424404-01-2; Document No.: M-424404-01-2; February 02, 2012; Pages: 59 850.SUPP **MRID** 48843740

Bruns, E.; Chironomus riparius 28-day chronic toxicity test with BYI 02960 (tech.) in a water-sediment system using spiked water; Bayer CropScience AG, Monheim, Germany; Report No.: M-401792-01-3; Document No.: M-401792-01-3; February 14, 2011; Pages: 90 850.SUPP **MRID** 48843741

Bruns, E.; Chironomus riparius 28-day chronic toxicity test with Sodium difluoroacetate in a water-sediment system using spiked water - limit test; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP181; Document No.: M-415913-01-3; October 06, 2011; Pages: 69 850.SUPP **MRID** 48843742

Bruns, E.; Chironomus riparius 28-day chronic toxicity test with 6-Chloronicotinic acid in a water-sediment system using spiked water - limit test; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP183; Document No.: M-416604-02-3; October 18, 2011; Pages: 73 850.SUPP **MRID** 48843743

Jans, D.; Toxicity to the parasitoid wasp Aphidius rhopalosiphi (DESTEPHANI-PEREZ) (Hymenoptera: Braconidae) using a laboratory test; BYI 02960 SL 200 g/L; Bayer CropScience AG, Frankfurt am Main, Germany; Report No.: CW09/079; Document No.: M-366965-01-3; April 15, 2010; Pages: 37 850.SUPP **MRID** 48843744

Jans, D.; Toxicity to the predatory mite Typhlodromus pyri SCHEUTEN (Acari, Phytoseiidae) using a laboratory test; BYI 02960 SL 200 g/L; Bayer CropScience AG, Frankfurt am Main, Germany; Report No.: CW09/073; Document No.: M-366957-01-2; April 15, 2010; Pages: 29 850.SUPP **MRID** 48843745

Leicher, T.; BYI 02960 (tech.): Acute toxicity to earthworms (Eisenia fetida) tested in artificial soil; Bayer CropScience AG, Monheim, Germany; Report No.: LRT/RG-A-131/09; Document No.: M-363742-01-2; February 18, 2010; Pages: 27 850.SUPP **MRID** 48843746

Leicher, T.; BYI 02960-difluoroacetic acid: acute toxicity to earthworms (Eisenia fetida) tested in artificial soil; Bayer

CropScience AG, Monheim, Germany; Report No.: LRT/RG-A-135/10; Document No.: M-368835-01-2; April 12, 2010; Pages: 24 850.SUPP **MRID** 48843747

Wetton, P. M.; Acute toxicity to earthworms (Eisenia foetida) IC-0; Safepharm Lab. Ltd., Derby, United Kingdom; Report No.: 282/575; Document No.: M-196591-01-2; August 25, 1999; Pages: 30 850.SUPP **MRID** 48843748

Leicher, T.; BYI 02960 SL 200 G: Effects on survival, growth and reproduction on the earthworm Eisenia fetida tested in artificial soil; Bayer CropScience AG, Monheim, Germany; Report No.: LRT-RG-R-76/09; Document No.: M-392964-01-4; October 21, 2010; Pages: 45 850.SUPP **MRID** 48843749

Leicher, T.; BYI 02960 Difluoroacetic acid: Effects onsurvival, growth and reproduction on the earthworm Eisenia fetida tested in artifical soil with 10 % peat; Bayer CropScience AG, Monheim, Germany; Report No.: LRT-RG-R-81/10; Document No.: M-398061-01-3; December 16, 2010; Pages: 37 850.SUPP **MRID** 48843750

Kling, A.; BYI 02960-hydroxy - Assessment of chronic effects to the honey bee, Apis mellifera L., in a 10 days continuous laboratory feeding limit test; Eurofins Agroscience Services~~EcoChem GmbH, Niefern-Öschelbronn, Germany; Report No.: S11-01960; Document No.: M-425212-01-2; February 15, 2012; Pages: 83 850.SUPP **MRID** 48843764

Kling, A.; Difluoroacetic acid - Assessment of chronic effects to the honey bee, Apis mellifera L., in a 10 days continuous laboratory feeding limit test; Eurofins Agroscience Services~~EcoChem GmbH, Niefern-Öschelbronn, Germany; Report No.: S11-01939; Document No.: M-425105-01-2; February 13, 2012; Pages: 82 850.SUPP **MRID** 48843765

Kling, A.; 6-chloronicotinic acid - Assessment of chronic effects to the honey bee, Apis mellifera L., in a 10 days continuous laboratory feeding limit test; Eurofins Agroscience Services~~EcoChem GmbH, Niefern-Öschelbronn, Germany; Report No.: S11-01957; Document No.: M-425155-01-2; February 13, 2012; Pages: 82 850.SUPP **MRID** 48843766

Kling, A.; 6-chloropicolyl alcohol - Assessment of chronic effects to the honey bee, Apis mellifera L., in a 10 days continuous laboratory feeding limit test; Eurofins Agroscience Services~~EcoChem GmbH, Niefern-Öschelbronn, Germany; Report No.: S11-01958; Document No.: M-425159-01-2; February 13, 2012; Pages: 84 850.SUPP **MRID** 48843767

Nikolakis, A.; Theis, M.; Przygoda, D.; BYI 02960 tech.: Effects of exposure to spiked diet on honeybee larvae (Apis mellifera carnica) in an in vitro laboratory testing design; Bayer CropScience AG, Monheim, Germany; Report No.: E 318 3897-9; Document No.: M-406645-01-3; May 02, 2011; Pages: 89 850.SUPP **MRID** 48843768

Leicher, T.; BYI 02960: Effects on soil litter degradation after spray application; Bayer CropScience AG, Monheim, Germany; Report No.: LRT-SLD-45/11; Document No.: M-413408-01-3; September 06, 2011; Pages: 62 850.SUPP **MRID** 48843769

Leicher, T.; BYI 02960: Effects on soil litter degradation if applied as seed treatment; Bayer CropScience AG, Monheim, Germany; Report No.: LRT-SLD-46/11; Document No.: M-413416-01-3; September 06, 2011; Pages: 66 850.SUPP **MRID** 48843770

Nikolakis, A.; Krieg, V.; Aumeier, P.; Gladbach, D.; Honey bee colony feeding study, evaluating the effects of BYI 02960-fortified sugar- and pollen diet on the development of honey bee colonies under confined semi-field conditions, followed by a post-exposure field observation period; Bayer CropScience AG, Monheim, Germany; Report No.: E 319 4111-0; Document No.: M-438748-01-1; September 24, 2012; Pages: 523 850.SUPP **MRID** 48843771

Riebschlaeger, T.; Acute toxicity of BYI 02960 SL 200 G to the waterflea Daphnia magna in a static laboratory test system; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP097; Document No.: M-393738-01-3; October 28, 2010; Pages: 57 850.1010 **MRID** 48844509

Bruns, E.; Acute toxicity of BYI 02960 SL 200 G to fish (Oncorhynchus mykiss) under static conditions-limit test; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP098; Document No.: M-398721-02-3; December 20, 2010; Pages: 57 850.1075 **MRID** 48844510

Bruns, E.; Acute toxicity of BYI 02960 SL 200 G to fish (Cyprinus carpio) under static conditions (limit test); Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP199; Document No.: M-420485-01-3; December 19, 2011; Pages: 55 850.1075 **MRID** 48844511

Stoughton, T. L.; Christ, M. T.; Toxicity of BYI 02960 sl 200 during an acute oral LD50 with the Northern bobwhite quail (Colinus virginianus); Bayer CropScience LP, Stilwell, KS, USA; Report No.: EBRVP093; Document No.: M-424312-01-1; February 03, 2012; Pages: 36 850.2100 **MRID** 48844512

Barfknecht, R.; Wilkens, S.; Acute oral toxicity of chicken (Gallus gallus domesticus) with BYI 02960 SL 200, according to OECD 223 - limit test-; Bayer CropScience AG, Monheim, Germany; Report No.: BAR/LD 142; Document No.: M-423043-01-3; January 06, 2012; Pages: 31 850.2100 **MRID** 48844513

Schmitzer, S.; Revised final report no.: 1 - Effects of BYI 02960 SL 200 G (acute contact and oral) on honey bees (Apis mellifera L.) in the laboratory; IBACON GmbH, Rossdorf, Germany; Report No.: 52331035; Document No.: M-359920-02-2; December 03, 2009; Pages: 35 850.3020 **MRID** 48844514

Schmitzer, S.; Effects of a test item mix of BYI 02960 SL 200 G + tebuconazole EW 250C G (acute contact and oral) on honey bees (Apis mellifera L.) in the laboratory; IBACON GmbH, Rossdorf, Germany; Report No.: 52531035; Document No.: M-363120-01-2; February 08, 2010; Pages: 38 850.3020 **MRID** 48844515

Rexer, H. U.; Assessment of side effects on the honeybee (Apis mellifera L.), exposed to winter oil-seed rape, grown from seeds treated with BYI 02960 FS 480 G and sequentially sprayed with BYI 02960 SL 200 G during immediate pre- and full flowering in a long-term field study in Northern Germany; Eurofins Agroscience Services EcoChem GmbH, Niefern-Oeschelbronn, Germany; Report No.: S10-03261; Document No.: M-438818-01-2; September 27, 2012; Pages: 402 850.3040 **MRID** 48844516

Rexer, H. U.; Assessment of side effects on the honeybee (Apis mellifera L.), exposed to winter oil-seed rape, grown from seeds treated with BYI 02960 FS 480 G and sequentially sprayed with BYI 02960 SL 200 G during immediate pre- and full flowering in a long-term field study in France; Eurofins Agroscience Services GmbH, Niefern-Oeschelbronn, Germany; Report No.: S10-03262; Document No.: M-438819-01-2; July 24, 2012; Pages: 384 850.3040 **MRID** 48844517

Bruns, E.; Pseudokirchneriella subcapitata growth inhibition test with BYI 02960 SL 200 G; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP095; Document No.: M-397244-01-3; December 20, 2010; Pages: 61 850.5400 **MRID** 48844518

Silke, G.; Chironomus riparius 28-day chronic toxicity test with BYI 02960 SL 200 G in a water-sediment system using spiked water; Bayer CropScience AG, Monheim, Germany; Report No.: EBRVP182; Document No.: M-416145-01-3; October 17, 2011; Pages: 79 850.SUPP **MRID** 48844519

Sur, R.; Ellerich, C.; Statement on residue dissipation of flupyradifurone in treated foliage of lettuce and spinach: kinetic evaluation of US data; Bayer CropScience AG, Monheim, Germany; Report No.: EnSa-12-0361; Document No.: M-434405-01-2; July 09, 2012; Pages: 36 850.SUPP **MRID** 48844520

Bocksch, S.; Determination of residues of BYI 02960 applied via drench application in tomato in the semi-field; Eurofins Agroscience Services EcoChem GmbH, Niefern-Oeschelbronn, Germany; Report No.: S10-03818; Document No.: M-424683-01-2; February 10, 2012; Pages: 108 850.SUPP **MRID** 48844521

Bocksch, S.; Determination of residues of BYI 02960 applied via drench application in watermelon in the semi-field; Eurofins Agroscience Services EcoChem GmbH, Niefern-Oeschelbronn, Germany; Report No.: S09-01391; Document No.: M-424666-01-2; February 09, 2012; Pages: 173 850.SUPP **MRID** 48844522

Bocksch, S.; Determination of residues of BYI 02960 applied via drench application in watermelon in the semi-field; Eurofins Agroscience Services EcoChem GmbH, Niefern-Oeschelbronn, Germany; Report No.: S10-03825; Document No.: M-424675-01-2; February 08, 2012; Pages: 117 850.SUPP **MRID** 48844523

Gould, T. J.; Lawrence, J.; Harbin, A. M.; Determination of residues of BYI 02960 in blossoms, nectar, and pollen when applied via Foliar Spray to early blooming citrus under semi-field conditions in Florida; eurofins agroscience services, Mebane, NC, USA; Report No.: RARVP017; Document No.: M-435033-01-1; July 24, 2012; Pages: 229 850.SUPP **MRID** 48844524

Gould, T. J.; Lawrence, J.; Harbin, A. M.; Determination of residues of BYI 02960 in blossoms, nectar, and pollen when applied via soil drench and Foliar Spray to melon under semi-field Conditions in North Carolina; eurofins agroscience services, Mebane, NC, USA; Report No.: RARVP019; Document No.: M-435037-01-1; July 24, 2012; Pages: 209 850.SUPP **MRID** 48844525

Uceda, L.; Determination of the residues of BYI 02960 in/on barley and wheat after spray application of BYI 02960 SL 200 in the field in Germany, Southern France and Italy; Bayer S.A.S., Bayer CropScience, Lyon, France; Report No.: 11-2958; Document No.: M-427494-01-2; March 22, 2012; Pages: 96 850.SUPP **MRID** 48844526

Gould, T. J.; Harbin, A. M.; BYI 02960 200 SL - Magnitude of the residue in bee food items, cotton; California Agricultural Research, Inc., Kerman, CA, USA; Report No.: EBRVP110; Document No.: M-435848-01-1; August 02, 2012; Pages: 200 850.SUPP **MRID** 48844527

Gould, T. J.; Harbin, A. M.; BYI 02960 200 SL - Magnitude of the residue in/on bee relevant blueberry matrices; California

Agricultural Research, Inc., Kerman, CA, USA; Report No.: RARVP020; Document No.: M-436312-01-1; August 14, 2012; Pages: 188 850.SUPP **MRID** 48844528

Netzband, D.; Dallstream, K. A.; BYI 02960 200 SL - Magnitude of the residue in/on bee relevant apple matrices; Bayer CropScience LP, Environmental Science, Stilwell, KS, USA; Report No.: EBRVP218; Document No.: M-438422-01-1; September 18, 2012; Pages: 208 850.SUPP **MRID** 48844529

Gould, T. J.; Lawrence, J.; Harbin, A. M.; Determination of residues of BYI 02960 in blossoms, nectar, and pollen when applied via foliar spray to early blooming apple under semi-field conditions in North Carolina; Eurofins Agroscience Services, Mebane, NC, USA; Report No.: RARVP018; Document No.: M-437208-01-2; August 27, 2012; Pages: 221 850.SUPP **MRID** 48844530

Schnorbach, H. J.; Evaluation of the effects of BYI 02960 SL 100 on honey bees (Apis mellifera) in a semifield tunnel test in full-flowering Phacelia tanacetifolia; Bayer CropScience AG, Monheim, Germany; Report No.: IA08DVG048G001; Document No.: M-427040-01-2; March 15, 2012; Pages: 57 850.SUPP **MRID** 48844531

Schnorbach, H. J.; Evaluation of the effects of BYI 02960 SL 200 on honey bees (Apis mellifera) in a semifield tunnel test in full-flowering Phacelia tanacetifolia; Bayer CropScience AG, Monheim, Germany; Report No.: IA09DVG051K619; Document No.: M-427046-01-2; March 15, 2012; Pages: 55 850.SUPP **MRID** 48844532

Rentschler, S.; BYI 02960 SL 200 G: A semi-field study in Germany 2009 to evaluate effects of spray applications in Phacelia tanacetifolia on the honeybee Apis mellifera L. (Hymenoptera, Apidea); Eurofins Agroscience Services EcoChem GmbH, Niefern-Öschelbronn, Germany; Report No.: S09-00854; Document No.: M-425576-01-2; February 17, 2012; Pages: 139 850.SUPP **MRID** 48844533

Proebsting, A.; BYI 02960 SL 200 G: A semi-field study in Denmark 2010 to evaluate effects of spray applications in Phacelia tanacetifolia on the honeybee Apis mellifera L. (Hymenoptera, Apidae); Eurofins Agroscience Services EcoChem GmbH, Niefern-Oeschelbronn, Germany; Report No.: S10-01954; Document No.: M-423156-01-2; January 19, 2012; Pages: 143 850.SUPP **MRID** 48844534

Proebsting, A.; BYI 02960 SL 200 G: A semi-field study in Italy 2011 to evaluate effects of spray applications in Phacelia tanacetifolia on the honeybee Apis mellifera L. (Hymenoptera, Apidae); Eurofins Agroscience Services EcoChem GmbH, Niefern-Oeschelbronn, Germany; Report No.: S10-01955; Document No.: M-423172-01-2; January 18, 2012; Pages: 142 850.SUPP **MRID** 48844535

Rentschler, S.; Determination of side-effects of BYI 02960 SL 200 G on honey bee (Apis mellifera L.) brood under semi-field conditions; Eurofins Agroscience Services, EcoChem GmbH, Niefern-Oeschelbronn, Germany; Report No.: S10-03819; Document No.: M-427438-01-2; March 19, 2012; Pages: 198 850.SUPP **MRID** 48844536

Rexer, H. U.; A field study to determine residues of BYI 02960 in guttation liquid from winter oil-seed rape (OSR) plants in Northern Germany in 2010/2011; Eurofins Agroscience Services GmbH, Niefern-Oeschelbronn, Germany; Report No.: S10-03312; Document No.: M-438826-01-2; September 27, 2012; Pages: 107 850.SUPP **MRID** 48844537

Rexer, H. U.; A field study to determine residues of BYI 02960 in guttation liquid from winter oil-seed rape (OSR) plants in France in 2010/2011; Eurofins Agroscience Services GmbH, Niefern-Oeschelbronn, Germany; Report No.: S10-03313; Document No.: M-438829-01-2; September 27, 2012; Pages: 106 850.SUPP **MRID** 48844538

Jans, D.; Toxicity to the parasitoid wasp Aphidius rhopalosiphi (DESTEPHANI-PEREZ) (Hymenoptera: Braconidae) using an extended laboratory test on barley BYI 02960 SL 200 (g/L); Bayer CropScience AG, Frankfurt am Main, Germany; Report No.: CW09/083; Document No.: M-366970-01-2; April 13, 2010; Pages: 40 850.SUPP **MRID** 48844539

Jans, D.; Toxicity to the predatory mite Typhlodromus pyri SCHEUTEN (Acari, Phytoseiidae) using an extended laboratory test on Phaseolus vulgaris BYI 02960 SL 200 (g/L); Bayer CropScience AG, Frankfurt am Main, Germany; Report No.: CW09/076; Document No.: M-366968-01-2; April 13, 2010; Pages: 35 850.SUPP **MRID** 48844540

Jans, D.; Toxicity to the ladybird beetle Coccinella septempunctata L. (Coleoptera, Coccinellidae) using an extended laboratory test on Phaseolus vulgaris; BYI 02960 SL 200 (g/L); Bayer CropScience AG, Frankfurt am Main, Germany; Report No.: CW09/074; Document No.: M-384754-01-3; June 30, 2010; Pages: 41 850.SUPP **MRID** 48844541

Jans, D.; Chronic toxicity (ER50) of BYI 02960 SL 200 (g/L) to the rove beetle Aleochara bilineata Gyll. (Coleoptera: Staphylinidae) under extended laboratory conditions; Bayer CropScience AG, Frankfurt am Main, Germany; Report No.: CW09/072; Document No.: M-384433-01-2; June 30, 2010; Pages: 29 850.SUPP **MRID** 48844542

Jans, D.; Toxicity to the parasitoid wasp Aphidius rhopalosiphi (DESTEPHANI-PEREZ) (Hymenoptera: Braconidae) in an extended laboratory test (under semi-field conditions aged residues on Zea mays) BYI 02960 SL 200 (g/L); Bayer CropScience AG, Frankfurt am Main, Germany; Report No.: CW10/018; Document No.: M-396372-01-3; November 30, 2010; Pages: 74 850.SUPP **MRID** 48844543

Schwarz, A.; Effects of BYI 02960 SL 200 (g/L) on the predatory bug Orius laevigatus extended laboratory study - aged residue test; IBACON GmbH, Rossdorf, Germany; Report No.: 58691053; Document No.: M-394033-01-3; October 28, 2010; Pages: 56 850.SUPP **MRID** 48844544

Aldershof, S.; Bakker, F.; A field study to assess the effects of BYI 02960 SL 200 g/L on the non-target, surface- and plantdwelling, arthropod fauna of a grassland habitat (off-crop) in The Netherlands during summer; MITOX Consultants, Amsterdam, Netherlands; Report No.: B154FFN; Document No.: M-425092-01-3; February 17, 2012; Pages: 209 850.SUPP **MRID** 48844545

Aldershof, S.; Bakker, F.; A field study to assess the effects of BYI 02960 (SL 200 g/L) on the non-target, surface- and plant-dwelling arthropod fauna of a grassland habitat (off-crop) in SW France during summer; MITOX Consultants, Amsterdam, Netherlands; Report No.: B153FFN; Document No.: M-425080-01-3; February 17, 2012; Pages: 201 850.SUPP **MRID** 48844546

Leicher, T.; BYI 02960 SL 200 G: acute toxicity to earthworms (Eisenia fetida) tested in artificial soil with 5 percent peat; Bayer CropScience AG, Monheim, Germany; Report No.: LRT/RG-A-143/10; Document No.: M-397720-01-3; December 14, 2010; Pages: 25 850.SUPP **MRID** 48844547

Menke, U.; BYI 02960 SL 200 G: Effects on the earthworm fauna of a grassland area within one year; Bayer CropScience AG, Monheim, Germany; Report No.: MNU/RG-F-8/12; Document No.: M-426607-01-2; March 07, 2012; Pages: 182 850.SUPP **MRID** 48844548

Frommholz, U.; BYI 02960 SL 200 G : Determination of effects on carbon transformation in soil; Bayer CropScience AG, Monheim, Germany; Report No.: FRM-C-116/10; Document No.: M-395469-01-3; November 23, 2010; Pages: 35 850.SUPP **MRID** 48844549

Frommholz, U.; BYI 02960 SL 200 G: Determination of effects on nitrogen transformation in soil; Bayer CropScience AG, Monheim, Germany; Report No.: FRM-N-148/10; Document No.: M-396112-01-3; November 29, 2010; Pages: 29 850.SUPP **MRID** 48844550

Appendix A. Fate Data Table for Flupyradifurone

Table A1. Summary of the new chemical screen of the environmental fate data for flupyradifurone

Guideline	Test Substance	Comments	Classification	Additional Data Needed?	MRID Citation
Hydrolysis 835.2120	Parent	50ºC, 5 days, sterility lost in one chamber at one time point	Fully Reliable	No	48843667 (Mislankar and Woodard, 2011)
Photodegradation in Water 835.2240	Parent	Only furanone ring labeled.	Fully Reliable	Yes, degradates associated with unlabeled ring are unknown. Additional data are needed to understand the possible degradates associated with the pyradine ring.	48843669 (Hall, 2011)
	Parent	Only furanone ring labeled	Fully Reliable		48843670 (Hall, 2011)
	Parent	Nonguideline quantum yield study	Not Reviewed		48843668 (Heinemann, 2011)
Photodegradation on Soil 835.2410	Parent	--	Fully Reliable	No	48843672 (Menke and Unold, 2011)
Photodegradation in Air 835.2370	Parent	No laboratory data. Estimates based on computer modeling.	Not classified	No, volatilization and atmospheric transport is expected to be a minor transport pathway.	48843671 (Hellpointner, 2010)
Aerobic Soil Metabolism 835.4100	Parent	120 day experiment 24 to 50% present as parent at study termination. Unextracted residues reached 17%. All German soils. Pyridinylmethyl group labeled.	Reliable with restrictions[2]	No, additional data are not needed at this time because the unextracted residues did not impact the risk conclusions at this time.	48843674 (Menke, 2011) 48843675 (Sur and Dorn, 2012)
	Parent	120 day experiment 20 to 45% present as parent at study termination. Furanone ring labeled. Unextrcted residues up to 34%. German soils.	Reliable with restrictions		48843676 (Menke, 2011) 48843678 (Sur and Dorn, 2012)
	Parent	Furanone labeled. Study terminated at 120 days and 30 and 67% remained as parent. 16-30% unextracted residues formed. U.S. soils.	Reliable with restrictions		48843677 (Ripperger, 2011)
	Parent	German soils. 120 day experiment 23 – 40% remained as parent at end of study. Unextracted residues reached 18%. Ethyl group labeled. Rings not labeled. German soils. Pyridine ring labeled also.	Reliable with restrictions		48843679 (Menke and Unold, 2011) 48843680 (Sur and Dorn, 2012)

Guideline	Test Substance	Comments	Classification	Additional Data Needed?	MRID Citation
	Parent	120 day experiment, 23% remained as parent. German soil. Unextracted residues reached 17%.	Reliable with restrictions		48843681 (Menke and Unold, 2011) 48843684 (Sur and Dorn, 2012)
	Parent	U.S. soils. Unextracted residues reached maximum of 11-25%. 120 day experiment, 40-67% remained as parent at end of study.	Yes		48843682 (Shepherd, 2011)
	Parent	Brazilian soils. Pyridine ring labeled. 120 day experiment, 54 – 72% remained as parent.	Yes		48843683 (de Souza, 2012)
	6-CNA	U.K soils. Unextracted residues up to 21%	Reliable with restrictions	No	48843685 (Sur and Dorn, 2012)
Anaerobic Soil Metabolism 835.4200 (162-2)	Parent	Unextracted residues reached a maximum of 30% in one soil. 3 different labels.	Reliable with restrictions	No, data indicates that flupyradifurone is relatively stable to anaerobic soil metabolism.	48843686 (Menke and Unold, 2012)
	Parent	U.S. soil. Unextracted residues reached 19% and remained constant through anaerobic phase. ~10% loss of parent during anaerobic phase, 1 soil. Pyridine labeled.	Reliable with restrictions		48843687 (Mislankar and Woodard, 2012)
	Parent	U.S. soil. Pyridine labeled. Only followed for 60 days under anaerobic conditions. Unextracted residues reached 15%.	Reliable with restrictions		48843688 (Woodard, 2012)
Aerobic Aquatic Metabolism 845.4300 (162-4)	Parent	Pyridine ring labeled only. Sediments from Germany. Unextracted residues reached 25%. 64 and 71% remained as parent at end of 120 day study.	Reliable with restrictions[1]	No. These studies should have been extended to one year to fully characterize the formation and decline curve. Additionally, a range of polar and nonpolar solvents should have been used to determine whether unextracted residues could be better characterized. The unextracted residue uncertainty is not currently having an affect on risk conclusions.	48843690 (Hellpointner and Unold, 2012)
	Parent	Furanone ring labeled, ethyl group labeled. Systems from Germany. Unextracted residues reached 27%. >67% remaining as parent at end of 120 day experiment.	Reliable with restrictions[1]		48843692 (Menke and Unold, 2012)
	DFA	Unextracted residues were high (16%) in one test system. Both systems had a couple of unextracted residue outliers at 40 and 55%.	Reliable with restrictions[1]		48843691 (Hellpointner and Unold, 2012)
Anaerobic	Parent	Unextracted residues reached 12%	Reliable with	No. Evidence indicates	48843689

Guideline	Test Substance	Comments	Classification	Additional Data Needed?	MRID Citation
Aquatic Metabolism 835.4400 (162-3)		in one system. Two U.S. pond systems. Pyridine ring labeled. Loss of parent in one sediment could be due to presence of unextracted residues. Studies were only conducted for 102 days.	restrictions	that compound is relatively stable to anaerobic metabolism. Therefore, additional data are not recommended at this time.	(Xu, 2012)
Adsorption/ Desorption 835.1230 And Leaching Studies 835.1240	Parent	4 German soils. Identity confirmed at highest test concentration only.	Fully reliable	No, data are recommended for measurement in one aquatic sediment. As this data item is expected to have a low impact on the risk conclusions, additional data are not requested at this time.	48843662 (Menke and Telscher, 2008)
	Parent	2 U.S. soils. Identity of test substance not confirmed. Aerobic soil half-lives suggest minimal loss in 24 hours.	Fully reliable		48843663 (Stroech, 2010)
	Parent	4 brazilian soils.	Fully reliable		48843664 (de Souza, 2012)
	DFA	5 German soils.	Fully reliable		48843665 (Menke and Unold, 2011)
	Parent	Soil column leaching study	Fully reliable		48843666 (de Souza, 2012)
Laboratory Volatility 835.1410 (163-2)	--	--	--	No, volatilization and atmospheric transport is expected to be a minor transport pathway.	--
Field volatilty 835.8100 (163-3)	--	--	--		--
Terrestrial Field Dissipation 835.6100 (164-1)	BYI 02960 200 SL	Bare ground Tulare County, CA	Reliable with restrictions	Yes, terrestrial field dissipation studies are recommended on cropped plots when plants may be an important route of dissipation as well as bare ground sites. Field dissipation studies should be completed on	48843693 (Lenz, 2012)
	BYI 02960 200 SL	Bare ground, Florida	Reliable with restrictions		48843694 (Lenz, 2012)

Guideline	Test Substance	Comments	Classification	Additional Data Needed?	MRID Citation
	BYI 02960 200 SL	Bare ground, Blained County, Idaho	Reliable with restrictions	representative use sites for the range of proposed uses in the United States. Currently, studies are only available for bare ground sites. Additionally, the degradates BYI-02960-succinamide and BYI 02960-azabicyclosuccinamide were major degradates observed in aquaous photolysis studies. These degradates should be followed in the terrestrial field dissipation studies.	48843695 (Lenz, 2012)
	BYI 02960 200 SL	3 bare ground plots in Canada	Reliable with restrictions		48843696 (Harbin, 2012)
	BYI 02960 200 SL	Bare ground sites in United Kingdom, France, Italy, Spain, and two sites in Germany. Sites were planted with grass.	Yes		48843697 (Heinemann, 2011)
Aquatic Sediment Dissipation 835.6200 (164-2)	Parent	Microcosm studies, 6 polycarbonate cylinders treated in pond. Germany	Reliable with restrictions	No, a terrestrial/aquatic field dissipation study would be needed to support use on cranberries. However, it is planned that the use on cranberries will not be included on the final label.	48843673 (Bruns, 2012)
Environmental Chemistry Methods	Soil and sediment	HPLC/MS/MS method used in U.S. terrestrial field dissipation studies. Examined residues of parent, DFA, 6CNA. LOQ was 5 ng/g and method detection limits ranged were 1.6, 1.1, and 0.6 for parent, 6CNA, and DFA, respectively.	Fully reliable	No	48843830, 48843831, 48843832, and 48843833 (ILV)
	Water	Direct injection with HPLC/MS/MS method examining residues of parent and DFA (LOQ =1 ng/mL), BYI 02960-succinamide (LOQ 1.0 ng/mL), and BYI-zazbicyclosuccinamide (LOQ 51.0 ng/mL).	Fully reliable	No	48843835, 48843836, 48843837 (ILV)
Storage Stability	Soil	Parent, DFA, and 6CNA	Fully reliable	No	48843840
Forestry Dissipation 835.6300	--	--	--	No	
Fish Bioconcentration 850.1730				No	

NA: Not applicable; DFA=Sodium dilfluoracetate [sodium salt]/difluoroacetci acid [free acid]; 6CNA=6-chloronicotinic acid; LOQ=limit of quantitation;

[1] This study was considered reliable with restrictions due to the presence of unextracted residues at greater than 10% applied radioactivity, uncertainty in the quality of the extraction procedure, and because studies were terminated before the DT_{50} was established and were not carried out for 1 year.

[2] Studies were classified as reliable with restrictions due to the presence of unextracted residues at greater than 10% applied radioactivity and a range of polar and nonpolar solvents were not explored to determine whether the unextracted residues could be further characterized. Studies were also classified as reliable with restrictions because they were terminated after 120 days and when a significant portion of the residues remained parent.

Appendix B. Effects Data Table for Flupyradifurone

Table B1. Summary of the new chemical screen of effects data for flupyradifurone (see Appendix J for study rating crosswalk with OPP classification systems)

Guideline	Description	MRID(s)	Test Substance	Common Name (Species)	Classification (Additional Data Needed?)
850.2100	Avian acute oral toxicity, waterfowl	None	N/A	N/A	N/A
	Avian acute oral toxicity, upland game bird species, TGAI	48843715 (Fredericks and Stoughton, 2011)	BYI 02960 (96.2%)	Northern Bobwhite Quail (*Colinus virginianus*)	Fully reliable
	Avian acute oral toxicity, passerine species, TGAI	48843716 (Christ and Fredericks, 2011)	BYI 02960 (96.2%)	Canary (*Serinus canaria*)	Reliable with restrictions
	Avian acute oral toxicity, additional species, TGAI	48843717 (Barfknecht and Wilkens 2011)	BYI 02960 (96.2%)	Chicken (*Gallus gallus*)	Reliable with restrictions
	Avian acute oral toxicity, TEP	48844512 (Stoughton and Christ, 2012)	BYI 02960 SL200 (17.1%)	Northern Bobwhite Quail (*Colinus virginianus*)	Fully reliable
	Avian acute oral toxicity, TEP	48844513 (Barfknecht and Wilkens 2012)	BYI 02960 SL200 (17.1%)	Chicken (*Gallus gallus*)	Reliable with restrictions
850.2200	Avian dietary toxicity, waterfowl species, TGAI	48843719 (Fredericks et al., 2010)	BYI 02960 (96.2%)	Mallard Duck (*Anas platyrhynchos*)	Fully reliable
	Avian dietary toxicity, upland game bird, TGAI	48843718 (Stoughton and Lam, 2010)	BYI 02960 (96.2%)	Northern Bobwhite Quail (*Colinus virginianus*)	Fully reliable
850.2300	Avian reproduction, waterfowl species, TGAI	48843721 (Stoughton et al., 2011)	BYI 02960 (96.2%)	Mallard Duck (*Anas platyrhynchos*)	Reliable with restrictions
	Avian reproduction, upland game bird species, TGAI	48843720 (Stoughton et al., 2012)	BYI 02960 (96.2%)	Northern Bobwhite Quail (*Colinus virginianus*)	Fully reliable
850.2400	Wild mammal toxicity	None	N/A	N/A	N/A

Guideline	Description	MRID(s)	Test Substance	Common Name (Species)	Classification (Additional Data Needed?)
850.2500	Simulated or actual field testing	None	N/A	N/A	N/A
850.1010	Freshwater invertebrate, acute toxicity, TGAI	48843701 (Banman and Lam, 2009)	BYI 02960 (96.2%)	Water Flea *Daphnia magna*	Fully reliable
850.1010	Freshwater invertebrate, acute toxicity, TEP	48844509 (Riebschlaeger, 2010)	BYI 02960 SL200G (17.1%)	Water Flea *Daphnia magna*	Fully reliable
850.1025	Estuarine/Marine Mollusk acute toxicity, TGAI	48843703 (Gallagher et al., 2009)	BYI 02960 (96.2%)	Eastern Oyster *Crassostrea virginica*	Fully reliable
850.1035	Estuarine/Marine crustacean acute toxicity, TGAI	48843704 (Gallagher et al., 2009)	BYI 02960 (96.2%)	Mysid Shrimp *Americamysis bahia*	Fully reliable
850.1035	Estuarine/Marine crustacean acute toxicity, TEP	None	N/A	N/A	N/A (No data needed: direct application to estuarine/marine environment is not indicated on labels, and TEP is unlikely to move to the estuarine/marine environment)
850.1075	Freshwater fish, acute toxicity, TGAI	48843706 (Matlock and Lam, 2010)	BYI 02960 (96.2%)	Fathead Minnow *Pimephales promelas*	Fully reliable
	Freshwater fish, acute toxicity, TGAI	48843707 (Bruns, 2011)	BYI 02960 (96.2%)	Common Carp *Cyprinus carpio*	Not reliable
	Freshwater fish, acute toxicity, TEP	48844511 (Bruns, 2011)	BYI 02960 SL200G (17.1%)	Common Carp *Cyprinus carpio*	Fully reliable
	Freshwater fish, acute toxicity, cold water species, TGAI	48843705 (Matlock and Lam, 2010)	BYI 02960 (96.2%)	Rainbow Trout *Oncorhunchus mykiss*	Fully reliable

Guideline	Description	MRID(s)	Test Substance	Common Name (Species)	Classification (Additional Data Needed?)
	Freshwater fish, acute toxicity, TEP	48844510 (Bruns, 2010)	BYI 02960 SL200G (17.1%)	Rainbow Trout *Oncorhunchus mykiss*	Fully reliable
	Estuarine/Marine fish acute toxicity, TGAI	48843710 (Banman and Lam, 2009)	BYI 02960 (96.2%)	Sheepshead Minnow *Cyprinodon variegatus*	Fully reliable
850.1300	Freshwater invertebrate, reproduction test, TGAI	48843711 (Riebschlaeger, 2011)	BYI 02960 (96.2%)	Water Flea *Daphnia magna*	Fully reliable
850.1350	Estuarine/marine invertebrate, reproduction test, TGAI	48843713 (Claude, 2011)	BYI 02960 (96.2%)	Mysid Shrimp *Americamysis bahia*	Reliable with restrictions
850.1400	Freshwater fish, early life stage test, TGAI	48843714 (Matlock and Lam, 2011)	BYI 02960 (96.2%)	Fathead Minnow *Pimephales promelas*	Fully reliable
	Saltwater fish, early life stage test, TGAI	None	N/A	N/A	N/A (No: flupyradifurone is not a major concern for fish based on available data)
850.1500	Freshwater fish life cycle test, TGAI	None	N/A	N/A	N/A
	Estuarine/marine Fish life cycle test	None	N/A	N/A	N/A
850.1735	Whole sediment 10-d freshwater invertebrate	None	N/A	N/A	N/A (No: Kow <3; Kd <50; Koc <1000)
850.1740	Whole sediment 10-d estuarine/marine invertebrate	None	N/A	N/A	N/A (No: Kow <3; Kd <50; Koc <1000)
Agency-wide guideline	Whole sediment chronic freshwater and/or marine invertebrate	None	N/A	N/A	N/A (No: Kow <3; Kd <50; Koc <1000)
850.1950	Simulated or actual field testing for aquatic organisms	None	N/A	N/A	N/A
850.3020	Honeybee acute contact and oral toxicity, TGAI	48843722 (Schmitzer, 2008)	BYI 02960 (99.5%)	Honeybee *Apis mellifera*	Fully reliable

Guideline	Description	MRID(s)	Test Substance	Common Name (Species)	Classification (Additional Data Needed?)
	Honeybee acute contact and oral toxicity, Degradate	48843723 (Schmitzer, 2010)	BYI0296 - difluoroethyl-amino-furanone (99.2%)	Honeybee *Apis mellifera*	Fully reliable
	Honeybee acute contact and oral toxicity, Degradate	48843724 (Schmitzer, 2011)	BYI 02960-hydroxy (95.5%)	Honeybee *Apis mellifera*	Reliable with restrictions
	Honeybee acute contact and oral toxicity, Degradate	48843725 (Schmitzer, 2010)	Difluoroacetic acid (95.8%)	Honeybee *Apis mellifera*	Fully reliable
	Honeybee acute contact and oral toxicity, Degradate	48843726 (Schmitzer, 2010)	6-chloronicotinic acid - AE F161089, (98.8%)	Honeybee *Apis mellifera*	Fully reliable
	Honeybee acute contact and oral toxicity, Degradate	48843727 (Schmitzer, 2010)	6-chloro-picolylalcohol (98.95)	Honeybee *Apis mellifera*	Fully reliable
	Honeybee acute contact and oral toxicity—TEP	48844514 (Schmitzer, 2009)	BYI 02960 SL200G (17.0%)	Honeybee *Apis mellifera*	Fully reliable
	Honeybee acute contact and oral toxicity—TEP	48844515 (Schmitzer, 2010)	BYI 02960 SL 200 G (17.0%) + Tebuconazole EW 250C G (25.4%)	Honeybee *Apis mellifera*	Fully reliable
	Honeybee acute contact and oral toxicity—TEP	48844711 Schmitzer, 2011)	BYI 02960 FS480G	Honeybee *Apis mellifera*	Fully reliable
850.3030	Honeybee toxicity of residues on foliage, TEP	48843728 (Porch and Krueger, 2011)	BYI 02960 SL 200 (39.9%)	Honeybee *Apis mellifera*	Reliable with restrictions
850.3040	Field testing for pollinators, TEP	48844516 (Rexer, 2012)	BYI 02960 FS480G and SL200G (sequentially)	Honeybee *Apis mellifera*	Reliable with restrictions
		48844517 (Rexer, 2012)	BYI 02960 FS480G and SL200G (sequentially)	Honeybee *Apis mellifera*	Reliable with restrictions

Guideline	Description	MRID(s)	Test Substance	Common Name (Species)	Classification (Additional Data Needed?)
850.4100	Seedling emergence, TEP	48843729 (Gosch, 2010)	BYI 02960 200 SL (17%)	*Beta vulgaris* (Sugar beet), *Brassica napus* (Oilseed rape), *Cucumis sativus* (Cucumber), *Fagopyrum esculentum* (Buckwheat), *Glycine max* (Soybean), *Lactuca sativa* (Lettuce), *Lycopersicon esculentum* (Tomato), *Allium cepa* (Onion), *Avena sativa* (Oat), *Lolium perenne* (Ryegrass), *Zea mays* (Corn)	Reliable with restrictions (Yes: statistically significant effects on dry weight and shoot length in the limit test; definitive test needed for dicot plants)
850.4150	Vegetative vigor, TEP	48843730 (Gosch, 2010)	BYI 02960 200 SL (17%)	*Beta vulgaris* (Sugar beet), *Brassica napus* (Oilseed rape), *Cucumis sativus* (Cucumber), *Fagopyrum esculentum* (Buckwheat), *Glycine max* (Soybean), *Lactuca sativa* (Lettuce), *Lycopersicon esculentum* (Tomato), *Allium cepa* (Onion), *Avena sativa* (Oat), *Lolium perenne* (Ryegrass), *Zea mays* (Corn)	Reliable with restrictions (Yes: statistically significant effects on dry weight in the limit test; definitive test needed for dicot plants)
850.4400	Aquatic plant, vascular plant, TGAI	48843731 (Banman et al., 2010)	BYI 02960 (96.2%)	Duckweed *Lemna gibba*	Reliable with restrictions
850.4500	Aquatic Plant, freshwater green alga species, TGAI	48843732 (Banman and Lam, 2010)	BYI 02960 (96.2%)	Green algae *Pseudokirchneriella subcapitata*	Fully reliable

Guideline	Description	MRID(s)	Test Substance	Common Name (Species)	Classification (Additional Data Needed?)
850.4500	Aquatic Plant, freshwater green alga species, TGAI	48844518 (Bruns, 2010)	BYI 02960 SL200G (17.1%)	Green algae *Pseudokirchneriella subcapitata*	Fully reliable
850.4500	Tier II Aquatic Plant, freshwater diatom, TGAI	None	N/A	N/A	N/A (Yes: data are generally requested for a freshwater diatom, marine diatom, and cyanobacteria)
850.4500	Tier I Aquatic Plant, marine diatom, TGAI	N/A	N/A	N/A	N/A (Yes: data are generally requested for a freshwater diatom, marine diatom, and cyanobacteria)
850.4550	Tier II Aquatic Plant, cyanobacterium, TGAI	N/A	N/A	N/A	N/A (Yes: data are generally requested for a freshwater diatom, marine diatom, and cyanobacteria)

Appendix C. Summary of Aquatic Modeling Completed

Table C1. Estimated Concentrations of Flupyradifurone Plus Unextracted Residues (FLU-UN) and Flupyradifurone alone (FLU) in Surface Water

Values with an asterisk were calculated for flupyradifurone alone. Values without an asterisk were calculated for flupyradifurone plus unextracted residues. Purple values were the highest across scenarios. Bold values were the highest value for the use site.

Use Site	Single App. Rate lbs. ai/A[a] (kg ai/ha)	# of App	Ret. Int. days	App. Type	Scenario Application Date (DD-MM)	EECs for parent plus unextracted residues in µg/L EECs for parent alone in µg/L*				
						Water Column			Pore Water	
						Peak	21-day average	60-day average	Peak	21-day average
Crop Group 15: Cereal Grains (except Rice)	0.18 (0.20)	2	7	F, A	IAcornSTD (01-06)	7.90	7.51	6.92	5.77	5.77
					ILcornSTD (01-06)	11.0	10.5	9.77	8.42	8.41
					INcornSTD (01-06	8.05	7.66	7.06	5.80	5.80
					KSSorghumSTD (01-06)	11.7	11.2	10.3	8.82	8.81
					MNcornSTD (01-07)	14.4	13.7	12.6	11.3	11.3
					MScornSTD (10-04)	15.6	14.8	13.6	10.8	10.8
					NCcornESTD (01-06)	10.3	9.84	8.98	7.80	7.96+
					NEcornSTD (02-09)	22.4 **23.5*** 19.4s*	21.7 **22.8*** 18.8s*	20.6 **21.6*** 18.0s*	17.9 **18.9*** 15.5s*	18.0+ **19.0+*** 15.6s*+
					NDwheatSTD (01-06)	11.0	10.5	9.84	9.00	9.09+
					OHcornSTD (01-05)	7.86	7.52	7.14	5.91	5.91
					PAcornSTD (01-07)	11.5	11.0	10.5	9.01	9.00
	0.18 (0.20)	2	7	F, G	**NEcornSTD (02-09)**	**22.2*** 20.2s*	**21.6*** 19.6s*	**20.5*** 18.8s*	**17.9*** 16.2s*	**17.9** 16.3s*
Cotton	0.18 (0.20)	2	7	F, A	CAcotton_WirrigSTD (01-01)	7.54	7.21	6.66	5.27	5.27
					MScottonSTD (10-05)	8.54	8.15	7.52	6.98	7.08+
					NCcottonSTD (20-09)	19.1 **19.6*** 16.2s*	18.4 **19.0*** 15.6s*	17.5 **18.1*** 15.1s*	15.4 **15.9*** 13.3s*	15.4 **15.9*** 13.3s*
				F, G	NCcottonSTD (20-09)	18.1 **18.6*** 16.9s*	17.5 **17.9*** 16.3s*	16.6 **17.2*** 15.7s*	14.7 **15.1*** 138.s*	14.7 **15.1*** 13.8s*
Peanut	0.18 (0.20)	2	7	F, A	NCpeanutSTD (25-09)	10.5 **10.9*** 7.31s*	10.0 **10.4*** 6.97s*	9.52 **9.81*** 6.69s*	7.72 **8.11*** 5.44s*	7.71 **8.10*** 5.44s*
				F, G	NCpeanutSTD (25-09)	9.09 **10.9*** 9.13s*	8.62 **10.4*** 8.95s*	8.36 **10.1*** 8.59s*	6.67 **8.46*** 7.14s*	6.66 **8.47*** 7.15s*+
Root Veg. (except Sugarbeet) and Tuberous and Corm Veg.	0.18 (0.20)	2	7	F, A	FLcarrotSTD (01-11)	18.0 **18.9*** 16.0s* 39.3a* 43.0b* 45.8c* 63.8d*	17.5 **18.3*** 15.3s* 37.6a* 41.7b* 44.5c* 62.1d8	15.8 **16.6*** 13.8s* 34.0a* 38.4b* 41.1c* 62.1d*	12.3 **13.0*** 10.7s* 27.9a* 32.1b* 35.1c* 56.2d*	12.2 **12.9** 10.6s* 26.8a* 30.8b* 33.8c* 55.9d*
					IDpotato_wirrigSTD (01-06)	4.92	4.71	4.39	3.73	3.72
					MEpotatoSTD (01-06)	8.12	7.89	7.61	7.00	6.99
					MIasparagusSTD (01-09)	6.02	5.87	6.20+	5.70	5.70
					MNsurgarbeetSTD (01-06)	10.8	10.3	9.61	8.68	8.67

Use Site	Single App. Rate lbs. ai/A[a] (kg ai/ha)	# of App	Ret. Int. days	App. Type	Scenario Application Date (DD-MM)	EECs for parent plus unextracted residues in µg/L EECs for parent alone in µg/L*				
						Water Column			Pore Water	
						Peak	21-day average	60-day average	Peak	21-day average
					ORmintSTD (15-04)	4.11	3.93	3.68	3.13	3.13
					NCsweetpotatoSTD (01-06)	9.43	9.01	8.25	7.42	7.47+
				F, G	FLcarrotSTD (01-11)	17.4 **18.2*** 16.7s*	16.7 **17.4*** 15.9s*	15.1 **15.8*** 14.4s*	11.6 **12.3*** 11.1s*	11.5 **12.2*** 11.0s*
Legume Veg. (Succulent or Dried)	0.18 (0.20)	2	7	F, A	MIbeansSTD (25-08)	**16.0** 15.9s 16.8* 12.3s*	**15.3** 15.1s 16.1* 11.8s*	**14.3** 13.7s 15.3* 11.7s*	**14.2** 10.4s 15.1* 11.6s*	**14.3+** 10.4s 15.2* 11.7s*+
					ORsnbeanssSTD (01-06)	7.56	7.23	6.71	5.73	5.73
				F, G	MIbeansSTD (25-08)	17.7 **19.1*** 17.8s*	17.0 **19.7*** 18.2s*	15.9 **17.9*** 16.5s*	14.2 **13.8*** 12.7s*	14.4+ **13.7*** 12.5s*
Fruiting Vegetables	0.18 (0.20)	2	7	F, A	CAtomato_wirrigSTD (01-03)	4.98	4.79	4.47	3.58	3.57
					FLtomatoSTD_v2 (22-05)	19.1 15.9s **19.9*** 16.5s*	18.1 15.1s **18.9*** 15.6s*	16.4 13.7s **17.3*** 14.3s*	12.6 10.4s **13.3*** 11.0s*	12.5 10.4s **13.3*** 11.0s*
					PAtomatoSTD (01-05)	6.63	6.41	6.09	5.08	5.07
					FLpeppersSTD (01-09)	10.9	10.4	10.2	7.78	7.78
	0.37 (0.40)	1	--	S, G	FLtomatoSTD_v2 (01-03)	**15.9*** 14.8s*	**16.3*** 15.1s*	**16.7*** 15.4s*	**12.7*** 11.7s*	**12.7*** 11.7s*
Cucurbit Vegetables	0.18 (0.20)	2	7	F, A	MOmelonSTD (10-04)	7.00	6.64	6.09	4.92	4.91
					FLcucumberSTD (01-11)	18.7 16.3s **19.8*** 17.1s*	19.6+ 16.9s **20.5*** 17.5s*+	17.8 15.1s **18.7*** 15.8s*	13.7 11.5s **14.5*** 12.1s*	13.5 11.4s **14.4*** 12.0s*
					NJmelonSTD (01-07)	10.6	10.1	9.45	9.41	9.40
					MImelonSTD (01-07)	9.70	9.19	8.47	6.91	6.91
				F, G	FLcucumberSTD (01-11)	18.2 **19.1*** 17.8s*	19.0+ **19.7*** 18.2s*	17.1 **17.9*** 16.5s*	13.0 **13.8*** 12.7*	12.9 **13.7*** 12.5s*
	0.37 (0.40)	1	--	S, G	FLcucumberSTD (01-11)	18.1 18.5* 16.9s*	18.2 19.0*+ 17.6s*+	19.3+ 20.3*+ 18.8s*+	14.2 14.9* 13.8s*	13.6 14.3* 13.2s*
Hops	0.14 (0.15)	1	0.14 (0.15)	F, A	ORhopsSTD (29-08)	5.40 **5.57*** 2.14s*	5.24 **5.41*** 2.07s*	5.22 **5.41*** 1.99s*	4.52 **4.73*** 1.74s*	4.52 **4.73*** 1.74s*
				F, G	ORhopsSTD (29-08)	3.85 3.98* 2.29s*	3.75 3.89* 2.22s*	3.67 3.84* 2.11s*	3.16 3.32* 1.84s*	3.16 3.32* 1.84s*
Citrus Fruit	0.18 (0.20)	2	7	F, A	CAcitrus_WirrigSTD (01-01)	4.34	4.13	3.84	3.26	3.26
					FLcitrusSTD (02-10)	22.8 20.6s **24.4*** 22.0s* 3.45∞*	23.6 21.3s **25.1*** 22.5s* --	22.8 20.1s **23.7*** 20.8s* --	17.2 15.1s **18.1*** 15.8s* 2.38∞*	17.0 14.9s **17.8*** 15.5s* --
				F, AB	FLcitrusSTD (02-10)	22.2	23.0+	21.9	16.4	16.2

Use Site	Single App. Rate lbs. ai/A[a] (kg ai/ha)	# of App	Ret. Int. days	App. Type	Scenario Application Date (DD-MM)	EECs for parent plus unextracted residues in µg/L EECs for parent alone in µg/L*				
						Water Column			Pore Water	
						Peak	21-day average	60-day average	Peak	21-day average
				F, G	FLcitrusSTD (02-10)	22.6	23.3	22.3	16.8	16.6
	0.37 (0.40)	1	--	S, G	FLcitrusSTD (02-10)	24.4 **24.6*** 23.1s* 1.75∞*	23.3 **23.7*** 22.2* --	22.3 **22.6*** 21.1s* --	17.0 **17.4*** 16.2s* 1.18∞*	16.9 **17.2*** 16.0s* --
Pome Fruit	0.18 (0.20)	2	7	F, A	CAfruit_WirrigSTD (16-01)	3.98	3.79	3.51	2.99	2.99
					NCapplesSTD (01-06)	7.31	6.91	6.42	5.70	5.74+
					ORappleSTD (01-10)	6.24	6.09	5.80	5.19	5.18
					PAappleSTD_V2 (24-8)	12.2 **12.5*** 8.73*	11.5 **11.8*** 8.26s*	10.5 **10.9*** 7.59s*	8.98 **9.34*** 6.40s*	9.00+ **9.36*+** 6.39s*
				F, AB	PAappleSTD_V2 (24-08)	10.2 10.5*	9.60 9.99*	8.87 9.19*	7.37 7.72*	7.37 7.72*
				F, G	PAappleSTD_V2 (24-08)	10.7 11.0* 9.10s*	10.1 10.4* 8.61s*	9.28 9.56* 7.90s*	7.81 8.05* 6.59s*	7.81 8.05* 6.58s*
Bushberry	0.18 (0.20)	2	7	F, A	NYgrapesSTD (01-09)	9.30 **9.65*** 6.06s*	9.05 **9.43*** 6.04s*	9.11+ **9.67*** 6.20s*	9.38 **9.88*** 6.46s*	9.52+ **10.0*+** 6.56s*
					ORberriesOP (07-04)	4.20	4.01	3.79	3.18	3.18
				F, G	NYgrapesSTD (01-09)	7.64 7.98* 6.32s*	7.50 7.96* 6.29s*	7.73+ 8.18*+ 6.46s*	8.03 8.48* 6.73s*	8.16+ 8.55* 6.84s*
Low Growing Berry (excluding Cranberry)	0.18 (0.20)	2	7	F, A	Flstrawberry_WirrigSTD (10-11)	**12.9*** 10.2s*	**12.8*** 9.66s*	**11.6*** 8.68s*	**8.78*** 6.39s*	**8.21*** 6.15s*
					ORberriesSTD (07-04)	4.20	4.01	3.79	3.18	3.18
				F, G	Flstrawberry_WirrigSTD (10-11)	**14.3*** 10.6s*	**16.2*** 10.1s*	**15.4*+** 9.04s*	**9.38*** 6.66s*	**9.23*** 6.41s*
Small Fruit Vine Climbing (except Fuzzy Kiwifruit)	0.18 (0.20)	2	7	F, A	High from bushberry, NYgrapesSTD (01-09)	8.26 5.71s **9.65*** 6.06s*	7.97 5.72s **9.43*** 6.04s*	7.63+ 5.89s+ **9.67*** 6.20s*	6.59 6.20s **9.88*** 6.46s*	6.60+ 6.30s+ **10.0*+** 6.56s*
					NYgrapesSTD (01-09)	7.90 8.28* 6.31s*	7.88 8.14* 6.03s*	7.43 7.64* 5.66s*	6.17 6.38* 4.67s*	6.17 6.39*+ 4.66s*
					ORberriesOP (07-04)	2.55	2.43	2.28	1.86	1.86
					CAgrapes_WirrigSTD (01-02)	2.45	2.32	2.14	1.69	1.69
Tree Nut	0.18 (0.20)	2	7	F, A	GApecansSTD (01-06)	9.52 **9.73*** 6.55s*	8.98 **9.26*** 6.51s*	8.21 **8.75*** 6.80s*	8.49 **8.90*** 6.53s*	8.60 **8.90*** 6.54s*
					CAalmond_WirrigSTD (16-01)	5.61	5.34	4.93	4.00	3.99
					ORfilbertSTD (02-11)	7.55	7.29	7.10	5.96	5.94
Prickly Pear	0.18 (0.20)	2	7	F, G	CAcitrus_WirrigSTD (01-01)	2.80 **2.98*** 1.24s*	2.67 **2.86*** 1.22s*	2.49 **2.68*** 1.27s*+	2.14 **2.22*** 1.04s*	2.14 **2.22*** 1.04s*
Nongrass Animal Feeds (Forage, Fodder, Straw,	0.18 (0.20)	2	7	F, A	ILalfalfaNMC (01-07)	10.9	10.4	9.81	8.19	8.18
					MNalfalfaOP (01-06)	8.58	8.21	7.66	6.92	6.91
					NCalfalfaOP (01-06)	9.89	9.36	8.64	7.77	7.82+
					PAalfalfaOP (01-07)	8.99	8.67	8.02	6.64	6.76+

Use Site	Single App. Rate lbs. ai/A[a] (kg ai/ha)	# of App	Ret. Int. days	App. Type	Scenario Application Date (DD-MM)	EECs for parent plus unextracted residues in µg/L EECs for parent alone in µg/L*				
						Water Column			Pore Water	
						Peak	21-day average	60-day average	Peak	21-day average
Hay)					TXalfalfaOP (09-05)	23.6 20.4s **25.2*** 21.8s* 3.55∞* 22.8e* 17.6f*	22.4 19.3s **24.0*** 20.8s* -- 21.5e* 15.7f*	20.5 17.7s **22.1*** 19.2s* -- 19.90e* 13.9f*	15.7 13.5s **17.2*** 14.8s* 2.47∞* 15.3e* 11.5f*	15.8+ 13.5s **17.2*** 14.9s* -- 15.30e* 11.5f*
					CArangelandhayRLF_V2 (01-01)	10.3	9.78	8.99	6.91	6.90
Soybean Seed Treatment	0.37 (0.40)	1	--	G	MSsoybeanSTD (14 days before crop emergence)	6.90 **6.97***	6.53 **6.61***	5.93 **6.05***	4.61 **4.70***	4.60 **4.70***

Abbreviations: App=Application; A=aerial application; AB=airblast application; Ave=average; Veg.=vegetables; Ret. Int.=retreatment interval

* Results designated with an asterisk are for residues of flupyradifurone alone. All other values reflect residues of flupyradifurone plus unextracted residues.

s Simulation without spray drift.

a Simulation for two seasons per year. Applications occurred on 10/1, 10/9, 11/1, and 11/9. The modified FLcarrotSTD scenario was used for this simulation.

b Simulation with three seasons a year. Applications occurred on 10/1, 10/9, 11/1, 11/9, 12/1, and 12/9. The modified FLcarrotSTD scenario was used for this simulation.

c Simulation with four seasons a year. Applications occurred on 10/1, 10/9, 11/1, 11/9, 12/1, 12/9, 01/01, and 01/09. The modified FLcarrotSTD scenario was used for this simulation.

d Simulation with five seasons a year. Applications occurred on 10/1, 10/9, 11/1, 11/9, 12/1, 12/9, 01/01, 01/09, 02/01, and 02/09. The modified FLcarrotSTD scenario was used for this simulation.

e Simulation was completed assuming a K_{oc} value of 274 L/kg-oc, double the standard K_{oc} input of 137 L/kg-oc. This simulates what a Koc might have been if sediment data were available.

f Simulation was completed assuming a K_{oc} value of 779 L/kg-oc. This is the highest K_{oc} measured at a 0.0023 mg/L equilibrium flupyradifurone concentration in water in the batch equilibrium study conducted on the Gleissolo soil. This simulation provides an estimation of the uncertainty in assuming linear sorption when nonlinear sorption is expected to occur.

[+] The 1 in 10 year 21-day average value reported is higher than the 1 in 10 year peak EECs. This may occur because the 21-day average calculation may include days from another year but at least one day is in the year of interest, while the calculation of the peak concentration is only based on values in that year.

∞ Simulation was completed assuming 0% application efficiency. This essentially estimates EECs that could result from spray drift alone. This value may be used to evaluate the toxicity of end-use products.

Table C2. Estimated Concentrations of Flupyradifurone plus Unextracted residues (FLU-UN) or Flupyradifurone alone (values designated with an asterick) in Groundwater Source Irrigation Water

Bold values were the highest value for the use site.

Use Site (Timing of App)	Single App. Rate lbs. ai/A (kg ai/ha)	# of App	Ret. Int. Days	App. Type	EEC for flupyradifurone plus unextracted residues EEC for flupyradifurone alone* (µg/L)				
					SCI-GROW	PRZM-GW			
					Peak	Scenario	Daily Peak	Post Breakthrough Average	Ave Breakthrough Time (Days)
Foliar Application (10 days post emergence)	0.18 (0.20)	2	7	F, A	2.10 1.09*	WI	95.7 63.5* 190a 284b	89.4 57.7* 178a 26b	4205
Soil Application (10 days post-emergence)	0.37 (0.40)	1	--	G	2.16	WI	96.0	89.6	4205
Seed Treatment (14 days pre-emergence)	0.37 (0.40)	1	--	G	2.16 1.01* 4.31α	WI	**95.7** 63.1*	89.7 58.0*	4205

Abbreviations: App=Application; A=aerial application; AB=airblast application; NJ/DE=Delmarva Sweet Corn; NC=NC cotton; WI=Wisconsin Corn; GA=Georgia Peanuts; Ave.=average; Ret. Int.=retreatment interval

* Results are for residues of flupyradifurone plus M47 plus M48. All other values reflect residues of flupyradifurone plus M47 plus M48 plus unextracted residues.

a Simulation for two seasons per year.

b Simulation with three seasons a year.

Appendix D. Example Aquatic Modeling Output for the Groundwater Modeling

Groundwater Analysis for Flupyradifurone and the Wisconsin Corn - WI Central Sands Scenario

Estimated groundwater concentrations and breakthrough times for Enter chemical name or descriptive information are presented in Table 1 for the Wisconsin Corn - WI Central Sands groundwater scenario. A graphical presentation of the daily concentrations in the aquifer is presented in Figure 1. These values were generated with the PRZM-GW (Version 1.07). Critical input values for the model are summarized in Tables 2 and 3.

Table D1. Groundwater Results for Enter chemical name or descriptive information and the Wisconsin Corn - WI Central Sands Scenario.

Peak Concentration (ppb)	95.7
Post-Breakthrough Mean Concentration (ppb)	89.4
Entire Simulation Mean Concentration (ppb)	57.8
Average Breakthrough Time (days)	4205.959
Throughputs	2.605827

Table D2. Chemical Properties for Groundwater Modeling of Enter chemical name or descriptive information.

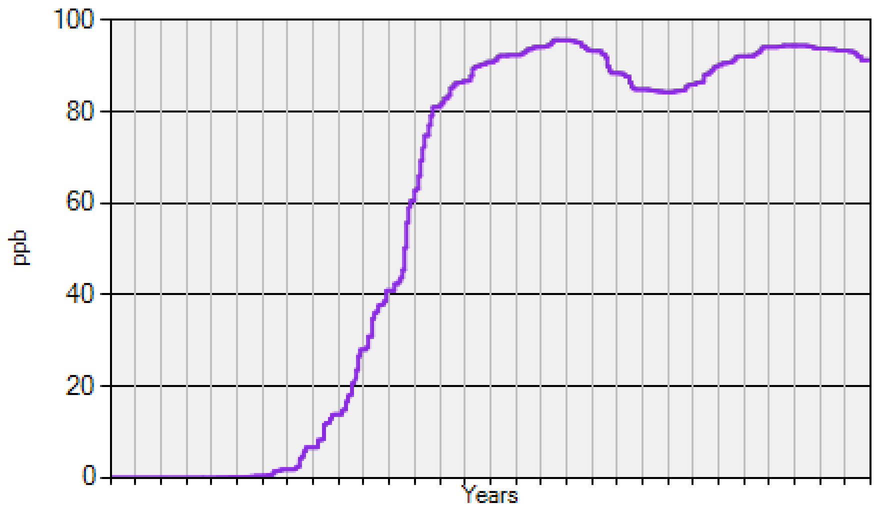
Koc (ml/g)	137
Surface Soil Half Life (days)	371
Hydrolysis Half Life (days)	0
Diffusion Coefficint Air (cm2/day)	0
Henry's Constant	0.0
Enthalpy (kcal/mol)	0.0

Table D3. Pesticide application scheme used for Enter chemical name or descriptive information. This application scheme was applied every year of the simulation.

Application Days Relative to Emergence Date (05/01)	Application Method	Application Rate (kg/ha)
10	Above canopy application	0.20

18	Above canopy application	0.20

Figure D1. Aquifer Breakthrough Curve for Enter chemical name or descriptive information and the Wisconsin Corn - WI Central Sands Scenario



Appendix E. Example Aquatic Modeling Output for the SWCC

Florida Citrus – Unextracted Residues
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 10:11

Peak 1-in-10 = 22.8 ppb
Chronic 1-in-10 = 10.7 ppb
Simulation Avg = 6.00 ppb
4-day avg 1-in-10 = 22.9 ppb
21-day avg 1-in-10 = 23.6 ppb
60-day avg 1-in-10 = 22.8 ppb
90-day avg 1-in-10 = 20.4 ppb

Benthic Pore Water Peak 1-in-10 = 17.2 ppb
Benthic Pore Water 21-day avg 1-in-10 = 17.0 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	4.91E+00	4.84E+00	4.67E+00	4.33E+00	3.86E+00	9.64E-01	3.08E+00	2.98E+00
2	4.27E+00	4.22E+00	4.03E+00	4.05E+00	4.06E+00	2.56E+00	3.17E+00	3.17E+00
3	1.74E+01	1.72E+01	1.68E+01	1.55E+01	1.45E+01	5.28E+00	1.13E+01	1.12E+01
4	2.72E+01	2.69E+01	2.58E+01	2.37E+01	2.11E+01	1.09E+01	1.78E+01	1.75E+01
5	3.37E+01	3.33E+01	3.20E+01	2.92E+01	2.57E+01	1.53E+01	2.24E+01	2.21E+01
6	2.34E+01	2.34E+01	2.43E+01	2.67E+01	2.74E+01	1.44E+01	2.25E+01	2.24E+01
7	1.36E+01	1.35E+01	1.29E+01	1.26E+01	1.27E+01	8.40E+00	1.22E+01	1.24E+01
8	1.41E+01	1.39E+01	1.35E+01	1.24E+01	1.17E+01	7.77E+00	1.01E+01	1.01E+01
9	1.02E+01	1.02E+01	1.05E+01	1.15E+01	1.17E+01	7.05E+00	1.01E+01	1.01E+01
10	7.57E+00	7.60E+00	7.85E+00	8.55E+00	8.59E+00	4.89E+00	7.67E+00	7.66E+00
11	5.59E+00	5.55E+00	5.36E+00	5.05E+00	4.82E+00	3.22E+00	4.46E+00	4.51E+00
12	1.82E+01	1.80E+01	1.70E+01	1.45E+01	1.09E+01	4.73E+00	1.03E+01	9.67E+00
13	1.34E+01	1.34E+01	1.40E+01	1.53E+01	1.43E+01	8.44E+00	1.13E+01	1.13E+01
14	1.17E+01	1.16E+01	1.10E+01	1.03E+01	9.68E+00	6.09E+00	8.26E+00	8.18E+00
15	8.40E+00	8.43E+00	8.73E+00	9.43E+00	9.80E+00	5.35E+00	8.27E+00	8.25E+00
16	7.87E+00	7.79E+00	7.44E+00	7.22E+00	6.66E+00	3.94E+00	5.73E+00	5.65E+00
17	6.83E+00	6.77E+00	6.55E+00	6.82E+00	6.87E+00	4.22E+00	5.76E+00	5.75E+00
18	7.93E+00	7.87E+00	7.58E+00	7.15E+00	6.83E+00	4.48E+00	5.96E+00	5.89E+00
19	7.78E+00	7.69E+00	7.33E+00	7.00E+00	6.87E+00	4.51E+00	5.98E+00	5.97E+00
20	6.73E+00	6.65E+00	6.50E+00	6.18E+00	6.31E+00	4.05E+00	5.45E+00	5.44E+00
21	1.03E+01	1.02E+01	9.66E+00	8.61E+00	7.15E+00	4.19E+00	6.60E+00	6.35E+00
22	1.47E+01	1.45E+01	1.41E+01	1.30E+01	1.14E+01	6.68E+00	1.02E+01	9.93E+00
23	1.13E+01	1.13E+01	1.17E+01	1.29E+01	1.22E+01	7.17E+00	1.04E+01	1.04E+01
24	1.09E+01	1.07E+01	1.03E+01	9.11E+00	7.65E+00	5.03E+00	7.31E+00	6.95E+00
25	8.91E+00	8.95E+00	9.32E+00	9.40E+00	8.88E+00	5.52E+00	7.73E+00	7.73E+00
26	8.90E+00	8.83E+00	8.49E+00	7.74E+00	6.90E+00	4.35E+00	6.06E+00	5.98E+00
27	1.11E+01	1.10E+01	1.06E+01	1.00E+01	9.14E+00	5.31E+00	7.94E+00	7.80E+00
28	9.25E+00	9.15E+00	8.81E+00	9.66E+00	9.57E+00	6.00E+00	8.01E+00	8.00E+00
29	7.93E+00	7.84E+00	7.56E+00	8.03E+00	7.95E+00	5.06E+00	7.03E+00	7.02E+00
30	5.87E+00	5.87E+00	6.03E+00	6.55E+00	6.75E+00	4.03E+00	5.86E+00	5.86E+00

****

****
Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 850.358306476219
zero hydrolysis 0
photolysis halflife (days) = 212.690322347906
volatile halflife (days) = 129273933.836524
total water col halflife (days) = 170.135908536992

zero burial 0
zero benthic metab 0
zero benthic hydrolysis 0
zero benthic total degradation 0
****
Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.7205 3.899
Due to Erosion = 0.0022 0.1215E-01
Due to Drift = 0.2772 1.500
******* Inputs *******
137.0 = oc partitioning coefficient
1118. = water column half Life
20.00 = reference temp for water column degradation
0.000 = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value
2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

Florida Citrus Parent Only
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 10:20

Peak 1-in-10 = 24.4 ppb
Chronic 1-in-10 = 11.5 ppb
Simulation Avg = 6.66 ppb
4-day avg 1-in-10 = 24.5 ppb
21-day avg 1-in-10 = 25.1 ppb
60-day avg 1-in-10 = 23.7 ppb
90-day avg 1-in-10 = 21.4 ppb

Benthic Pore Water Peak 1-in-10 = 18.1 ppb
Benthic Pore Water 21-day avg 1-in-10 = 17.8 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	4.92E+00	4.86E+00	4.69E+00	4.39E+00	3.91E+00	9.78E-01	3.11E+00	3.00E+00
2	4.47E+00	4.43E+00	4.25E+00	4.13E+00	4.13E+00	2.73E+00	3.32E+00	3.28E+00
3	1.78E+01	1.75E+01	1.72E+01	1.59E+01	1.50E+01	5.57E+00	1.17E+01	1.15E+01
4	2.79E+01	2.76E+01	2.66E+01	2.46E+01	2.21E+01	1.17E+01	1.86E+01	1.83E+01
5	3.49E+01	3.45E+01	3.34E+01	3.07E+01	2.72E+01	1.67E+01	2.36E+01	2.33E+01
6	2.51E+01	2.52E+01	2.60E+01	2.83E+01	2.90E+01	1.61E+01	2.38E+01	2.37E+01
7	1.48E+01	1.47E+01	1.41E+01	1.42E+01	1.44E+01	9.72E+00	1.37E+01	1.38E+01
8	1.50E+01	1.49E+01	1.44E+01	1.34E+01	1.29E+01	8.81E+00	1.12E+01	1.12E+01
9	1.12E+01	1.12E+01	1.16E+01	1.25E+01	1.27E+01	7.95E+00	1.10E+01	1.10E+01
10	8.43E+00	8.46E+00	8.72E+00	9.42E+00	9.45E+00	5.63E+00	8.44E+00	8.44E+00
11	6.05E+00	6.01E+00	5.82E+00	5.52E+00	5.51E+00	3.74E+00	5.08E+00	5.13E+00
12	1.84E+01	1.81E+01	1.73E+01	1.48E+01	1.12E+01	5.15E+00	1.06E+01	9.96E+00
13	1.39E+01	1.39E+01	1.45E+01	1.57E+01	1.47E+01	9.15E+00	1.16E+01	1.16E+01
14	1.24E+01	1.23E+01	1.18E+01	1.11E+01	1.04E+01	6.85E+00	8.92E+00	8.84E+00
15	9.19E+00	9.23E+00	9.52E+00	1.02E+01	1.06E+01	6.09E+00	8.93E+00	8.92E+00
16	8.37E+00	8.28E+00	7.95E+00	7.73E+00	7.17E+00	4.50E+00	6.19E+00	6.11E+00
17	7.24E+00	7.19E+00	6.97E+00	7.34E+00	7.39E+00	4.71E+00	6.22E+00	6.22E+00
18	8.38E+00	8.32E+00	8.04E+00	7.63E+00	7.30E+00	4.93E+00	6.37E+00	6.28E+00
19	8.25E+00	8.16E+00	7.82E+00	7.49E+00	7.35E+00	5.01E+00	6.39E+00	6.38E+00
20	7.19E+00	7.11E+00	6.98E+00	6.71E+00	6.83E+00	4.54E+00	5.90E+00	5.89E+00
21	1.06E+01	1.05E+01	1.00E+01	9.00E+00	7.56E+00	4.64E+00	6.95E+00	6.70E+00
22	1.52E+01	1.50E+01	1.46E+01	1.36E+01	1.20E+01	7.18E+00	1.07E+01	1.04E+01
23	1.19E+01	1.20E+01	1.24E+01	1.35E+01	1.28E+01	7.92E+00	1.09E+01	1.09E+01
24	1.13E+01	1.12E+01	1.08E+01	9.64E+00	8.20E+00	5.68E+00	7.79E+00	7.46E+00
25	9.46E+00	9.50E+00	9.86E+00	9.93E+00	9.43E+00	6.13E+00	8.22E+00	8.21E+00
26	9.34E+00	9.28E+00	8.96E+00	8.26E+00	7.42E+00	4.86E+00	6.50E+00	6.41E+00
27	1.16E+01	1.16E+01	1.11E+01	1.06E+01	9.71E+00	5.86E+00	8.42E+00	8.27E+00
28	9.88E+00	9.78E+00	9.45E+00	1.02E+01	1.01E+01	6.64E+00	8.50E+00	8.49E+00
29	8.54E+00	8.46E+00	8.18E+00	8.70E+00	8.61E+00	5.71E+00	7.60E+00	7.59E+00
30	6.49E+00	6.51E+00	6.68E+00	7.20E+00	7.39E+00	4.61E+00	6.43E+00	6.42E+00

****
****

Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 2265.84740160345
zero hydrolysis 0
photolysis halflife (days) = 212.690322347906

volatile halflife (days) = 129273933.836524
total water col halflife (days) = 194.438472623865

zero burial 0
benthic metab halflife (days) = 2770.89025983262
zero benthic hydrolysis 0
total benthic halflife (days) = 2770.89025983262
****
Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.7184 3.858
Due to Erosion = 0.0023 0.1212E-01
Due to Drift = 0.2793 1.500
******* Inputs *******
137.0 = oc partitioning coefficient
2979. = water column half Life
20.00 = reference temp for water column degradation
3643. = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value
2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

Florida Citrus – Parent only – Ground application at 0.40 kg/ha

Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 10:25

Peak 1-in-10 = 26.6 ppb
Chronic 1-in-10 = 13.8 ppb
Simulation Avg = 5.45 ppb

4-day avg 1-in-10 = 26.3 ppb
21-day avg 1-in-10 = 25.5 ppb
60-day avg 1-in-10 = 24.3 ppb
90-day avg 1-in-10 = 22.0 ppb

Benthic Pore Water Peak 1-in-10 = 18.8 ppb
Benthic Pore Water 21-day avg 1-in-10 = 18.6 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	2.50E+00	2.47E+00	2.35E+00	2.19E+00	1.82E+00	4.54E-01	1.51E+00	1.44E+00
2	1.82E+00	1.83E+00	1.90E+00	2.09E+00	2.07E+00	1.20E+00	1.59E+00	1.59E+00
3	2.69E+01	2.65E+01	2.57E+01	2.33E+01	2.18E+01	6.18E+00	1.64E+01	1.61E+01
4	2.76E+01	2.72E+01	2.63E+01	2.44E+01	2.20E+01	1.43E+01	1.90E+01	1.88E+01
5	3.28E+01	3.25E+01	3.15E+01	2.90E+01	2.55E+01	1.63E+01	2.24E+01	2.21E+01
6	2.37E+01	2.38E+01	2.45E+01	2.67E+01	2.73E+01	1.47E+01	2.25E+01	2.25E+01
7	1.68E+01	1.67E+01	1.60E+01	1.49E+01	1.39E+01	8.64E+00	1.16E+01	1.16E+01
8	1.52E+01	1.51E+01	1.47E+01	1.40E+01	1.41E+01	9.26E+00	1.16E+01	1.16E+01
9	1.12E+01	1.12E+01	1.16E+01	1.25E+01	1.32E+01	7.38E+00	1.13E+01	1.13E+01
10	6.22E+00	6.24E+00	6.42E+00	6.90E+00	6.92E+00	3.90E+00	6.55E+00	6.59E+00
11	3.17E+00	3.14E+00	3.03E+00	2.86E+00	2.98E+00	1.96E+00	2.93E+00	2.99E+00
12	1.47E+01	1.45E+01	1.37E+01	1.16E+01	8.07E+00	3.22E+00	7.90E+00	7.28E+00
13	1.10E+01	1.10E+01	1.14E+01	1.24E+01	1.17E+01	7.38E+00	8.96E+00	8.95E+00
14	1.40E+01	1.38E+01	1.35E+01	1.24E+01	1.16E+01	6.49E+00	9.54E+00	9.44E+00
15	9.87E+00	9.91E+00	1.02E+01	1.11E+01	1.17E+01	6.01E+00	9.55E+00	9.54E+00
16	5.89E+00	5.83E+00	5.59E+00	5.30E+00	4.87E+00	3.22E+00	4.37E+00	4.45E+00
17	4.59E+00	4.61E+00	4.76E+00	5.16E+00	5.11E+00	3.06E+00	4.34E+00	4.33E+00
18	6.00E+00	5.93E+00	5.68E+00	5.58E+00	5.35E+00	3.12E+00	4.44E+00	4.40E+00
19	5.10E+00	5.04E+00	4.83E+00	5.17E+00	5.33E+00	3.31E+00	4.45E+00	4.44E+00
20	4.02E+00	3.97E+00	3.87E+00	4.16E+00	4.22E+00	2.73E+00	3.66E+00	3.65E+00
21	7.74E+00	7.64E+00	7.28E+00	6.43E+00	4.85E+00	2.82E+00	4.67E+00	4.42E+00
22	1.11E+01	1.10E+01	1.07E+01	1.00E+01	9.70E+00	5.45E+00	8.16E+00	8.03E+00
23	8.72E+00	8.75E+00	9.05E+00	9.83E+00	9.76E+00	5.53E+00	8.22E+00	8.21E+00
24	8.66E+00	8.56E+00	8.21E+00	6.99E+00	5.37E+00	3.54E+00	5.37E+00	5.01E+00
25	7.14E+00	7.17E+00	7.45E+00	7.52E+00	7.09E+00	4.25E+00	5.94E+00	5.94E+00
26	5.73E+00	5.70E+00	5.52E+00	5.10E+00	4.36E+00	2.86E+00	3.91E+00	3.84E+00
27	8.78E+00	8.72E+00	8.40E+00	7.77E+00	7.02E+00	3.86E+00	6.12E+00	5.97E+00
28	8.63E+00	8.55E+00	8.21E+00	8.02E+00	7.55E+00	5.25E+00	6.53E+00	6.48E+00
29	6.69E+00	6.71E+00	6.92E+00	7.50E+00	7.68E+00	4.49E+00	6.53E+00	6.53E+00
30	4.15E+00	4.16E+00	4.26E+00	4.58E+00	4.66E+00	2.77E+00	4.25E+00	4.26E+00

****
****

Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 2265.84740160345
zero hydrolysis 0
photolysis halflife (days) = 212.690322347906
volatile halflife (days) = 129273933.836524
total water col halflife (days) = 194.438472623865

zero burial 0
benthic metab halflife (days) = 2770.89025983262
zero benthic hydrolysis 0
total benthic halflife (days) = 2770.89025983262

****
Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff =   0.9966   4.345
Due to Erosion =   0.0034   0.1490E-01
Due to Drift   =   0.0000   0.000
******* Inputs *******
137.0   = oc partitioning coefficient
2979.   = water column half Life
20.00   = reference temp for water column degradation
3643.   = benthic Half Life
20.00   = Reference temp for benthic degradation
2.000   = Q ten value
2.500   = photolysis half life
40.00   = reference latitude for photolysis study
0.000   = hydrolysis half life
288.3   = molecular wt
0.1300E-07 = vapor pressure
3200.   = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000   = initial depth
2.000   = maximum depth
2   1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000   = PRBEN
0.5000E-01 = benthic compartment depth
0.5000   = benthic porosity
1.350   = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000   = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190   = DFAC
30.00   = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000   = DOC in water column
0.4000   = biomass in water column

Pennsylvania Apples, parent only
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 10:39

Peak 1-in-10   =   8.63   ppb
Chronic 1-in-10   =   5.89   ppb
Simulation Avg   =   4.17   ppb
4-day avg 1-in-10 =   8.58   ppb
21-day avg 1-in-10 =   8.36   ppb
60-day avg 1-in-10 =   8.01   ppb
90-day avg 1-in-10 =   7.75   ppb

Benthic Pore Water Peak 1-in-10   =   6.95   ppb

Benthic Pore Water 21-day avg 1-in-10 =   6.95   ppb
Benthic Conversion Factor   = 5.85   -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water   = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	5.34E+00	5.28E+00	5.10E+00	4.70E+00	4.44E+00	1.90E+00	3.49E+00	3.48E+00
2	5.41E+00	5.36E+00	5.18E+00	4.85E+00	4.71E+00	3.57E+00	4.28E+00	4.27E+00
3	5.51E+00	5.47E+00	5.29E+00	5.12E+00	4.97E+00	3.94E+00	4.50E+00	4.50E+00
4	6.61E+00	6.55E+00	6.31E+00	5.89E+00	5.65E+00	4.21E+00	5.00E+00	4.99E+00
5	5.49E+00	5.45E+00	5.28E+00	5.16E+00	4.98E+00	3.99E+00	4.51E+00	4.55E+00
6	7.53E+00	7.46E+00	7.19E+00	6.70E+00	6.39E+00	4.29E+00	5.67E+00	5.66E+00
7	8.64E+00	8.60E+00	8.37E+00	8.06E+00	7.80E+00	5.85E+00	6.97E+00	6.97E+00
8	6.63E+00	6.58E+00	6.47E+00	6.10E+00	6.21E+00	5.28E+00	6.22E+00	6.33E+00
9	1.10E+01	1.09E+01	1.05E+01	9.76E+00	9.27E+00	5.92E+00	7.83E+00	7.82E+00
10	9.84E+00	9.75E+00	9.42E+00	8.94E+00	8.55E+00	6.84E+00	7.75E+00	7.75E+00
11	8.17E+00	8.10E+00	7.84E+00	7.38E+00	7.07E+00	5.89E+00	6.71E+00	6.83E+00
12	5.94E+00	5.90E+00	5.71E+00	5.62E+00	5.86E+00	4.58E+00	5.86E+00	5.97E+00
13	4.91E+00	4.88E+00	4.73E+00	4.49E+00	4.50E+00	3.68E+00	4.27E+00	4.35E+00
14	6.80E+00	6.75E+00	6.52E+00	6.10E+00	5.84E+00	4.07E+00	5.13E+00	5.13E+00
15	6.38E+00	6.32E+00	6.12E+00	5.70E+00	5.46E+00	4.22E+00	4.86E+00	4.86E+00
16	5.92E+00	5.87E+00	5.71E+00	5.35E+00	5.17E+00	3.98E+00	4.63E+00	4.63E+00
17	5.18E+00	5.13E+00	4.98E+00	4.68E+00	4.48E+00	3.71E+00	4.12E+00	4.20E+00
18	6.32E+00	6.26E+00	6.02E+00	5.62E+00	5.38E+00	3.87E+00	4.68E+00	4.68E+00
19	5.14E+00	5.09E+00	4.97E+00	4.81E+00	4.63E+00	3.74E+00	4.21E+00	4.21E+00
20	4.70E+00	4.66E+00	4.50E+00	4.18E+00	3.99E+00	3.22E+00	3.69E+00	3.76E+00
21	5.70E+00	5.65E+00	5.56E+00	5.25E+00	5.02E+00	3.58E+00	4.42E+00	4.41E+00
22	5.40E+00	5.37E+00	5.25E+00	5.03E+00	4.86E+00	3.84E+00	4.40E+00	4.40E+00
23	4.69E+00	4.65E+00	4.49E+00	4.22E+00	4.08E+00	3.27E+00	3.88E+00	3.96E+00
24	5.19E+00	5.14E+00	4.95E+00	4.60E+00	4.41E+00	3.30E+00	3.88E+00	3.88E+00
25	4.59E+00	4.55E+00	4.43E+00	4.25E+00	4.08E+00	3.18E+00	3.64E+00	3.64E+00
26	6.04E+00	5.98E+00	5.83E+00	5.50E+00	5.25E+00	3.71E+00	4.59E+00	4.59E+00
27	5.03E+00	4.99E+00	4.82E+00	4.61E+00	4.47E+00	3.63E+00	4.15E+00	4.22E+00
28	6.59E+00	6.53E+00	6.29E+00	5.83E+00	5.55E+00	3.92E+00	4.87E+00	4.86E+00
29	8.49E+00	8.44E+00	8.21E+00	7.63E+00	7.25E+00	4.85E+00	6.19E+00	6.18E+00
30	7.23E+00	7.16E+00	6.91E+00	6.46E+00	6.19E+00	4.95E+00	5.62E+00	5.70E+00

****
Effective compartment halflives averaged over simulation duration:

zero washout   0
water col metab halflife (days) =   4429.05217232110
zero hydrolysis   0
photolysis halflife (days) =   289.084753547405
volatile halflife (days) =   187228803.611772
total water col halflife (days) =   271.371861396606

zero burial   0
benthic metab halflife (days) =   5416.25950445310
zero benthic hydrolysis   0
total benthic halflife (days) =   5416.25950445310
****
Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff =   0.3950   0.9873
Due to Erosion =   0.0048   0.1203E-01
Due to Drift   =   0.6002   1.500

******* Inputs *******
137.0 = oc partitioning coefficient
2979. = water column half Life
20.00 = reference temp for water column degradation
3643. = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value
2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

New York Grapes – Parent Only
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 10:38

Peak 1-in-10 = 6.06 ppb
Chronic 1-in-10 = 4.06 ppb
Simulation Avg = 2.00 ppb
4-day avg 1-in-10 = 6.06 ppb
21-day avg 1-in-10 = 6.04 ppb
60-day avg 1-in-10 = 6.20 ppb
90-day avg 1-in-10 = 6.37 ppb

Benthic Pore Water Peak 1-in-10 = 6.46 ppb
Benthic Pore Water 21-day avg 1-in-10 = 6.56 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	7.68E-01	7.61E-01	7.33E-01	7.10E-01	6.54E-01	1.75E-01	5.72E-01	5.57E-01
2	1.53E+00	1.52E+00	1.49E+00	1.44E+00	1.38E+00	7.66E-01	1.18E+00	1.18E+00

3	1.23E+00	1.23E+00	1.24E+00	1.31E+00	1.37E+00	9.92E-01	1.21E+00	1.21E+00
4	9.01E-01	9.01E-01	9.07E-01	9.35E-01	9.23E-01	7.25E-01	8.89E-01	8.88E-01
5	1.45E+00	1.43E+00	1.39E+00	1.35E+00	1.22E+00	7.32E-01	1.26E+00	1.23E+00
6	1.22E+00	1.22E+00	1.25E+00	1.31E+00	1.30E+00	9.87E-01	1.23E+00	1.23E+00
7	1.55E+00	1.54E+00	1.50E+00	1.45E+00	1.41E+00	9.34E-01	1.31E+00	1.31E+00
8	1.26E+00	1.26E+00	1.29E+00	1.36E+00	1.40E+00	1.03E+00	1.30E+00	1.31E+00
9	8.22E-01	8.22E-01	8.24E-01	8.51E-01	8.66E-01	7.13E-01	8.82E-01	8.94E-01
10	3.80E+00	3.78E+00	3.75E+00	3.61E+00	3.50E+00	1.51E+00	4.36E+00	4.26E+00
11	3.09E+00	3.09E+00	3.09E+00	3.23E+00	3.35E+00	2.61E+00	3.45E+00	3.52E+00
12	2.41E+00	2.40E+00	2.33E+00	2.27E+00	2.35E+00	1.94E+00	2.36E+00	2.40E+00
13	1.96E+00	1.97E+00	1.97E+00	2.04E+00	2.12E+00	1.52E+00	2.04E+00	2.06E+00
14	1.12E+00	1.12E+00	1.12E+00	1.18E+00	1.21E+00	9.29E-01	1.22E+00	1.24E+00
15	8.70E-01	8.70E-01	8.73E-01	8.91E-01	8.82E-01	7.47E-01	8.95E-01	9.00E-01
16	9.64E-01	9.59E-01	9.48E-01	9.12E-01	8.96E-01	6.91E-01	1.07E+00	1.03E+00
17	4.94E+00	4.91E+00	4.83E+00	4.58E+00	4.40E+00	1.82E+00	4.25E+00	4.25E+00
18	3.91E+00	3.91E+00	3.91E+00	4.05E+00	4.22E+00	3.37E+00	4.09E+00	4.13E+00
19	9.32E+00	9.24E+00	8.97E+00	8.49E+00	8.13E+00	4.14E+00	7.30E+00	7.29E+00
20	7.20E+00	7.16E+00	7.05E+00	7.32E+00	7.68E+00	6.15E+00	8.63E+00	8.36E+00
21	6.11E+00	6.11E+00	6.11E+00	6.32E+00	6.54E+00	4.88E+00	6.69E+00	6.82E+00
22	3.70E+00	3.70E+00	3.71E+00	3.89E+00	4.05E+00	3.05E+00	4.02E+00	4.08E+00
23	3.97E+00	3.94E+00	3.87E+00	3.70E+00	3.56E+00	2.37E+00	3.20E+00	3.19E+00
24	3.29E+00	3.28E+00	3.25E+00	3.32E+00	3.46E+00	2.77E+00	3.69E+00	3.65E+00
25	2.58E+00	2.59E+00	2.64E+00	2.76E+00	2.85E+00	2.12E+00	2.94E+00	3.00E+00
26	5.63E+00	5.58E+00	5.44E+00	5.09E+00	4.85E+00	2.55E+00	4.09E+00	4.08E+00
27	4.09E+00	4.11E+00	4.21E+00	4.47E+00	4.73E+00	3.37E+00	4.09E+00	4.09E+00
28	2.93E+00	2.94E+00	3.00E+00	3.15E+00	3.27E+00	2.44E+00	3.26E+00	3.31E+00
29	2.70E+00	2.68E+00	2.59E+00	2.49E+00	2.41E+00	1.92E+00	2.25E+00	2.24E+00
30	3.37E+00	3.35E+00	3.29E+00	3.14E+00	3.03E+00	2.12E+00	3.19E+00	3.19E+00

****
****

Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 5258.27312887639
zero hydrolysis 0
photolysis halflife (days) = 330.838274194186
volatile halflife (days) = 139177229.656322
total water col halflife (days) = 311.254149584418

zero burial 0
benthic metab halflife (days) = 6430.30849563501
zero benthic hydrolysis 0
total benthic halflife (days) = 6430.30849563501
****
Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.8191 0.8484
Due to Erosion = 0.1809 0.1873
Due to Drift = 0.0000 0.000
******* Inputs *******
137.0 = oc partitioning coefficient
2979. = water column half Life
20.00 = reference temp for water column degradation
3643. = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value

2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

California Strawberry – Parent plus unextracted residues – aerial application
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 10:46

Peak 1-in-10 = 12.4 ppb
Chronic 1-in-10 = 6.97 ppb
Simulation Avg = 4.31 ppb
4-day avg 1-in-10 = 12.3 ppb
21-day avg 1-in-10 = 11.8 ppb
60-day avg 1-in-10 = 11.0 ppb
90-day avg 1-in-10 = 10.4 ppb

Benthic Pore Water Peak 1-in-10 = 8.54 ppb
Benthic Pore Water 21-day avg 1-in-10 = 8.53 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	4.92E+00	4.86E+00	4.62E+00	4.32E+00	4.10E+00	2.63E+00	3.19E+00	3.19E+00
2	9.14E+00	9.07E+00	8.71E+00	8.01E+00	7.57E+00	5.06E+00	6.18E+00	6.18E+00
3	8.97E+00	8.88E+00	8.52E+00	7.98E+00	7.61E+00	5.31E+00	6.57E+00	6.56E+00
4	5.51E+00	5.47E+00	5.28E+00	5.00E+00	4.80E+00	3.53E+00	4.51E+00	4.51E+00
5	5.10E+00	5.05E+00	4.86E+00	4.53E+00	4.36E+00	3.13E+00	3.87E+00	3.87E+00
6	5.83E+00	5.77E+00	5.68E+00	5.31E+00	5.06E+00	3.51E+00	4.33E+00	4.32E+00
7	4.99E+00	4.95E+00	4.84E+00	4.54E+00	4.42E+00	3.24E+00	4.01E+00	4.00E+00
8	6.29E+00	6.23E+00	6.00E+00	5.69E+00	5.42E+00	3.77E+00	4.66E+00	4.65E+00
9	1.27E+01	1.26E+01	1.21E+01	1.12E+01	1.06E+01	7.08E+00	8.66E+00	8.65E+00

10	8.19E+00	8.14E+00	7.95E+00	7.47E+00	7.13E+00	5.15E+00	6.55E+00	6.54E+00
11	5.55E+00	5.50E+00	5.35E+00	5.16E+00	5.03E+00	3.72E+00	4.67E+00	4.66E+00
12	5.07E+00	5.03E+00	4.84E+00	4.49E+00	4.28E+00	3.05E+00	3.82E+00	3.82E+00
13	7.07E+00	7.00E+00	6.79E+00	6.34E+00	6.02E+00	4.11E+00	5.05E+00	5.04E+00
14	5.37E+00	5.33E+00	5.16E+00	4.91E+00	4.73E+00	3.41E+00	4.27E+00	4.27E+00
15	5.66E+00	5.62E+00	5.42E+00	5.08E+00	4.83E+00	3.38E+00	4.19E+00	4.19E+00
16	5.56E+00	5.51E+00	5.32E+00	4.95E+00	4.72E+00	3.39E+00	4.20E+00	4.19E+00
17	4.62E+00	4.58E+00	4.43E+00	4.38E+00	4.24E+00	3.05E+00	3.79E+00	3.79E+00
18	7.39E+00	7.32E+00	7.02E+00	6.58E+00	6.25E+00	4.25E+00	5.23E+00	5.22E+00
19	1.34E+01	1.33E+01	1.29E+01	1.19E+01	1.12E+01	7.41E+00	9.11E+00	9.10E+00
20	9.65E+00	9.60E+00	9.33E+00	8.69E+00	8.27E+00	5.92E+00	7.46E+00	7.45E+00
21	6.12E+00	6.06E+00	5.89E+00	5.61E+00	5.37E+00	3.92E+00	5.03E+00	5.03E+00
22	8.90E+00	8.81E+00	8.45E+00	7.77E+00	7.35E+00	5.00E+00	6.16E+00	6.15E+00
23	7.95E+00	7.87E+00	7.72E+00	7.26E+00	6.91E+00	4.83E+00	6.03E+00	6.02E+00
24	5.96E+00	5.91E+00	5.69E+00	5.32E+00	5.07E+00	3.63E+00	4.60E+00	4.59E+00
25	6.64E+00	6.57E+00	6.31E+00	5.97E+00	5.70E+00	3.94E+00	4.87E+00	4.87E+00
26	8.21E+00	8.14E+00	7.88E+00	7.27E+00	6.88E+00	4.71E+00	5.82E+00	5.81E+00
27	1.33E+01	1.32E+01	1.26E+01	1.16E+01	1.09E+01	7.28E+00	8.96E+00	8.95E+00
28	6.69E+00	6.64E+00	6.43E+00	6.02E+00	5.87E+00	4.53E+00	5.66E+00	5.69E+00
29	5.67E+00	5.62E+00	5.42E+00	5.23E+00	5.01E+00	3.59E+00	4.51E+00	4.51E+00
30	6.68E+00	6.62E+00	6.37E+00	5.88E+00	5.57E+00	3.88E+00	4.80E+00	4.80E+00

****
****

Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 1747.83545637332
zero hydrolysis 0
photolysis halflife (days) = 242.285964103120
volatile halflife (days) = 114223441.685679
total water col halflife (days) = 212.788629569952

zero burial 0
zero benthic metab 0
zero benthic hydrolysis 0
zero benthic total degradation 0
****

Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.5221 1.639
Due to Erosion = 0.0000 0.2678E-04
Due to Drift = 0.4779 1.500
******* Inputs *******
137.0 = oc partitioning coefficient
1118. = water column half Life
20.00 = reference temp for water column degradation
0.000 = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value
2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area

0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

California Strawberry, Aerial application, with drift, parent only
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 10:48

Peak 1-in-10 = 12.6 ppb
Chronic 1-in-10 = 7.31 ppb
Simulation Avg = 4.61 ppb
4-day avg 1-in-10 = 12.5 ppb
21-day avg 1-in-10 = 12.1 ppb
60-day avg 1-in-10 = 11.2 ppb
90-day avg 1-in-10 = 10.6 ppb

Benthic Pore Water Peak 1-in-10 = 8.79 ppb
Benthic Pore Water 21-day avg 1-in-10 = 8.78 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	4.91E+00	4.85E+00	4.62E+00	4.34E+00	4.12E+00	2.70E+00	3.22E+00	3.22E+00
2	9.24E+00	9.18E+00	8.82E+00	8.14E+00	7.71E+00	5.25E+00	6.30E+00	6.30E+00
3	9.19E+00	9.11E+00	8.76E+00	8.23E+00	7.87E+00	5.60E+00	6.80E+00	6.79E+00
4	5.81E+00	5.77E+00	5.58E+00	5.30E+00	5.10E+00	3.83E+00	4.79E+00	4.79E+00
5	5.35E+00	5.30E+00	5.11E+00	4.78E+00	4.62E+00	3.38E+00	4.11E+00	4.10E+00
6	6.05E+00	5.99E+00	5.90E+00	5.53E+00	5.29E+00	3.75E+00	4.54E+00	4.53E+00
7	5.20E+00	5.17E+00	5.05E+00	4.76E+00	4.64E+00	3.47E+00	4.21E+00	4.20E+00
8	6.48E+00	6.42E+00	6.20E+00	5.90E+00	5.64E+00	4.01E+00	4.85E+00	4.85E+00
9	1.29E+01	1.28E+01	1.23E+01	1.15E+01	1.09E+01	7.42E+00	8.89E+00	8.89E+00
10	8.57E+00	8.51E+00	8.32E+00	7.85E+00	7.52E+00	5.54E+00	6.89E+00	6.89E+00
11	5.89E+00	5.85E+00	5.69E+00	5.50E+00	5.37E+00	4.06E+00	4.99E+00	4.98E+00
12	5.35E+00	5.30E+00	5.12E+00	4.77E+00	4.56E+00	3.33E+00	4.09E+00	4.08E+00
13	7.29E+00	7.22E+00	7.02E+00	6.58E+00	6.26E+00	4.37E+00	5.27E+00	5.26E+00
14	5.61E+00	5.58E+00	5.41E+00	5.16E+00	4.99E+00	3.67E+00	4.50E+00	4.50E+00
15	5.89E+00	5.85E+00	5.65E+00	5.31E+00	5.07E+00	3.62E+00	4.41E+00	4.41E+00
16	5.76E+00	5.71E+00	5.53E+00	5.16E+00	4.93E+00	3.62E+00	4.40E+00	4.39E+00

17	4.83E+00	4.80E+00	4.65E+00	4.59E+00	4.46E+00	3.28E+00	3.99E+00	3.99E+00
18	7.59E+00	7.52E+00	7.23E+00	6.80E+00	6.48E+00	4.51E+00	5.43E+00	5.43E+00
19	1.36E+01	1.35E+01	1.31E+01	1.21E+01	1.15E+01	7.77E+00	9.35E+00	9.34E+00
20	1.00E+01	1.00E+01	9.73E+00	9.10E+00	8.69E+00	6.35E+00	7.83E+00	7.82E+00
21	6.50E+00	6.45E+00	6.27E+00	5.99E+00	5.76E+00	4.29E+00	5.39E+00	5.39E+00
22	9.19E+00	9.09E+00	8.74E+00	8.08E+00	7.67E+00	5.33E+00	6.44E+00	6.44E+00
23	8.26E+00	8.18E+00	8.04E+00	7.58E+00	7.24E+00	5.18E+00	6.33E+00	6.32E+00
24	6.29E+00	6.23E+00	6.02E+00	5.65E+00	5.40E+00	3.95E+00	4.90E+00	4.90E+00
25	6.91E+00	6.84E+00	6.58E+00	6.24E+00	5.98E+00	4.23E+00	5.13E+00	5.13E+00
26	8.47E+00	8.41E+00	8.15E+00	7.55E+00	7.17E+00	5.03E+00	6.08E+00	6.08E+00
27	1.36E+01	1.35E+01	1.29E+01	1.19E+01	1.13E+01	7.68E+00	9.25E+00	9.24E+00
28	7.11E+00	7.06E+00	6.85E+00	6.44E+00	6.30E+00	4.95E+00	6.05E+00	6.08E+00
29	6.01E+00	5.96E+00	5.77E+00	5.57E+00	5.35E+00	3.93E+00	4.84E+00	4.83E+00
30	6.95E+00	6.90E+00	6.64E+00	6.16E+00	5.86E+00	4.18E+00	5.06E+00	5.06E+00

****
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Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 4657.24671246521
zero hydrolysis 0
photolysis halflife (days) = 242.285964103120
volatile halflife (days) = 114223441.685679
total water col halflife (days) = 230.304257398377

zero burial 0
benthic metab halflife (days) = 5695.31714451520
zero benthic hydrolysis 0
total benthic halflife (days) = 5695.31714451520
****

Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.5210 1.632
Due to Erosion = 0.0000 0.2673E-04
Due to Drift = 0.4790 1.500
******* Inputs *******
137.0 = oc partitioning coefficient
2979. = water column half Life
20.00 = reference temp for water column degradation
3643. = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value
2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN

0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

Georgia, Pecan, aerial, drift, parent only
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 10:53

Peak 1-in-10 = 9.73 ppb
Chronic 1-in-10 = 6.06 ppb
Simulation Avg = 3.67 ppb
4-day avg 1-in-10 = 9.63 ppb
21-day avg 1-in-10 = 9.26 ppb
60-day avg 1-in-10 = 8.75 ppb
90-day avg 1-in-10 = 9.08 ppb

Benthic Pore Water Peak 1-in-10 = 8.90 ppb
Benthic Pore Water 21-day avg 1-in-10 = 8.90 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	2.45E+00	2.41E+00	2.32E+00	2.12E+00	1.99E+00	9.51E-01	1.52E+00	1.52E+00
2	4.53E+00	4.48E+00	4.38E+00	4.01E+00	3.78E+00	2.19E+00	3.02E+00	3.01E+00
3	6.21E+00	6.14E+00	5.88E+00	5.40E+00	5.09E+00	3.18E+00	4.17E+00	4.17E+00
4	7.03E+00	6.96E+00	6.79E+00	6.32E+00	5.99E+00	3.89E+00	4.99E+00	4.98E+00
5	7.35E+00	7.27E+00	7.04E+00	6.49E+00	6.13E+00	4.15E+00	5.18E+00	5.17E+00
6	1.75E+01	1.73E+01	1.65E+01	1.50E+01	1.40E+01	7.85E+00	1.11E+01	1.11E+01
7	8.08E+00	8.10E+00	8.30E+00	8.78E+00	9.19E+00	6.16E+00	9.29E+00	9.50E+00
8	5.35E+00	5.30E+00	5.14E+00	4.79E+00	4.81E+00	3.68E+00	4.95E+00	5.07E+00
9	5.73E+00	5.67E+00	5.44E+00	5.02E+00	4.75E+00	3.24E+00	4.03E+00	4.03E+00
10	5.24E+00	5.19E+00	5.01E+00	4.73E+00	4.50E+00	3.15E+00	3.86E+00	3.86E+00
11	4.90E+00	4.86E+00	4.72E+00	4.38E+00	4.17E+00	2.95E+00	3.60E+00	3.59E+00
12	9.92E+00	9.80E+00	9.37E+00	8.53E+00	8.02E+00	4.62E+00	6.44E+00	6.43E+00
13	6.38E+00	6.32E+00	6.19E+00	5.82E+00	5.53E+00	4.33E+00	5.47E+00	5.59E+00
14	5.03E+00	4.98E+00	4.78E+00	4.43E+00	4.21E+00	3.19E+00	3.86E+00	3.95E+00
15	5.90E+00	5.83E+00	5.58E+00	5.13E+00	4.84E+00	3.20E+00	4.07E+00	4.07E+00
16	5.48E+00	5.43E+00	5.27E+00	4.95E+00	4.72E+00	3.29E+00	4.06E+00	4.06E+00
17	4.29E+00	4.25E+00	4.12E+00	3.84E+00	3.65E+00	2.76E+00	3.29E+00	3.36E+00
18	4.70E+00	4.65E+00	4.45E+00	4.13E+00	3.91E+00	2.65E+00	3.31E+00	3.31E+00
19	5.24E+00	5.19E+00	4.99E+00	4.72E+00	4.48E+00	3.00E+00	3.83E+00	3.83E+00
20	4.57E+00	4.52E+00	4.39E+00	4.14E+00	3.94E+00	2.87E+00	3.44E+00	3.43E+00
21	4.11E+00	4.07E+00	4.02E+00	3.77E+00	3.57E+00	2.55E+00	3.09E+00	3.08E+00
22	1.44E+01	1.43E+01	1.36E+01	1.23E+01	1.16E+01	6.09E+00	9.02E+00	9.01E+00
23	8.08E+00	8.01E+00	7.77E+00	7.46E+00	7.72E+00	5.80E+00	7.74E+00	7.91E+00

24	5.25E+00	5.20E+00	5.08E+00	4.81E+00	4.90E+00	3.73E+00	5.02E+00	5.14E+00
25	6.83E+00	6.76E+00	6.47E+00	5.92E+00	5.60E+00	3.65E+00	4.68E+00	4.68E+00
26	5.89E+00	5.83E+00	5.64E+00	5.22E+00	4.96E+00	3.56E+00	4.31E+00	4.30E+00
27	6.80E+00	6.72E+00	6.47E+00	5.95E+00	5.62E+00	3.74E+00	4.74E+00	4.73E+00
28	4.62E+00	4.58E+00	4.41E+00	4.08E+00	3.87E+00	3.04E+00	3.88E+00	3.97E+00
29	6.21E+00	6.16E+00	5.94E+00	5.44E+00	5.12E+00	3.25E+00	4.22E+00	4.21E+00
30	5.59E+00	5.53E+00	5.31E+00	4.88E+00	4.65E+00	3.29E+00	4.02E+00	4.02E+00

****
****

Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 2901.24491598198
zero hydrolysis 0
photolysis halflife (days) = 221.249282307510
volatile halflife (days) = 209980114.624810
total water col halflife (days) = 205.572111995484

zero burial 0
benthic metab halflife (days) = 3547.91380628477
zero benthic hydrolysis 0
total benthic halflife (days) = 3547.91380628477
****

Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.4669 1.321
Due to Erosion = 0.0027 0.7551E-02
Due to Drift = 0.5304 1.500
******* Inputs *******
137.0 = oc partitioning coefficient
2979. = water column half Life
20.00 = reference temp for water column degradation
3643. = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value
2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC

30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

Georgia, Pecan, no drift, parent only, aerial application
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 10:55

Peak 1-in-10 = 6.55 ppb
Chronic 1-in-10 = 4.07 ppb
Simulation Avg = 1.73 ppb
4-day avg 1-in-10 = 6.47 ppb
21-day avg 1-in-10 = 6.51 ppb
60-day avg 1-in-10 = 6.80 ppb
90-day avg 1-in-10 = 7.11 ppb

Benthic Pore Water Peak 1-in-10 = 6.53 ppb
Benthic Pore Water 21-day avg 1-in-10 = 6.54 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	8.22E-02	8.11E-02	7.69E-02	6.96E-02	6.52E-02	2.91E-02	4.90E-02	4.89E-02
2	1.49E+00	1.47E+00	1.41E+00	1.30E+00	1.22E+00	5.83E-01	9.30E-01	9.29E-01
3	2.85E+00	2.81E+00	2.69E+00	2.46E+00	2.31E+00	1.33E+00	1.84E+00	1.84E+00
4	3.63E+00	3.59E+00	3.49E+00	3.30E+00	3.13E+00	1.95E+00	2.57E+00	2.57E+00
5	3.95E+00	3.91E+00	3.75E+00	3.47E+00	3.27E+00	2.18E+00	2.73E+00	2.73E+00
6	1.40E+01	1.38E+01	1.31E+01	1.19E+01	1.12E+01	5.86E+00	8.67E+00	8.66E+00
7	6.38E+00	6.40E+00	6.55E+00	6.93E+00	7.26E+00	4.17E+00	7.32E+00	7.48E+00
8	2.54E+00	2.55E+00	2.61E+00	2.75E+00	2.87E+00	1.69E+00	2.97E+00	3.05E+00
9	2.22E+00	2.20E+00	2.11E+00	1.96E+00	1.86E+00	1.24E+00	1.56E+00	1.56E+00
10	1.80E+00	1.78E+00	1.73E+00	1.66E+00	1.60E+00	1.16E+00	1.39E+00	1.39E+00
11	1.53E+00	1.51E+00	1.47E+00	1.36E+00	1.29E+00	9.46E-01	1.12E+00	1.14E+00
12	6.57E+00	6.48E+00	6.18E+00	5.60E+00	5.24E+00	2.63E+00	4.02E+00	4.02E+00
13	3.07E+00	3.08E+00	3.15E+00	3.34E+00	3.50E+00	2.34E+00	3.50E+00	3.57E+00
14	1.62E+00	1.63E+00	1.66E+00	1.76E+00	1.84E+00	1.20E+00	1.89E+00	1.94E+00
15	2.44E+00	2.41E+00	2.30E+00	2.12E+00	1.99E+00	1.21E+00	1.61E+00	1.61E+00
16	2.16E+00	2.14E+00	2.10E+00	1.94E+00	1.84E+00	1.30E+00	1.59E+00	1.59E+00
17	1.13E+00	1.14E+00	1.16E+00	1.23E+00	1.28E+00	7.60E-01	1.31E+00	1.34E+00
18	1.20E+00	1.19E+00	1.13E+00	1.07E+00	1.01E+00	6.48E-01	8.40E-01	8.39E-01
19	1.96E+00	1.95E+00	1.87E+00	1.80E+00	1.71E+00	1.00E+00	1.39E+00	1.39E+00
20	1.23E+00	1.22E+00	1.19E+00	1.15E+00	1.20E+00	8.73E-01	1.20E+00	1.23E+00
21	7.89E-01	7.82E-01	7.57E-01	7.10E-01	7.43E-01	5.54E-01	7.59E-01	7.77E-01
22	1.11E+01	1.09E+01	1.03E+01	9.35E+00	8.75E+00	4.09E+00	6.61E+00	6.61E+00
23	5.06E+00	5.07E+00	5.20E+00	5.51E+00	5.78E+00	3.81E+00	5.77E+00	5.89E+00
24	2.62E+00	2.62E+00	2.69E+00	2.84E+00	2.96E+00	1.74E+00	3.05E+00	3.12E+00
25	3.42E+00	3.38E+00	3.23E+00	2.94E+00	2.76E+00	1.66E+00	2.23E+00	2.23E+00
26	2.47E+00	2.45E+00	2.39E+00	2.23E+00	2.11E+00	1.57E+00	1.87E+00	1.91E+00
27	3.40E+00	3.36E+00	3.23E+00	2.95E+00	2.78E+00	1.75E+00	2.28E+00	2.28E+00
28	1.65E+00	1.66E+00	1.70E+00	1.80E+00	1.88E+00	1.05E+00	1.90E+00	1.95E+00
29	2.72E+00	2.68E+00	2.59E+00	2.37E+00	2.22E+00	1.25E+00	1.76E+00	1.76E+00
30	2.21E+00	2.18E+00	2.09E+00	1.92E+00	1.82E+00	1.30E+00	1.56E+00	1.56E+00

****
****
Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 2901.24491598198
zero hydrolysis 0
photolysis halflife (days) = 221.249282307510
volatile halflife (days) = 209980114.624810
total water col halflife (days) = 205.572111995484

zero burial 0
benthic metab halflife (days) = 3547.91380628477
zero benthic hydrolysis 0
total benthic halflife (days) = 3547.91380628477
****
Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.9943 1.321
Due to Erosion = 0.0057 0.7551E-02
Due to Drift = 0.0000 0.000
******* Inputs *******
137.0 = oc partitioning coefficient
2979. = water column half Life
20.00 = reference temp for water column degradation
3643. = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value
2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

California Citrus (Prickly Pear), ground, drift

Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 10:58

Peak 1-in-10 = 2.98 ppb
Chronic 1-in-10 = 1.83 ppb
Simulation Avg = 1.39 ppb
4-day avg 1-in-10 = 2.95 ppb
21-day avg 1-in-10 = 2.86 ppb
60-day avg 1-in-10 = 2.68 ppb
90-day avg 1-in-10 = 2.56 ppb

Benthic Pore Water Peak 1-in-10 = 2.22 ppb
Benthic Pore Water 21-day avg 1-in-10 = 2.22 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	1.24E+00	1.22E+00	1.16E+00	1.06E+00	1.04E+00	6.76E-01	7.68E-01	7.67E-01
2	2.06E+00	2.04E+00	2.01E+00	1.88E+00	1.78E+00	1.31E+00	1.54E+00	1.54E+00
3	3.02E+00	2.99E+00	2.88E+00	2.69E+00	2.58E+00	1.88E+00	2.24E+00	2.24E+00
4	2.37E+00	2.35E+00	2.27E+00	2.11E+00	2.01E+00	1.43E+00	1.84E+00	1.83E+00
5	2.03E+00	2.01E+00	1.94E+00	1.80E+00	1.81E+00	1.38E+00	1.65E+00	1.65E+00
6	2.20E+00	2.18E+00	2.11E+00	2.02E+00	1.96E+00	1.41E+00	1.73E+00	1.73E+00
7	2.33E+00	2.31E+00	2.22E+00	2.09E+00	2.00E+00	1.43E+00	1.75E+00	1.75E+00
8	2.04E+00	2.02E+00	1.95E+00	1.81E+00	1.74E+00	1.25E+00	1.54E+00	1.54E+00
9	1.94E+00	1.92E+00	1.85E+00	1.72E+00	1.64E+00	1.15E+00	1.43E+00	1.43E+00
10	1.87E+00	1.85E+00	1.78E+00	1.74E+00	1.68E+00	1.21E+00	1.46E+00	1.46E+00
11	2.00E+00	1.98E+00	1.91E+00	1.77E+00	1.68E+00	1.20E+00	1.46E+00	1.46E+00
12	1.91E+00	1.89E+00	1.82E+00	1.69E+00	1.60E+00	1.26E+00	1.39E+00	1.39E+00
13	2.60E+00	2.58E+00	2.48E+00	2.29E+00	2.19E+00	1.54E+00	1.89E+00	1.88E+00
14	2.29E+00	2.27E+00	2.19E+00	2.05E+00	1.96E+00	1.55E+00	1.84E+00	1.84E+00
15	2.18E+00	2.16E+00	2.08E+00	1.99E+00	1.91E+00	1.36E+00	1.70E+00	1.70E+00
16	1.99E+00	1.97E+00	1.90E+00	1.85E+00	1.78E+00	1.27E+00	1.57E+00	1.57E+00
17	1.95E+00	1.93E+00	1.86E+00	1.72E+00	1.66E+00	1.27E+00	1.48E+00	1.48E+00
18	5.09E+00	5.03E+00	4.83E+00	4.44E+00	4.20E+00	2.87E+00	3.44E+00	3.43E+00
19	2.98E+00	2.96E+00	2.89E+00	2.71E+00	2.60E+00	1.84E+00	2.47E+00	2.47E+00
20	2.27E+00	2.25E+00	2.20E+00	2.05E+00	1.95E+00	1.38E+00	1.76E+00	1.76E+00
21	2.00E+00	1.98E+00	1.91E+00	1.86E+00	1.78E+00	1.26E+00	1.56E+00	1.56E+00
22	1.94E+00	1.92E+00	1.85E+00	1.71E+00	1.63E+00	1.16E+00	1.42E+00	1.42E+00
23	2.91E+00	2.88E+00	2.76E+00	2.55E+00	2.43E+00	1.73E+00	2.06E+00	2.06E+00
24	2.22E+00	2.20E+00	2.13E+00	1.98E+00	1.88E+00	1.33E+00	1.69E+00	1.69E+00
25	1.97E+00	1.95E+00	1.88E+00	1.74E+00	1.66E+00	1.18E+00	1.45E+00	1.45E+00
26	1.94E+00	1.92E+00	1.85E+00	1.71E+00	1.63E+00	1.14E+00	1.42E+00	1.42E+00
27	2.41E+00	2.39E+00	2.29E+00	2.11E+00	2.01E+00	1.40E+00	1.69E+00	1.69E+00
28	2.06E+00	2.04E+00	1.96E+00	1.82E+00	1.74E+00	1.23E+00	1.54E+00	1.53E+00
29	2.05E+00	2.03E+00	1.96E+00	1.87E+00	1.82E+00	1.31E+00	1.59E+00	1.59E+00
30	1.97E+00	1.95E+00	1.88E+00	1.75E+00	1.66E+00	1.17E+00	1.46E+00	1.45E+00

****
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Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 2888.72777828107
zero hydrolysis 0

photolysis halflife (days) = 235.256836094185
volatile halflife (days) = 169914019.380742
total water col halflife (days) = 217.540151846075

zero burial 0
benthic metab halflife (days) = 3532.60667884456
zero benthic hydrolysis 0
total benthic halflife (days) = 3532.60667884456
****
Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.2498 0.2478
Due to Erosion = 0.0004 0.4072E-03
Due to Drift = 0.7498 0.7440
******* Inputs *******
137.0 = oc partitioning coefficient
2979. = water column half Life
20.00 = reference temp for water column degradation
3643. = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value
2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

California Citrus (Prickly Pear), ground, no drift
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 11: 8

Peak 1-in-10 = 1.24 ppb
Chronic 1-in-10 = 0.779 ppb

Simulation Avg = 0.349 ppb
4-day avg 1-in-10 = 1.23 ppb
21-day avg 1-in-10 = 1.22 ppb
60-day avg 1-in-10 = 1.27 ppb
90-day avg 1-in-10 = 1.28 ppb

Benthic Pore Water Peak 1-in-10 = 1.04 ppb
Benthic Pore Water 21-day avg 1-in-10 = 1.04 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	2.32E-02	2.32E-02	2.32E-02	2.32E-02	2.32E-02	1.26E-02	1.43E-02	1.43E-02
2	7.47E-01	7.39E-01	7.06E-01	6.61E-01	6.24E-01	3.96E-01	4.79E-01	4.78E-01
3	1.55E+00	1.53E+00	1.46E+00	1.36E+00	1.31E+00	8.75E-01	1.06E+00	1.06E+00
4	5.90E-01	5.91E-01	6.04E-01	6.35E-01	6.61E-01	3.86E-01	6.84E-01	7.00E-01
5	5.46E-01	5.41E-01	5.19E-01	4.91E-01	4.67E-01	3.26E-01	4.00E-01	4.00E-01
6	6.06E-01	6.00E-01	5.77E-01	5.34E-01	5.07E-01	3.55E-01	4.37E-01	4.37E-01
7	6.26E-01	6.19E-01	5.95E-01	5.50E-01	5.24E-01	3.68E-01	4.50E-01	4.50E-01
8	2.70E-01	2.68E-01	2.60E-01	2.55E-01	2.53E-01	1.93E-01	2.62E-01	2.68E-01
9	1.40E-01	1.39E-01	1.35E-01	1.34E-01	1.39E-01	9.59E-02	1.44E-01	1.47E-01
10	2.65E-01	2.62E-01	2.50E-01	2.29E-01	2.17E-01	1.55E-01	1.76E-01	1.75E-01
11	1.95E-01	1.96E-01	2.03E-01	2.02E-01	1.92E-01	1.46E-01	1.71E-01	1.70E-01
12	4.31E-01	4.26E-01	4.07E-01	3.71E-01	3.49E-01	2.03E-01	2.75E-01	2.75E-01
13	8.72E-01	8.62E-01	8.26E-01	7.58E-01	7.18E-01	4.88E-01	5.90E-01	5.89E-01
14	8.63E-01	8.54E-01	8.19E-01	7.53E-01	7.13E-01	4.92E-01	5.94E-01	5.94E-01
15	4.58E-01	4.54E-01	4.42E-01	4.15E-01	4.20E-01	3.00E-01	4.21E-01	4.29E-01
16	3.53E-01	3.49E-01	3.37E-01	3.14E-01	2.99E-01	2.14E-01	2.68E-01	2.68E-01
17	3.24E-01	3.22E-01	3.10E-01	2.87E-01	2.73E-01	2.20E-01	2.53E-01	2.52E-01
18	3.52E+00	3.48E+00	3.32E+00	3.03E+00	2.85E+00	1.82E+00	2.20E+00	2.20E+00
19	1.20E+00	1.20E+00	1.22E+00	1.29E+00	1.34E+00	7.91E-01	1.39E+00	1.42E+00
20	4.94E-01	4.91E-01	4.81E-01	5.05E-01	5.26E-01	3.25E-01	5.45E-01	5.58E-01
21	3.34E-01	3.31E-01	3.20E-01	2.99E-01	2.89E-01	2.10E-01	2.65E-01	2.65E-01
22	1.46E-01	1.45E-01	1.41E-01	1.42E-01	1.48E-01	1.04E-01	1.52E-01	1.56E-01
23	1.25E+00	1.23E+00	1.18E+00	1.07E+00	1.01E+00	6.67E-01	7.88E-01	7.87E-01
24	4.15E-01	4.16E-01	4.25E-01	4.47E-01	4.66E-01	2.69E-01	4.82E-01	4.94E-01
25	1.60E-01	1.60E-01	1.64E-01	1.72E-01	1.79E-01	1.18E-01	1.86E-01	1.90E-01
26	1.26E-01	1.26E-01	1.30E-01	1.36E-01	1.29E-01	8.21E-02	1.18E-01	1.17E-01
27	6.07E-01	6.00E-01	5.72E-01	5.21E-01	4.91E-01	3.41E-01	3.84E-01	3.83E-01
28	2.40E-01	2.40E-01	2.46E-01	2.61E-01	2.51E-01	1.75E-01	2.56E-01	2.58E-01
29	4.43E-01	4.38E-01	4.19E-01	3.85E-01	3.64E-01	2.46E-01	2.97E-01	2.97E-01
30	1.58E-01	1.59E-01	1.62E-01	1.70E-01	1.77E-01	1.05E-01	1.83E-01	1.88E-01

****

Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 2888.72777828107
zero hydrolysis 0
photolysis halflife (days) = 235.256836094185
volatile halflife (days) = 169914019.380742
total water col halflife (days) = 217.540151846075

zero burial 0
benthic metab halflife (days) = 3532.60667884456
zero benthic hydrolysis 0

total benthic halflife (days) = 3532.60667884456
****
Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.9984 0.2478
Due to Erosion = 0.0016 0.4072E-03
Due to Drift = 0.0000 0.000
******* Inputs *******
137.0 = oc partitioning coefficient
2979. = water column half Life
20.00 = reference temp for water column degradation
3643. = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value
2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

TX alfalfa, parent, aerial, drift
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 11:11

Peak 1-in-10 = 25.2 ppb
Chronic 1-in-10 = 13.1 ppb
Simulation Avg = 8.79 ppb
4-day avg 1-in-10 = 24.9 ppb
21-day avg 1-in-10 = 24.0 ppb
60-day avg 1-in-10 = 22.1 ppb
90-day avg 1-in-10 = 20.9 ppb

Benthic Pore Water Peak 1-in-10 = 17.2 ppb

Benthic Pore Water 21-day avg 1-in-10 = 17.2 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	4.00E+00	3.97E+00	3.82E+00	3.53E+00	3.33E+00	1.74E+00	2.67E+00	2.67E+00
2	1.11E+01	1.09E+01	1.07E+01	9.86E+00	9.29E+00	5.25E+00	7.38E+00	7.37E+00
3	6.26E+00	6.21E+00	6.07E+00	5.95E+00	5.98E+00	4.70E+00	6.06E+00	6.20E+00
4	1.67E+01	1.65E+01	1.57E+01	1.43E+01	1.34E+01	7.59E+00	1.07E+01	1.07E+01
5	2.62E+01	2.59E+01	2.49E+01	2.30E+01	2.16E+01	1.34E+01	1.75E+01	1.75E+01
6	1.17E+01	1.17E+01	1.20E+01	1.27E+01	1.33E+01	9.42E+00	1.36E+01	1.39E+01
7	1.25E+01	1.24E+01	1.21E+01	1.14E+01	1.08E+01	7.87E+00	9.37E+00	9.36E+00
8	1.83E+01	1.81E+01	1.77E+01	1.65E+01	1.57E+01	1.00E+01	1.29E+01	1.29E+01
9	1.06E+01	1.05E+01	1.02E+01	9.69E+00	9.76E+00	8.19E+00	9.99E+00	1.02E+01
10	1.95E+01	1.92E+01	1.85E+01	1.70E+01	1.62E+01	1.04E+01	1.34E+01	1.34E+01
11	1.04E+01	1.03E+01	1.00E+01	9.81E+00	1.03E+01	8.15E+00	1.05E+01	1.07E+01
12	1.12E+01	1.11E+01	1.07E+01	1.01E+01	9.62E+00	7.23E+00	8.72E+00	8.71E+00
13	1.15E+01	1.14E+01	1.11E+01	1.06E+01	1.01E+01	7.10E+00	8.76E+00	8.75E+00
14	1.57E+01	1.56E+01	1.51E+01	1.41E+01	1.33E+01	9.32E+00	1.15E+01	1.15E+01
15	2.57E+01	2.54E+01	2.44E+01	2.25E+01	2.12E+01	1.32E+01	1.72E+01	1.72E+01
16	1.52E+01	1.50E+01	1.45E+01	1.40E+01	1.34E+01	1.07E+01	1.36E+01	1.39E+01
17	8.29E+00	8.23E+00	8.17E+00	8.62E+00	9.00E+00	6.59E+00	9.26E+00	9.48E+00
18	1.32E+01	1.30E+01	1.25E+01	1.18E+01	1.12E+01	7.31E+00	9.34E+00	9.33E+00
19	3.11E+01	3.08E+01	2.93E+01	2.68E+01	2.55E+01	1.49E+01	2.03E+01	2.03E+01
20	1.50E+01	1.48E+01	1.46E+01	1.54E+01	1.62E+01	1.12E+01	1.64E+01	1.68E+01
21	2.10E+01	2.08E+01	2.04E+01	1.88E+01	1.78E+01	1.14E+01	1.47E+01	1.47E+01
22	1.89E+01	1.87E+01	1.82E+01	1.76E+01	1.69E+01	1.17E+01	1.44E+01	1.44E+01
23	1.54E+01	1.53E+01	1.50E+01	1.42E+01	1.35E+01	9.91E+00	1.19E+01	1.19E+01
24	8.23E+00	8.16E+00	7.98E+00	8.28E+00	8.66E+00	6.28E+00	8.89E+00	9.10E+00
25	1.02E+01	1.01E+01	9.73E+00	9.19E+00	8.78E+00	5.93E+00	7.51E+00	7.50E+00
26	1.39E+01	1.38E+01	1.33E+01	1.23E+01	1.17E+01	7.63E+00	9.69E+00	9.68E+00
27	1.99E+01	1.96E+01	1.92E+01	1.76E+01	1.66E+01	1.03E+01	1.35E+01	1.35E+01
28	1.39E+01	1.38E+01	1.33E+01	1.26E+01	1.20E+01	9.11E+00	1.08E+01	1.10E+01
29	1.63E+01	1.61E+01	1.54E+01	1.48E+01	1.40E+01	9.38E+00	1.18E+01	1.18E+01
30	1.12E+01	1.11E+01	1.07E+01	1.02E+01	9.93E+00	7.76E+00	9.11E+00	9.33E+00

****
****

Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 2716.96690609239
zero hydrolysis 0
photolysis halflife (days) = 220.999441902424
volatile halflife (days) = 138298143.709545
total water col halflife (days) = 204.375139623146

zero burial 0
benthic metab halflife (days) = 3322.56140949802
zero benthic hydrolysis 0
total benthic halflife (days) = 3322.56140949802
****

Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.7797 5.312
Due to Erosion = 0.0001 0.4190E-03
Due to Drift = 0.2202 1.500

******* Inputs *******
137.0 = oc partitioning coefficient
2979. = water column half Life
20.00 = reference temp for water column degradation
3643. = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value
2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

MS soybean, Parent only
Variable Volume Water Model, Version 0.0

****
Performed on: 4/17/2014 at 11:16

Peak 1-in-10 = 6.97 ppb
Chronic 1-in-10 = 3.54 ppb
Simulation Avg = 1.84 ppb
4-day avg 1-in-10 = 6.91 ppb
21-day avg 1-in-10 = 6.61 ppb
60-day avg 1-in-10 = 6.05 ppb
90-day avg 1-in-10 = 5.71 ppb

Benthic Pore Water Peak 1-in-10 = 4.70 ppb
Benthic Pore Water 21-day avg 1-in-10 = 4.70 ppb
Benthic Conversion Factor = 5.85 -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.633E-01

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	4.71E-01	4.66E-01	4.46E-01	4.15E-01	4.02E-01	2.30E-01	3.18E-01	3.18E-01
2	5.86E+00	5.80E+00	5.54E+00	5.03E+00	4.73E+00	2.71E+00	3.64E+00	3.64E+00

3	2.29E+00	2.30E+00	2.35E+00	2.48E+00	2.58E+00	1.70E+00	2.66E+00	2.72E+00
4	5.27E+00	5.20E+00	5.08E+00	4.67E+00	4.40E+00	2.71E+00	3.49E+00	3.49E+00
5	2.13E+00	2.14E+00	2.19E+00	2.31E+00	2.41E+00	1.47E+00	2.48E+00	2.54E+00
6	1.39E+00	1.38E+00	1.34E+00	1.24E+00	1.18E+00	8.82E-01	1.06E+00	1.07E+00
7	2.03E+00	2.01E+00	1.93E+00	1.78E+00	1.69E+00	1.11E+00	1.42E+00	1.42E+00
8	3.85E+00	3.82E+00	3.65E+00	3.36E+00	3.18E+00	2.00E+00	2.56E+00	2.55E+00
9	2.69E+00	2.67E+00	2.57E+00	2.38E+00	2.26E+00	1.65E+00	2.01E+00	2.01E+00
10	1.36E+00	1.35E+00	1.32E+00	1.27E+00	1.32E+00	9.74E-01	1.37E+00	1.40E+00
11	3.16E+00	3.12E+00	3.05E+00	2.80E+00	2.63E+00	1.59E+00	2.09E+00	2.08E+00
12	1.34E+00	1.34E+00	1.37E+00	1.45E+00	1.51E+00	9.02E-01	1.55E+00	1.59E+00
13	2.85E+00	2.82E+00	2.70E+00	2.47E+00	2.32E+00	1.44E+00	1.87E+00	1.86E+00
14	7.33E+00	7.24E+00	6.98E+00	6.40E+00	6.02E+00	3.60E+00	4.72E+00	4.71E+00
15	3.08E+00	3.06E+00	3.05E+00	3.22E+00	3.35E+00	2.27E+00	3.45E+00	3.54E+00
16	1.44E+00	1.44E+00	1.48E+00	1.55E+00	1.62E+00	1.10E+00	1.68E+00	1.72E+00
17	3.95E+00	3.90E+00	3.77E+00	3.49E+00	3.29E+00	2.01E+00	2.60E+00	2.60E+00
18	2.07E+00	2.05E+00	1.99E+00	1.89E+00	1.81E+00	1.41E+00	1.85E+00	1.89E+00
19	3.62E+00	3.58E+00	3.44E+00	3.20E+00	3.04E+00	1.95E+00	2.47E+00	2.47E+00
20	7.10E+00	7.03E+00	6.73E+00	6.16E+00	5.80E+00	3.56E+00	4.60E+00	4.60E+00
21	2.84E+00	2.85E+00	2.92E+00	3.07E+00	3.21E+00	1.95E+00	3.31E+00	3.38E+00
22	2.68E+00	2.65E+00	2.55E+00	2.35E+00	2.22E+00	1.52E+00	1.88E+00	1.88E+00
23	1.09E+01	1.08E+01	1.05E+01	9.57E+00	8.99E+00	5.29E+00	6.97E+00	6.96E+00
24	4.66E+00	4.63E+00	4.56E+00	4.68E+00	4.89E+00	3.40E+00	5.03E+00	5.15E+00
25	2.19E+00	2.18E+00	2.21E+00	2.33E+00	2.43E+00	1.64E+00	2.52E+00	2.59E+00
26	1.03E+00	1.03E+00	1.06E+00	1.11E+00	1.16E+00	7.40E-01	1.21E+00	1.24E+00
27	5.40E-01	5.36E-01	5.24E-01	4.98E-01	5.20E-01	3.94E-01	5.39E-01	5.52E-01
28	5.02E+00	4.96E+00	4.73E+00	4.46E+00	4.21E+00	2.43E+00	3.23E+00	3.23E+00
29	2.31E+00	2.29E+00	2.23E+00	2.18E+00	2.27E+00	1.69E+00	2.34E+00	2.40E+00
30	1.35E+00	1.33E+00	1.31E+00	1.25E+00	1.26E+00	9.67E-01	1.31E+00	1.34E+00

****

Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 3098.53925897206
zero hydrolysis 0
photolysis halflife (days) = 226.307838768034
volatile halflife (days) = 170342135.750770
total water col halflife (days) = 210.903790226708

zero burial 0
benthic metab halflife (days) = 3789.18379336529
zero benthic hydrolysis 0
total benthic halflife (days) = 3789.18379336529
****
Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 1.0000 1.367
Due to Erosion = 0.0000 0.000
Due to Drift = 0.0000 0.000
******* Inputs *******
137.0 = oc partitioning coefficient
2979. = water column half Life
20.00 = reference temp for water column degradation
3643. = benthic Half Life
20.00 = Reference temp for benthic degradation
2.000 = Q ten value

2.500 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
288.3 = molecular wt
0.1300E-07 = vapor pressure
3200. = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column

Appendix F. Estimation of Exposure of Terrestrial Plants to Flupyradifurone and Unextracted Residues in Groundwater Used as Irrigation Water

To estimate exposure to plants when groundwater contaminated by flupyradifurone is applied to crops, the following method was used.

Assume a field is irrigated with one inch of water containing 96.0 μg flupyradifurone plus unextracted residues/L water.

One acre has 6,272,640 cubic inches of water on the field. The one acre field with one inch of water has 3,630 cubic ft of water (6,272,640 x 0.00058 cubic ft/cubic inch). The field has 27,156 gallons of water (3,630 cubic ft x 7.481 gallons/cubic ft). Therefore, one inch of water on the one acre field weighs 226,625 lbs (27,156 gallons x 8.3453 lbs/gallon of water).

$$\frac{226{,}625 \text{ lb of water/acre} \times 112\ \mu\text{g/L}}{1{,}000{,}000{,}000} = 0.0218 \text{ lbs ai/A}$$

Appendix G. Example STIR (v. 1.0) input and output data

Welcome to the EFED
Screening Tool for Inhalation Risk

This tool is designed to provide the risk assessor with a rapid method for determining the potential significance of the inhalation exposure route to birds and mammals in a risk assessment.

NOTE: When entering values, press the "Enter" key in order to update linked cells.

Input

Application and Chemical Information	
Enter Chemical Name	Flupyradifurone
Enter Chemical Use	
Is the Application a Spray? (enter y or n)	y
If Spray What Type (enter ground or air)	air
Enter Chemical Molecular Weight (g/mole)	288.68
Enter Chemical Vapor Pressure (mmHg)	1.30E-08
Enter Application Rate (lb a.i./acre)	0.18
Toxicity Properties	
Bird	
Enter Lowest Bird Oral LD_{50} (mg/kg bw)	232
Enter Mineau Scaling Factor	1.15
Enter Tested Bird Weight (kg)	0.178
Mammal	
Enter Lowest Rat Oral LD_{50} (mg/kg bw)	2000
Enter Lowest Rat Inhalation LC_{50} (mg/L)	4671
Duration of Rat Inhalation Study (hrs)	4
Enter Rat Weight (kg)	0.35

Output

Results Avian (0.020 kg)		
Maximum Vapor Concentration in Air at Saturation (mg/m^3)	2.02E-04	
Maximum 1-hour Vapor Inhalation Dose (mg/kg)	2.54E-05	
Adjusted Inhalation LD_{50}	3.02E+03	
Ratio of Vapor Dose to Adjusted Inhalation LD_{50}	8.40E-09	Exposure not Likely Significant
Maximum Post-treatment Spray Inhalation Dose (mg/kg)	1.73E-02	
Ratio of Droplet Inhalation Dose to Adjusted Inhalation LD_{50}	5.72E-06	Exposure not Likely Significant

Results Mammalian (0.015 kg)		
Maximum Vapor Concentration in Air at Saturation (mg/m^3)	2.02E-04	
Maximum 1-hour Vapor Inhalation Dose (mg/kg)	3.19E-05	
Adjusted Inhalation LD_{50}	2.78E+05	
Ratio of Vapor Dose to Adjusted Inhalation LD_{50}	1.15E-10	Exposure not Likely Significant
Maximum Post-treatment Spray Inhalation Dose (mg/kg)	2.17E-02	
Ratio of Droplet Inhalation Dose to Adjusted Inhalation LD_{50}	7.82E-08	Exposure not Likely Significant

Appendix H. Example T-REX (v. 1.5.2) input and output data.

Upper Bound Kenaga Residues For RQ Calculation

Chemical Name:	Flupyradifurone
Use	0
Formulation	0
Application Rate	0.18 lbs a.i./acre
Half-life	35 days
Application Interval	7 days
Maximum # Apps./Year	2
Length of Simulation	1 year
Variable application rates?	no

Acute and Chronic RQs are based on the Upper Bound Kenaga Residues.

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

RQs reported as "0.00" in the RQ tables below should be noted as <0.01 in your assessment. This is due to rounding and significant figure issues in Excel.

Endpoints			
Avian	Bobwhite quail	LD50 (mg/kg-bw)	232.00
	Mallard duck)	LC50 (mg/kg-diet)	4741.00
	Bobwhite quail	NOAEL(mg/kg-bw)	40.00
	Bobwhite quail	NOAEC (mg/kg-diet)	302.00
Mammals		LD50 (mg/kg-bw)	2000.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	7.70
		NOAEC (mg/kg-diet)	100.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	80.81
Tall Grass	37.04
Broadleaf plants	45.45
Fruits/pods/seeds	5.05
Arthropods	31.65

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	167.14
100	212.78
1000	300.56

Dose-based EECs	Avian Classes and Body Weights (grams)		
(mg/kg-bw)	small 20	mid 100	large 1000
Short Grass	92.03	52.48	23.50
Tall Grass	42.18	24.05	10.77
Broadleaf plants	51.77	29.52	13.22
Fruits/pods	5.75	3.28	1.47
Arthropods	36.05	20.55	9.20
Seeds	1.28	0.73	0.33

Dose-based RQs	Avian Acute RQs Size Class (grams)		
(Dose-based EEC/adjusted LD50)	20	100	1000
Short Grass	0.55	0.25	0.08
Tall Grass	0.25	0.11	0.04
Broadleaf plants	0.31	0.14	0.04
Fruits/pods	0.03	0.02	0.00
Arthropods	0.22	0.10	0.03
Seeds	0.01	0.00	0.00

Dietary-based RQs (Dietary based EEC/LC50 or	RQs	
	Acute	Chronic
Short Grass	0.02	0.27
Tall Grass	0.01	0.12
Broadleaf plants	0.01	0.15
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

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	4395.66	16.92
Herbivores/	35	3556.56	13.69
insectivores	1000	1538.32	5.92
	15	4395.66	16.92
Granivores	35	3556.56	13.69
	1000	1538.32	5.92

Dose-Based EECs	Mammalian Classes and Body weight (grams)		
(mg/kg-bw)	15	35	1000
Short Grass	77.04	53.25	12.35
Tall Grass	35.31	24.41	5.66
Broadleaf plants	43.34	29.95	6.94
Fruits/pods	4.82	3.33	0.77
Arthropods	30.18	20.86	4.84
Seeds	1.07	0.74	0.17

Dose-based RQs	Small mammal 15 grams		Medium mammal 35 grams		Large mammal 1000 grams	
(Dose-based EEC/LD50 or NOAEL)	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.02	4.55	0.01	3.89	0.01	2.08
Tall Grass	0.01	2.09	0.01	1.78	0.00	0.96
Broadleaf plants	0.01	2.56	0.01	2.19	0.00	1.17
Fruits/pods	0.00	0.28	0.00	0.24	0.00	0.13
Arthropods	0.01	1.78	0.01	1.52	0.00	0.82
Seeds	0.00	0.06	0.00	0.05	0.00	0.03

Dietary-based RQs	Mammal RQs	
(Dietary-based EEC/LC50 or NOAEC)	Acute	Chronic
Short Grass	#DIV/0!	0.81
Tall Grass	#DIV/0!	0.37
Broadleaf plants	#DIV/0!	0.45
Fruits/pods/seeds	#DIV/0!	0.05
Arthropods	#DIV/0!	0.32

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

Appendix I. Toxicity Comparisons of Flupyradifurone and Transformation Products.

Table I1 contains a list of toxicity endpoints for aquatic and terrestrial organisms for which parent and transformation product data exist. Based on the available ecotoxicity data, none of the transformation products of flupyradifurone tested appear to be more toxic than the parent to freshwater fish (rainbow trout, *Onchorhynchus mykiss*), freshwater aquatic invertebrates (*Daphnia magna;* non-biting midges, *Chironomus spp.*), terrestrial invertebrates (honeybees, *Apis mellifera*; earthworms, *Eisenia fetida*) and freshwater aquatic algae (green algae; *Pseudokirchneriella subcapitata*). However, in some cases, toxicity studies with transformation products were not carried out at high enough concentrations to definitively conclude that they are not of equal or greater toxicity to the organisms tested as compared to the parent compound.

Table I1. Toxicity Comparison of Flupyradifurone and Transformation Products.

Test Material	MW (g/mol)	Test Species	Endpoint	Toxicity Value (95% Confidence Interval)	Degradate Toxicity Expressed in Parent Compound Equivalents[b]
Freshwater Fish					
BYI 02960 (technical)	288.68	Rainbow trout (*Onchorhynchus mykiss*)	96-hr LC_{50}	>80 mg ai/L	N/A
BYI 02960-succinamide	306.69			>100[c] mg ai/L	>94 mg/L
Sodium Difluoroacetate	96.03			>10[c] mg ai/L	>30 mg/L[a]
Freshwater Invertebrates					
BYI 02960 (technical)	288.68	*Daphnia. magna*	48-hr EC_{50}	>77.6[c] mg ai/L	N/A
Sodium Difluoroacetate	96.03			>10[c] mg ai/L	>30 mg/L[a]
6-chloronicotinic acid	157.56			>95.1 mg ai/L	>174 mg/L
BYI 02960 (technical)	288.68		21-day NOAEC	3.2[d] mg ai/L (parental body length)	N/A
BYI 02960-succinamide	306.69			43.3 mg ai/L (time to first brood)	41 mg/L
BYI 02960 (technical)	288.68	Non-biting midge *Chironomus riparius*	48-hr EC_{50}	0.0617 mg ai/L (0.0414-0.109)	N/A
BYI 02960-succinamide	306.69			>100 mg ai/L	>94 mg/L
BYI 02960-azabicyclo-succinamide	288.25			>100 mg ai/L	>100 mg/L
6-chloronicotinic acid	157.56	Non-biting midge *Chironomus tentans*		>1[c] mg ai/L	>1.8 mg/L

Test Material	MW (g/mol)	Test Species	Endpoint	Toxicity Value (95% Confidence Interval)	Degradate Toxicity Expressed in Parent Compound Equivalents[b]
BYI 02960 (technical)	288.68	Non-biting midge *Chironomus riparius*	28-day NOAEC	0.010[e] mg ai/L (emergence rate, development rate)	N/A
Sodium Difluoroacetate	96.03	Non-biting midge *Chironomus riparius*	28-day NOAEC	100[f] mg ai/L (emergence rate, development rate)	301 mg/L
6-chloronicotinic acid	157.56	Non-biting midge *Chironomus riparius*	28-day NOAEC	100[f] mg ai/L (emergence rate, development rate)	183 mg/L
Aquatic Plants					
BYI 02960 (technical)	288.68	Green alga *Pseudokirchneriella subcapitata*	96-hr NOAEC/ EC_{50}	80/>80 mg ai/L	N/A
Sodium Difluoroacetate	96.03	Green alga *Pseudokirchneriella subcapitata*	72-hr NOAEC/ EC_{50}	10/>10[c] mg ai/L	30/>30 mg/L[a]
BYI 02960-succinamide	306.69	Green alga *Pseudokirchneriella subcapitata*	72-hr NOAEC/ EC_{50}	10/>10[c] mg ai/L	9.4/>9.4 mg/L[a]
6-chloronicotinic acid	157.56	Green alga *Pseudokirchneriella subcapitata*	72-hr NOAEC/ EC_{50}	100/>100 mg ai/L	183/>183 mg/L
Terrestrial Invertebrates					
BYI 02960 (technical)	288.68	Honeybee *Apis mellifera*	96-hr Contact LD_{50}	122.8 µg ai/bee	N/A
BYI 02960-difluoro-amino-furanone	163.12	Honeybee *Apis mellifera*	48-hr Contact LD_{50}	>100 µg ai/bee	177 µg/bee
BYI 02960-hyroxy	304.68	Honeybee *Apis mellifera*	48-hr Contact LD_{50}	>100 µg ai/bee	95 µg/bee[a]
Difluoroacetic acid	96.03	Honeybee *Apis mellifera*	48-hr Contact LD_{50}	>100 µg ai/bee	301 µg/bee
6-chloronicotinic acid	157.56	Honeybee *Apis mellifera*	48-hr Contact LD_{50}	>100 µg ai/bee	183 µg/bee
6-chloro-picolylalcohol	143.57	Honeybee *Apis mellifera*	48-hr Contact LD_{50}	>100 µg ai/bee	201 µg/bee
BYI 02960 (technical)	288.68	Honeybee *Apis mellifera*	48-hr Oral LD_{50}	1.2 µg ai/bee	N/A
BYI 02960-difluoro-amino-furanone	163.12	Honeybee *Apis mellifera*	48-hr Oral LD_{50}	>81.5 µg ai/bee	144 µg/bee
BYI 02960-hyroxy	304.68	Honeybee *Apis mellifera*	48-hr Oral LD_{50}	>105.3 µg ai/bee	100 µg/bee
Difluoroacetic acid	96.03	Honeybee *Apis mellifera*	48-hr Oral LD_{50}	>107.9 µg ai/bee	324 µg/bee
6-chloronicotinic acid	157.56	Honeybee *Apis mellifera*	48-hr Oral LD_{50}	>107.1 µg ai/bee	196 µg/bee
6-chloro-picolylalcohol	143.57	Honeybee *Apis mellifera*	48-hr Oral LD_{50}	>106.7 µg ai/bee	215 µg/bee
BYI 02960 (technical)	288.68	Honeybee *Apis mellifera*	10-day NOAEC	10 mg ai/L	N/A

Test Material	MW (g/mol)	Test Species	Endpoint	Toxicity Value (95% Confidence Interval)	Degradate Toxicity Expressed in Parent Compound Equivalents[b]
BYI 02960-difluoro-amino-furanone	163.12			10 mg ai/L	18 mg/L
BYI 02960-hyroxy	304.68			10 mg ai/L	9.5 mg/L[a]
Difluoroacetic acid	96.03			10 mg ai/L	30 mg/L
6-chloronicotinic acid	157.56			10 mg ai/L	18 mg/L
6-chloro-picolylalcohol	143.57			10 mg ai/L	20 mg/L
BYI 02960 (technical)	288.68	Earthworm *Eisenia fetida*	14-day LC_{50}	192.9 mg ai/kg dry soil	N/A
Difluoroacetic acid	96.03			>1,000 mg ai/kg dry soil	3000 mg/kg dry soil
6-chloronicotinic acid	157.56			>1,000 mg ai/kg dry soil	1830 mg/kg dry soil
BYI 02960 (SL 200 G)[g]	288.68		28-day NOAEC	1.5 mg ai/kg dry soil	N/A
Difluoroacetic acid	96.03			62 mg ai/kg dry soil	186 mg/kg dry soil
6-chloronicotinic acid	157.56			95 mg ai/kg dry soil	174 mg/kg dry soil

N/A = Not Applicable

[a] Due to limits determined by the highest concentration tested, it is not possible to determine if the transformation product is less, equal, or more toxic than the parent compound.

[b] Degradate toxicity in parent compound equivalents (mg/L) = (MW parent/MW degradate) x (toxicity endpoint of degradate (mg/L)).

[c] Based on single concentration limit test

[d] Endpoint based on comparison to solvent control; endpoints for this study will be recalculated before finalizing study review.

[e] Spiked water test; endpoint based on nominal concentrations and comparison to pooled controls.

[f] Spiked water test; endpoint based on nominal concentrations and comparison to pooled controls; only one concentration tested (100 mg ai/L)

[g] Transformation product endpoint comparisons do not account for any effects of inert ingredients in SL 200 G as compared to the technical grade active ingredient alone.

Appendix J. OECD and OPP Rating System for Data Evaluation Records and/or Monographs

The OECD rating system is outlined on page 22 of the Guidance Document on the Planning and Implementation of Joint Reviews of Pesticides; March 2011.

Table J1. Summary of OPP and OECD Rating Systems

OECD Rating	OPP Rating	OECD Definition
Fully Reliable	Acceptable	GLP compliant and fully compliant with the Test Guideline specified
Reliable with Restrictions	Supplemental	GLP compliant but not fully compliant with the Test Guideline specified, but nevertheless judged to provide a reliable basis for regulatory decision making.
Not Reliable	Invalid	Not GLP compliant and/or not compliant with the Test Guideline specified, and judged to not provide a reliable basis for regulatory decision-making.