Cyclobutrifluram Ecological Risk Assessment at U.S. EPA

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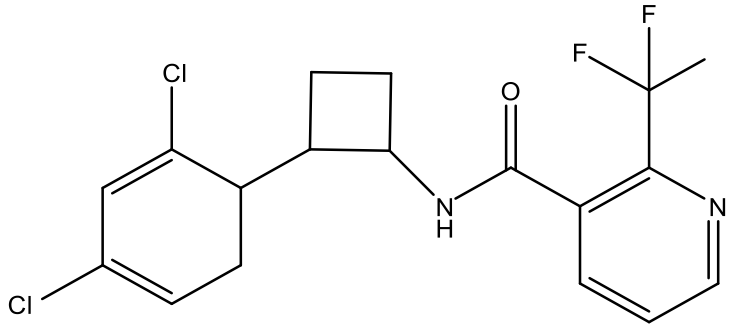
Cyclobutrifluram: Ecological Risk Assessment and Biological Evaluation including Effects Determinations for Federally Listed Endangered and Threatened Species and Designated Critical Habitats for the Section 3 Registration of a New Active Ingredient

Section 3 New Chemical Ecological Risk Assessment and Biological Evaluation for Cyclobutrifluram

June 26, 2025



Cyclobutrifluram; CAS No 1460292-16-3 USEPA PC Code: 126002

Cyclobutrifluram is a chiral compound containing 2 stereoisomers; S, S isomer >90% and R, R isomer <10%.

There is one technical product (TGAI) containing 85% active ingredient. Four end-use products are proposed for registration in the United States for the control of parasitic nematodes and of soil-borne and foliar fungal

diseases affecting agricultural crops (romaine lettuce, soybean, and cotton), turf, and ornamentals. Cyclobutrifluram is considered systemic and affects respiration through disruption of mitochondrial complex II by inhibition of succinate dehydrogenase.

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3 - Taxon-Level Risk Assessment

4 - Biological Evaluation with Effects Determinations for ESA[1]- Listed Species and Designated Critical Habitats

[1]Endangered Species Act

Ecotoxicity MRIDs

850.1010 Acute toxicity freshwater invertebrates (Daphnia sp.) – 2 studies

850.1025 Acute toxicity estuarine and marine organisms – 2 studies

850.1075 Freshwater and saltwater fish acute toxicity test – 5 studies

850.1300 Aquatic invertebrate life cycle (Daphnia sp.) – 1 study

850.1400 Freshwater and saltwater fish early-life stage – 2 studies

850.1735 Whole sediment: acute freshwater invertebrates (Hyalella azteca, Chironomus dilutus) – 2 studies

850.1740 Whole sediment: acute marine invertebrates (L. plumulosus) – 1 study

850.2100 Avian oral toxicity – 3 studies

850.2200 Avian dietary toxicity – 2 studies

850.2300 Avian reproduction – 2 studies

850.3020 and Non-guideline OECD 213 & 214 Honey bee adult acute contact and oral

Toxicity – 1 study

Ecotoxicity MRIDs

Non-guideline OECD 237 Honey bee larval acute oral toxicity – 1 study

Non-guideline OECD 239 Honey bee larval chronic oral toxicity – 1 study

Non-guideline OECD 245 Honey bee adult chronic oral toxicity – 1 study

Non-Guideline Earthworm toxicity – Sublethal Reproduction – 3 studies

Non-Guideline Earthworm Acute toxicity – 1 study

850.4100 Terrestrial plant toxicity (seedling emergence) – 1 study

850.4150 Terrestrial plant toxicity (vegetative vigor) – 1 study

850.4400 Aquatic plant toxicity (Lemna spp.) – 1 study

850.4500 Algal toxicity – 4 studies

850.4550 Cyanobacteria toxicity (Anabaena flos-aquae) – 1 study

Additional Non-Guideline Studies – 4 studies (parasitic wasp Aphidius Rhopalosiphi, Predatory Mites *Typhlodromus pyri* and *Hypoaspis aculeifer,* Benthic Invertebrates)

Environmental Fate MIRDs

835.1230 Leaching and Adsorption/Desorption – 4 studies

835.2120 Hydrolysis – 1 study

835.2240 Photodegradation in Water – 1 study

835.2410 Photodegradation on Soil – 1 study

835.4100 Aerobic Soil Metabolism – 4 studies

835.4200 Anaerobic Soil Metabolism – 1 study

835.4300 Aerobic Aquatic Metabolism - 1 study

835.4400 Anaerobic Aquatic Metabolism – 1 study

835.6100 Terrestrial Field Dissipation – 6 studies

850.1730 Fish Bioconcentration Study - 1 study

850.6100 Environmental Chemistry Methods and Associated Independent Laboratory Validation – 12 studies

860.1380 STOR (Storage Stability) – 1 study

Table 1-1. Summary of Risk Quotients for Taxonomic Groups from Proposed Uses of Cyclobutrifluram

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC		Additional Information/ Lines of Evidence
			Non-listed Species	Listed Species	
Freshwater Fish	Acute	<0.01	No	No	--
	Chronic	<0.01 - 0.01	No	No	--
Estuarine/ Marine Fish	Acute	NC	No	No	Non-definitive acute endpoint; exposure is below highest tested levels where there were no effects.
	Chronic	<0.01 - 0.03	No	No	--
Freshwater Invertebrates (Water-Column Exposure)	Acute	NC	No	No	Non-definitive acute endpoint; exposure is below highest tested levels where there were no effects.
	Chronic	<0.01 - 0.02	No	No	--
Estuarine/ Marine Invertebrates (Water-Column Exposure)	Acute	0.01 - 0.05	No	No	--
	Chronic	0.01 - 0.09	No	No	--
Freshwater Invertebrates (Sediment Exposure)	Subchronic	Acute:[2] NC Chronic: <0.01 - 0.03	No	No	--

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC		Additional Information/ Lines of Evidence
			Non-listed Species	Listed Species	
Estuarine/Marine Invertebrates (Sediment Exposure)	Subchronic	Acute:[2] 0.01 - 0.05 Chronic: <0.01	No	No	--
Birds	Acute	NC	No	No	Non-definitive acute endpoint; exposure is below highest tested levels where there were no effects.
	Dietary	NC	No	No	Non-definitive acute endpoint; exposure is below highest tested levels where there were no effects.
	Chronic	<0.01 - **2.4**	Yes	Yes	LOC exceedances based on cotton seed treatment. Non-definitive LOAEC. No effects observed up to the highest test concentrations. Risk for birds from consumption of treated seeds is expected to be low. Daily diets would need to consist of greater than 100% treated seeds to reach the number of seeds of concern.
Mammals	Acute	NC	No	No	Non-definitive acute endpoint.
	Chronic	<0.01 – **10**	Yes	Yes	LOC exceedances based on seed treatment applications. Non-definitive LOAEC. No effects observed up to the highest test concentrations. Daily diets would need to consist of 10-98% treated seeds to reach the number of seeds of concern.

Taxa	Exposure Duration		Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC		Additional Information/ Lines of Evidence
				Non-listed Species	Listed Species	
Terrestrial Invertebrates[3]	Acute Adult		NC	No	No	Non-definitive acute endpoints. Chronic LOC exceedances for adults and larvae based on turf use. Non-definitive LOAEL for adult chronic study. No effects observed up to the highest test dose. Risk to honey bees is expected to be low, due to restrictions on the label to avoid applying in the presence of blooming plants. Studies conducted with other terrestrial invertebrates suggest the potential for reproductive effects.
	Chronic Adult		0.01 – **1.2**	Yes	Yes	
	Acute Larval		NC	No	No	
	Chronic Larval		0.13 - **19**	Yes	Yes	
	Listed Species-Contact	Soil[4]	<0.01		No	--
		Spray Droplets[5]	NC		No	Non-definitive endpoint. No effects observed up to the highest test dose.
		Treated Surfaces[6]	0.37		No	Representative of chronic exposure.
	Listed Species - Dietary[7]	Acute	NC		No	Non-definitive acute endpoints; exposure is below highest tested levels where there were no effects.
		Chronic	<0.01 - **10**		Yes	Chronic LOC exceedances for larvae, based on turf and ornamental uses, for consumption of tall grass, broadleaf plants, and arthropods.
Aquatic Plants	NA		Non-Listed: <0.01 - 0.01 Listed: <0.01 - 0.12	No	No	--
Semi-Aquatic Plants	NA		Non-Listed: NC Listed: 0.01 - 0.16	No	No	Non-definitive endpoint for non-listed species; exposure is below highest tested levels where there were no effects.

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC		Additional Information/ Lines of Evidence
			Non-listed Species	Listed Species	
Terrestrial Plants	NA	Non-Listed: NC Listed: 0.01 - 0.43	No	No	Non-definitive endpoint for non-listed species; exposure is below highest tested levels where there were no effects.

Level of Concern (LOC) Definitions:
Terrestrial Vertebrates: Acute (non-listed)=0.5; Acute (listed)= 0.1; Chronic=1.0
Terrestrial Invertebrates: Acute (non-listed)=0.4; Acute (listed)= 0.05; Chronic=1.0
Aquatic Animals: Acute (non-listed)=0.5; Acute (listed)= 0.05 Chronic=1.0
Plants: 1.0
Bold values exceed the LOC for non-listed and listed species.
NC=Not Calculable; NA=Not Applicable
[1] RQs reflect exposure estimates for cyclobutrifluram and maximum application rates allowed on labels.
[2] Based on water-column toxicity data compared to pore-water concentration.
[3] RQs for non-listed terrestrial invertebrates are applicable to honey bees, which are also a surrogate for other species of bees. RQs for listed terrestrial invertebrates include considerations of honey bees and other terrestrial invertebrates (*e.g.*, earthworms, beneficial arthropods) when toxicity data are available.
[4] Based on earthworm (*Eisenia andrei*) sub-lethal reproduction study.
[5] Based on honey bee (*Apis mellifera*) contact exposure study.
[6] Based on parasitic wasp (*Aphidius rhopalosiphi*) mortality and reproduction study.
[7] Based on honey bee (*A. mellifera*) acute and chronic oral toxicity studies.

Table 2-1. Summary of the Maximum Labeled Use Patterns for Cyclobutrifluram

Use Site/ Location	Form.	App Type/ Target	App Equip[1]	App Time	Max Single Rate lb a.i./A	Max # App/yr*	Max Annual Rate lb a.i./A/yr*	MRI (d)	PHI (d)	Comments (e.g,. geographic/application timing restrictions, pollinator specific language)[2]
Cotton/ ag	FS	Seed[3]	G	At planting	0.085	1	0.085	NA	NA	▯ This product must be used only by commercial seed treatment facilities or with commercial seed treatment equipment on farm. The use of a hopper-box, planter-box, slurry-box or other seed treatment applications at or immediately before planting is not permitted. ▯ Do not feed or harvest soybean hay, forage, and silage. Do not use for feed, food, or oil purposes. ▯ Cyclobutrifluram treated seed may be planted on the same acres 1 time per year.
Soybean[4]/ ag	FS	Seed[3]	G	At planting	0.083	1	0.083	NA	NA	
Romaine Lettuce/ ag	SC	Soil	G, C	Prior/At Plating	0.089	1	0.089	NA	NA	▯ Not for residential use. ▯ Do not apply through any ultra-low volume (ULV) spray system. ▯ For chemigation, do not apply until after crop emergence in direct-seeded crops. ▯ Not for plants grown for transplanting purposes. ▯ Not for greenhouse use unless otherwise specified in the specific crop directions for use table.

Use Site/ Location	Form.	App Type/ Target	App Equip[1]	App Time	Max Single Rate lb a.i./A	Max # App/yr*	Max Annual Rate lb a.i./A/yr*	MRI (d)	PHI (d)	Comments (e.g,. geographic/application timing restrictions, pollinator specific language)[2]
Turf/ Sod-farm, Residential, Golf Course[5]	SC	Foliage	G	All[6]	0.22	2	0.45	14	NA	• 0.0051 lb a.i./1,000 sq ft for spot treatments on turf. A minimum of 1 gallon of spray solution/1000 sq ft is recommended for spot treatments on turf. • 0.22 lb a.i./10,000 sq ft per acre per year for spot treatments on Golf Course Greens, Tees, and Fairways. Treat no more than 10,000 sq ft per acre per year. • Do not use for commercial grass seed production. • Do not apply this product aerially. • Do not apply by chemigation to turf. • Do not apply to fruit and nut trees, vines, or berry plants that will bear harvestable fruit within 12 months. • DO NOT apply when lawn weeds are flowering. • DO NOT allow to drift to plants that are flowering.
Ornamentals (Nursery)/ outdoor or indoor	SC	Soil/ Container	G, C	All[6]	0.187	2	0.374	14	NA	

Abbreviations: Form.= formulation; App= application; equip=equipment; a.i.= active ingredient; MRI= minimum retreatment interval; d= day; PHI= preharvest interval; Ag= agricultural; FS= flowable soluble for seed treatment; G= ground; SC= soluble concentrate; C= chemigation.

* Information is provided on an annual basis, unless otherwise specified.

[1] The labels for ornamentals and romaine state that ground applications can be made by container drenches and broadcast, banded, and directed sprays using application equipment typically used for ground applications, such as, but not limited to, Hydraulic boom sprayers, Mechanically pressurized hand-guns, Hand-pressurized hand-wand sprayers, Backpack sprayers, Irrigation for soil applications. Specific application method instructions for romaine lettuce are: "Apply using one of the following application methods: in furrow, drench, shank, drip, or banded soil application prior to transplant."

[2] Based on statements in the proposed labels, the applicant is considering not registering proposed uses of cyclobutrifluram in California (all uses) and New York (cotton statewide; turf and ornamentals in specific counties); however, those statements are not currently a requirement on the proposed labels.

[3]Seed = seed treatment. Maximum Annual Application rate for uses on A22417 Seed Treatment label pertains to use of all cyclobutrifluram-containing products through any combination of seed and foliar applications, but only seed treatment uses are permitted for cotton and soybean. An analysis of the range of seeding rates recommended across the US for cotton and soybeans confirmed that the high end of the effective per acre application rate approaches the

Table 2.2 List of the Models Used to Assess Risk

Environment	Taxa of Concern	Exposure Media	Exposure Pathway	Model(s) or Pathway
Aquatic	Vertebrates/ Invertebrates (including sediment dwelling)	Surface water and sediment[1]	Runoff and spray drift to water and sediment	PWC version 2.001[2]
Terrestrial	Vertebrate	Dietary items	- Dietary residues from liquid sprays (includes residues on foliage, seeds/pods, arthropods, and soil) - Ingestion of Seeds	T-REX version 1.5.2[3] -Kenaga nomogram (for liquid sprays) - ingestion of treated seeds calculations
		Consumption of aquatic organisms	Residues taken up by aquatic organisms	KABAM version 1.0[4]
	Bees and other terrestrial invertebrates	Contact Dietary items	Spray contact and ingestion of residues in/on dietary items as a result of direct application	BeeREX version 1.0 T-REX version 1.5.2[3]
All Environments	Plants (Aquatic and Terrestrial)	Spray drift/runoff	Runoff and spray drift to terrestrial, wetland, and aquatic plants	PAT version 2.8[5]
All Environments	All	Movement through air to aquatic and terrestrial media	Spray drift [Spray drift is generally not applicable to seed treatments] (USEPA, 2012)	AgDRIFT version 2.1.1 (Spray drift)

1 Sediment analysis is recommended when the soil-water distribution coefficient (Kd) ≥50-L/kg-soil; the log KOW≥3; or the KOC ≥ 1000 L/kg-organic carbon. Analysis of risk in sediment from exposure in pore water may also occur if aquatic invertebrates are particularly sensitive, as it is expected that RQs will exceed LOCs even if the sediment is not the primary exposure media.

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

3 The Terrestrial Residue Exposure (T-REX) Model is used to estimate pesticide concentration on avian, mammalian, and listed terrestrial invertebrate food items. For liquid applications to bare soil, arthropod and seed residues estimated from the Kenaga nomogram are possible dietary exposure routes on the field and foliar residues estimate exposure adjacent to the field and that may occur with spray drift.

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

5 The Plant Assessment Tool (PAT) is a mechanistic model that incorporates environmental fate and transport data to estimate pesticide concentrations in terrestrial, wetland, and aquatic plant habitats. PAT uses exposure estimates generated in the Pesticide in Water Calculator (PWC) version 2.001 and spray drift estimates from

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FIELD EVALUATION OF THE EPA (KENAGA) NOMOGRAM, A METHOD FOR ESTIMATING WILDLIFE EXPOSURE TO PESTICIDE RESIDUES ON PLANTS

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Abstract—The Kenaga nomogram was developed by the U.S. Environmental Protection Agency (EPA) in the mid 1970s and has since been used prior to the registration of a pesticide to estimate the maximum potential pesticide residue level on plant material in the food chain of wildlife. The objective of this study was to evaluate the nomogram using field data. Six pesticides representing a variety of pesticide classes were applied to 15 plant species. Five of the six nomogram categories were tested with plant parts representing differences in surface morphology (i.e., glabrous vs. pubescent leaves). The sixth category was a mixed-grass community seeded with three grass species. Pesticide residue levels were determined the day of application and up to 32 d afterward. While the linear nomogram model does not represent the data as well as other models, relatively few data points (10%) collected on the day of pesticide application exceeded the nomogram predictions. The one systemic pesticide tested had degradation rates similar to nonsystemic pesticides in most categories. Present nomogram categories were significantly different from each other in most cases. However, the forage category should be combined with the leaves and leafy-crop category and have higher estimated residue levels than the Kenaga nomogram. A considerable amount of variation occurs in the level of pesticide residue on plant materials even under controlled experimental conditions and therefore nomogram values should be used as an estimate only until actual field residue data are available. The nomogram, with modifications, appears to be a reasonable regulatory device if careful thought is given in selecting the plant category for making residue estimates.

Keywords—Food chain Kenaga nomogram Plant residue Pesticide exposure

The Kenaga nomogram (based on research by Eugene Kenega at Dow Chemical - now Corteva Agriscience) was developed by the U.S. EPA in the mid 1970s and has since been used prior to the registration of a pesticide to estimate the maximum potential pesticide residue level on plant material in the food chain of wildlife.

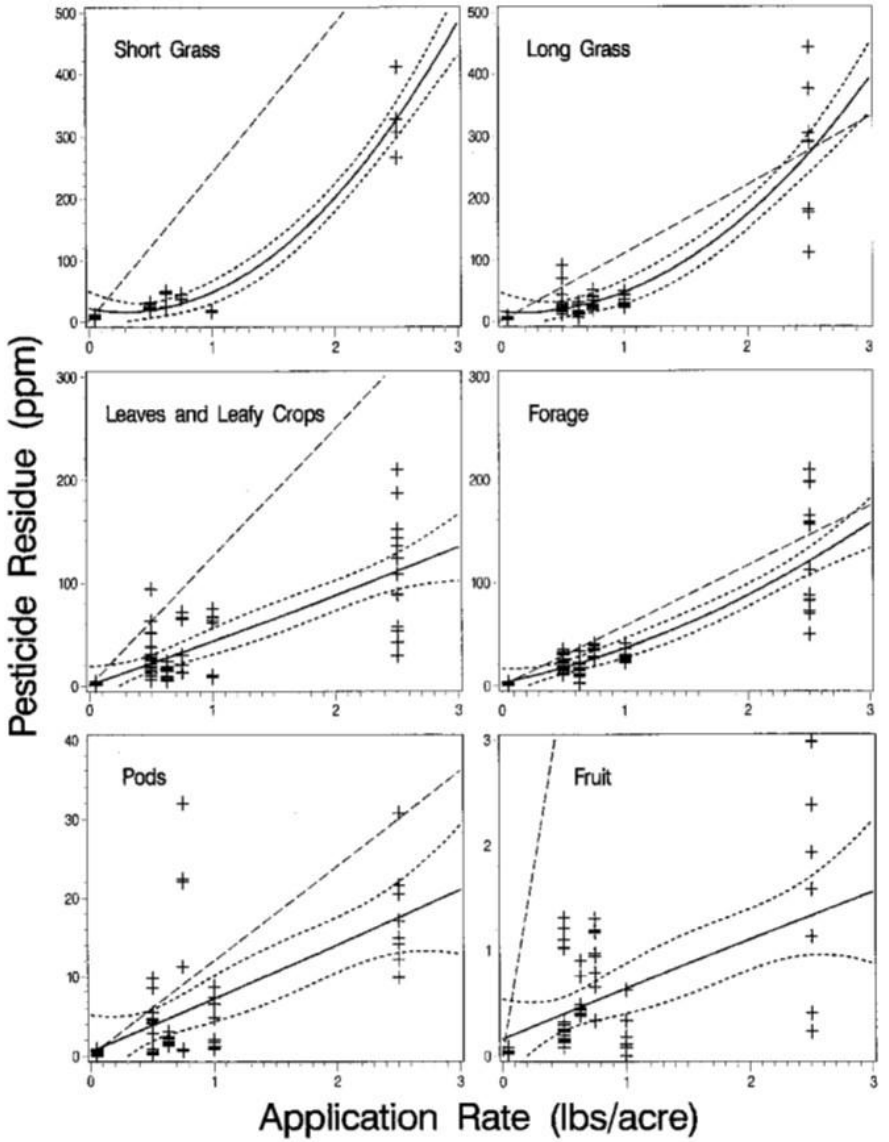


Fig. 2. Models and data of day 0 pesticide residues found on plants and plant parts. 1 5 Pesticide residues from samples collected the day of pesticide application. Solid line 5 Regression model of the actual residue data with 95% confidence intervals on either side of the regression line. The straight dashed line is the original nomogram model.

Table 3-1. Physical and Chemical Properties for Cyclobutrifluram

Parameter	Value					Source / (Classification)/ Comment [4]
Molecular Weight (g/mole)	389.2					MRID 51459902 (NA)
Water (pure) Solubility Limit at 20°C (mg/L)	33 for PAI[3] 18 for TGAI[3]					MRID 51459902 (A)
Vapor Pressure at 20°C (torr)	< 4.65E-8 (< 6.2 x 10-6 Pa)					MRID 51459902 (A)
Henry's Law Constant at 20°C (unitless)	3.12 E-8 (Registrant calculated value was **< 7.3. E-5 Pa m^3 / mol)**					Calculated[1] (NA)
Log Dissociation Constant (pKa)	No pKa was observed in the pH range of 2 to 12.0 by spectrophotometric analysis of a solution of cyclobutrifluram in water					MRID 51459902 (A)
Octanol-water Partition Coefficient (K_{OW}) at 20°C (unitless)	1706.01 (log K_{OW} = 3.2)					MRID 51459902 (A)
Soil-Water Distribution Coefficients (K_d) or Freundlich Coefficient (K_F) Organic Carbon-Normalized Distribution Coefficients (K_{OC}) or Freundlich Coefficients (K_{FOC})	***Soil***	***K_{oc} (L/kg-OC)***	***K_d (L/kg-soil)***	***K_F ((L/kg-soil)$^{-1/n}$)***	***K_{Foc} ((L/kg-OC)$^{-1/n}$)***	MRID 51460215 (A) According to the McCall (1981) Classification scale to assess a chemical's potential mobility in soil (based on its K_{Foc}), cyclobutrifluram can be classified as having a low to medium potential mobility Moderately Mobile according to the FAO (2000) Classification
	Sand	643	3.73	3.32	572	
	Sandy clay loam	405	7.66	7.32	387	
	Loam	338	7.03	6.32	304	
	Silt loam	301	6.80	6.41	284	
	Clay loam	465	4.00	3.63	422	
	Sandy loam	306	6.52	6.10	286	
	Mean	**410**	**5.96**	**5.52**	**375.83**	
	Std Deviation	**130.55**	**1.67**	**1.64**	**111.71**	
	Coefficient of Variation (%)	**31.87**	**27.96**	**29.70**	**29.72**	
Fish Bioconcentration Factor (BCF) (L/kg-wet weight fish)	**Species**	**BCF**		**Depuration**		MRID 51459430 (S) Based on total residues[2]
	Bluegill sunfish (*Lepomis macrochirus*)	31 (whole fish)		97% by Day 14		

[1] All estimated K_{AW} values were calculated according to "*Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in Problem Formulations for Registration Review, Registration Review Risk*

Table 3-2. Summary of Environmental Degradation Data for Cyclobutrifluram

Study	System	Observed DT50 and DT90 (days), respectively[6]	Calculated Half-life (days)[1]	MRID Source (Study Classification)/ Comment[2]
Abiotic Hydrolysis[3] (50°C+)[1]	pH 4	NA	Stable	51460222 (A)
	pH 7	NA	Stable	
	pH 9	NA	Stable	
Soil Photolysis (20°C)	pH 7	25 to 35 >35	29.6	51460205 (S)
Aqueous Photolysis (25°C)	pH 7	13 to 29 DT50 >29 DT90; 7 to 14 DT50 20 to 31 DT90	23.4[4] (^{14}C-pyridinyl); 11.5 (^{14}C-pyridinyl)	51460223 (S)
Aerobic Soil Metabolism[5] (20°C)[3] **(Study with 14C pyridinyl label unless otherwise specified.)** **Studies were supplemental primarily due to incomplete characterization of degradates.**	18 Acres UK sandy clay loam pH 5.7, OC 1.89%	>120 >120	619 (SFO)	51460201 (S)
	East Anglia UK, sandy loam pH 7.6, OC 2.12%	>120 >120	445 (DFOP)	51460201 (S)
	Gartenack, Switz., silt loam pH 7.5, OC 2.25%; ^{14}C pyridinyl label	>120 >120	245 (SFO)	51460201 (S)
	Gartenack, Switz., silt loam pH 7.5, OC 2.25%; ^{14}C phenyl label	>125 >125	150 (SFO) Used mean, 2 **labels = 198**	51460202 (S)
	Sarpy, NE, loam pH 6.9, OC 2.07%	>120 >120	986 (SFO)	51460201 (S)
	Capay CA, clay loam pH 7.7,	>120 >120	1097 (SFO)	51460201 (S)

Study	System	Observed DT50 and DT90 (days), respectively[6]	Calculated Half-life (days)[1]	MRID Source (Study Classification)/ Comment[2]
	20 °C, OC 0.86%			
Aerobic Aquatic Metabolism (20°C) Calculated from combined results of separate tests with phenyl-U-^{14}C]- and [pyridinyl-2-^{14}C]-labeled parent with both test systems. Study is supplemental primarily due to incomplete characterization of degradates.	Calwich Abbey Lake UK, Silt Loam; water pH 8.1, sediment pH 7.6	>101 >101	713 (SFO)	51460220 (S)
	Golden Lake ND, sand; water pH 8.3, sediment pH 8.1 EOS = 101 d	>101 >101	776 (SFO)	51460220 (A)
Anaerobic Aquatic Metabolism (20°C) Calculated from combined results of separate tests with phenyl-U-^{14}C]- and [pyridinyl-2-^{14}C]-labeled parent with both test systems.	Calwich Abbey Lake UK, Silt Loam, pH 8.1, sediment pH 7.6)	>100 >100	676 (SFO)	51460219 (A)
	Golden Lake North Dakota, US Water:sand sediment (20□C, water pH 8.3, sediment pH 8.1)	>100 >100	1230 (SFO)	51460219 (A)
Anaerobic Soil Metabolism (20°C) (Study with ^{14}C pyridinyl label unless otherwise specified.)	18 Acres UK sandy clay loam pH 5.7, OC 1.89%	>122 >122	884 (SFO)	51460204 (A)
	East Anglia UK, sandy loam pH 7.6, OC 2.12%	>122 >122	349 (SFO)	51460204 (A)
	Gartenack, Switz., silt loam pH 7.5, OC 2.25%; ^{14}C combined labels	>122 >122	570 (SFO)	51460204 (A)

Study	System	Observed DT50 and DT90 (days), respectively[6]	Calculated Half-life (days)[1]	MRID Source (Study Classification)/ Comment[2]
	Sarpy, NE, loam pH 6.9, OC 2.07%	>122 >122	288 (SFO)	51460204 (A)
	Capay CA, clay loam pH 7.7, 20 °C, OC 0.86%	>122 >122	379 (SFO)	51460204 (A)

[1] SFO=single first order; DFOP=double first order in parallel; IORE=indeterminate order (IORE); SFO DT_{50}=single first order half-life; tR_{IORE}=the half-life of a SFO model that passes through a hypothetical DT_{90} of the IORE fit; DFOP slow DT_{50}=slow rate half-life of the DFOP fit, --=not available or applicable; SFO-LN=SFO calculated using natural log transformed data. 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 EPA guidance (NAFTA, 2012).

[2] A = Acceptable, S = Supplemental, U = Unacceptable.

[3] The hydrolysis studies were only done at 50, 60 and 70°C and the loss of parent over the course of the 30-day studies was usually < 2% (<5% for [pyridinyl-2-^{14}C] at pH 4 and 9.

[4] Recommended aqueous photolysis value for environmental fate modeling, adjusted for 12-hours of sunlight per day at 40° N latitude.

[5]Although adequate characterization of parent cyclobutrifluram decline was provided in the MRID 51460201 and 514960202 studies, degradates were not sufficiently characterized and parent degradation was limited over the course of the study. Additional information on the degradates formed is provided in a non-guideline intact soil core aerobic metabolism study, which is supplemental. (The data are valid, but the study conditions are not as specified for an 835.4100 study) and provides more detailed accounting of the aerobic soil metabolism pathway.

[6] DT = Disappearance time. This is a point in time or interval in time in which 50 or 90% loss of the applied cyclobutrifluram occurred (DT50 or DT90, respectively).

Table 3-3. Fate of Cyclobutrifluram in Field Dissipation Studies

System Details[1]	Observed Parent Dissipation Value[2]		Modeled Total Soil Profile[1]		Deepest Soil Layer Detection (cm)	Source MRID
	DT50 (days)	DT90 (days)	DT50 (days)	DT90 (days)		
Ontario, Canada bare plot Loam pH 7.1 EOS = 486d	14-49	>485	25.5 (IORE)	13600 (IORE)	70-100	51460208 (A)
Georgia bare plot Sand pH 7.0 EOS = 540d	28-120	>365	64.5 (DFOP)	654 (DFOP)	70-100	51460209 (A)
Georgia peanut crop Sand pH 7.0 EOS = 540d	28-120	>365	60.5 (IORE)	396 (IORE)	20-40	51460209 (A)
Georgia Turf plot (Grass+thatch+soil) Sand pH 6.7 EOS = 553d	28-90	267-358	69.2 (IORE)	413 (IORE)	15-30	51460213 (A)
California Turf plot Loamy sand pH 8.1 EOS = 558d	28-61	271-362	86.8 (SFO)	234 (SFO)	30-45	51460212 (A)
Washington Bare plot Sand pH 8.3 EOS = 545 d	63-120	>359	110 (IORE)	694 (IORE)	80-100	51460210 (A)
Washington Potato crop Sand pH 8.3 EOS = 545 d	63-271	>271	147 (IORE)	1734 (IORE)	80-100	51460210 (A)
California Bare plot Loamy sand pH 6.9 EOS= 539d	58-90	360-450	103 (DFOP)	544 (DFOP)	80-100	51460211 (A)

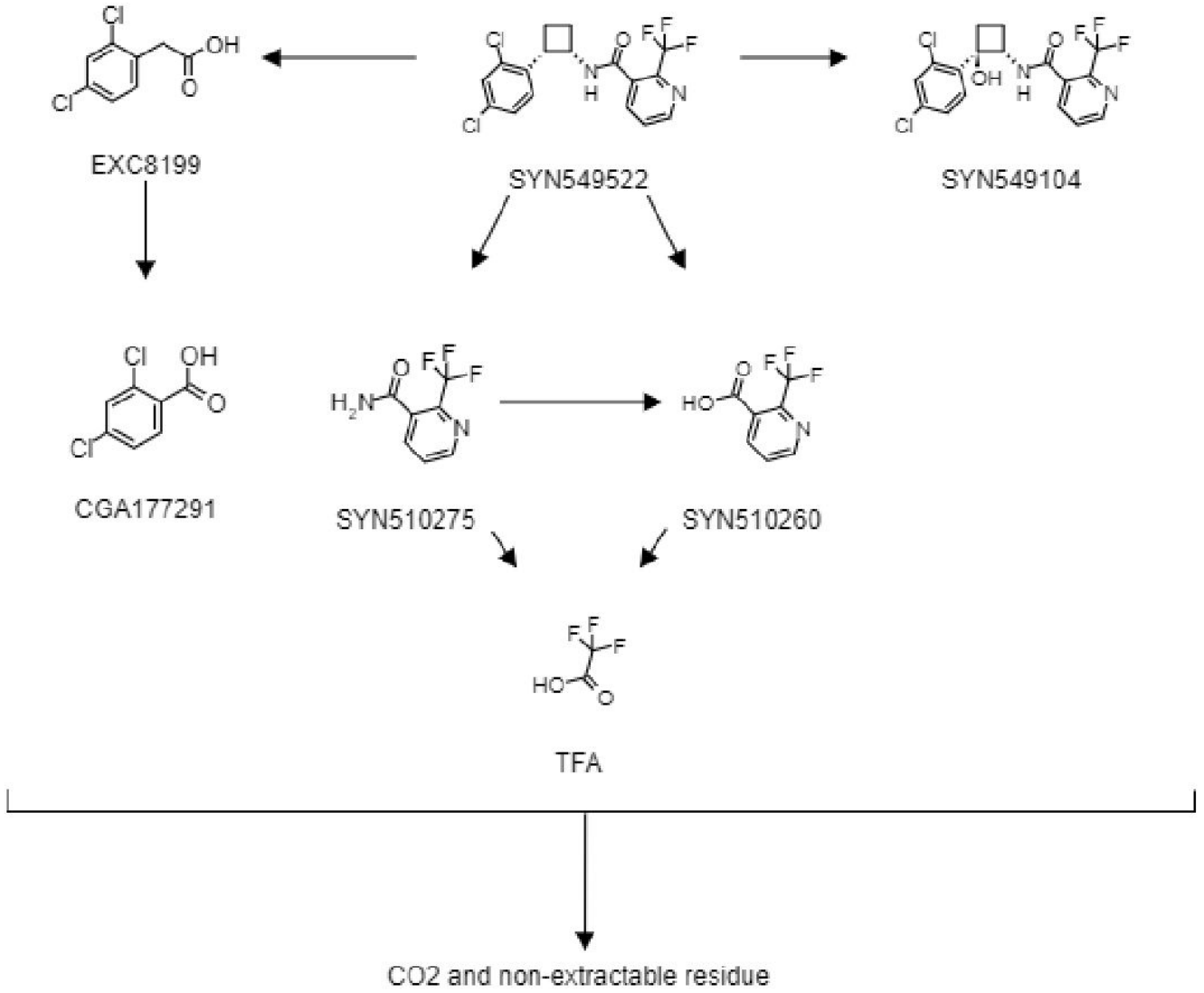
System Details[1]	Observed Parent Dissipation Value[2]		Modeled Total Soil Profile[1]		Deepest Soil Layer Detection (cm)	Source MRID
	DT50 (days)	DT90 (days)	DT50 (days)	DT90 (days)		
California Cotton crop Loamy sand pH 6.9 EOS = 539d	90-269	>360	178 (SFO)	591 (SFO)	80-100	51460211 (A)

[1] EOS = End of study in days after the first application of cyclobutrifluram

[2] DT_{50} and DT_{90} values were calculated using nonlinear regression and single first-order (SFO), double first-order in parallel (DFOP), and indeterminate-order equation (IORE). The equations can be found in the document, *Standard Operating Procedure for Using the NAFTA Guidance to Calculate Representative Half-life Values and Characterize Pesticide Degradation*, U.S. Environmental Protection Agency, November 30, 2012.

Proposed Metabolic Pathway of Cyclobutrifluram in Soil.

Nature of the residue: Which metabolites/ degradates of toxicological concern?



Schematic of the Photolytic Pathway of Cyclobutrifluram

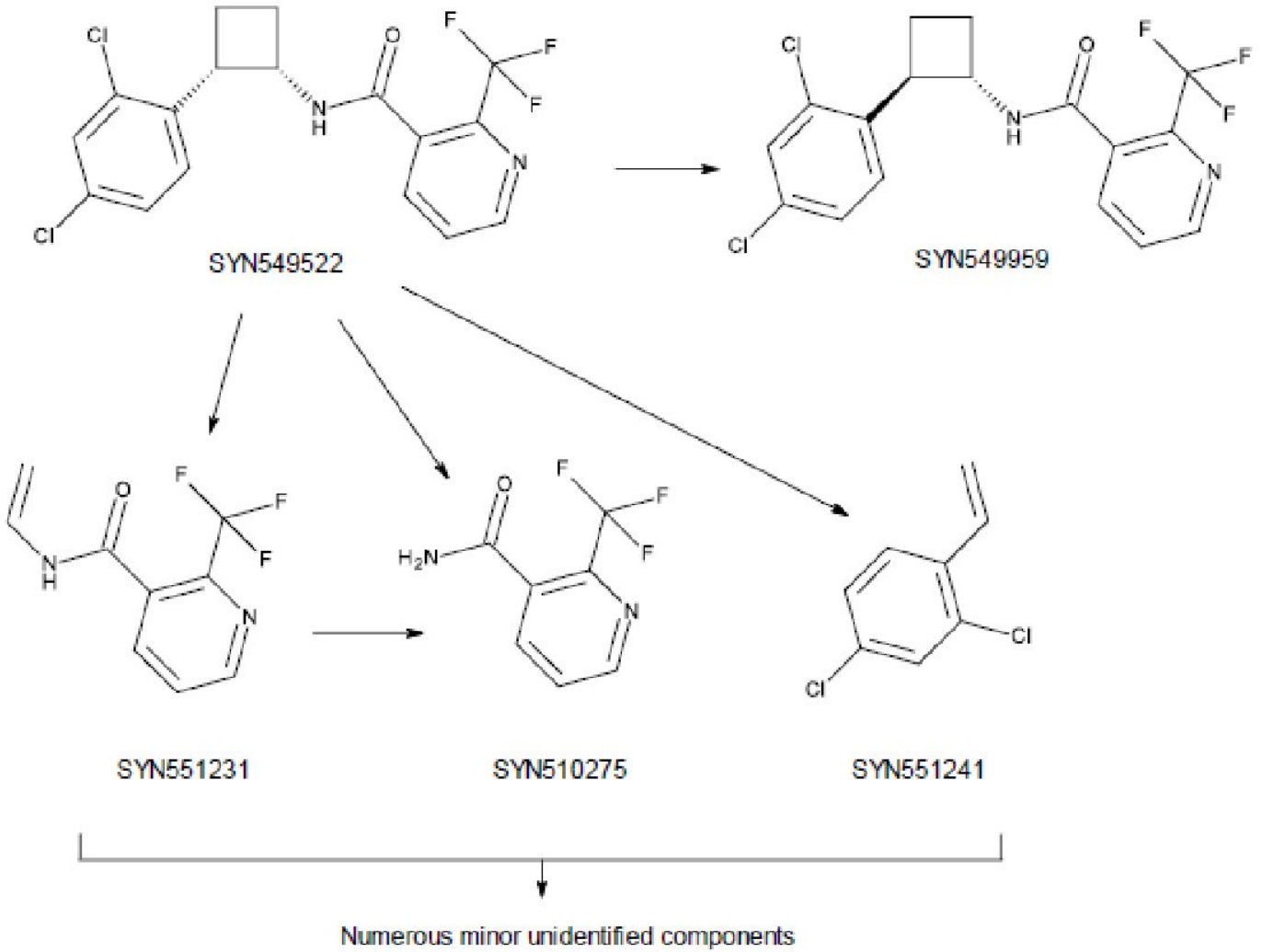


Table 3-4. Aquatic Animal Toxicity Endpoints for Cyclobutrifluram

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)	MRID or ECOTOX No./ Classification	Comments
Freshwater Fish (Surrogates for Vertebrates)					
Acute	TGAI (99.7)	Fathead Minnow (*Pimephales promelas*)	**96-h LC_{50} = 11,000**	**51459425 Acceptable**	Slightly Toxic
		Common Carp (*Cyprinus carpio*)	96-h LC_{50} > 19,000	51459427 Acceptable	29% mortality at highest concentration Endpoint may be approaching functional solubility.
		Rainbow Trout (*Oncorhynchus mykiss*)	96-h LC_{50} = 13,000	51459423 Acceptable	Slightly Toxic 100% of surviving fish exhibited sublethal effects at highest concentration until complete mortality at 72h.
	SYN510275 (Metabolite) (99)	Fathead Minnow (*P. promelas*)	96-h LC_{50} > 99,000	51459424 Acceptable	
Chronic (ELS)	TGAI (99.7)	Fathead Minnow (*P. promelas*)	**32-d NOAEC = 1,900 LOAEC = 4,700**	**51459429 Acceptable**	Length ↓6% at LOAEC

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)	MRID or ECOTOX No./ Classification	Comments
Estuarine/Marine Fish (Surrogates for Vertebrates)					
Acute	TGAI (99.7)	Sheepshead Minnow (*Cyprinodon variegatus*)	**96-h LC_{50} > 18,000**	**51459426 Acceptable**	43% mortality at highest concentration and 100% partial loss of equilibrium in highest level at 48 and 72h Endpoint may be approaching functional solubility.
Chronic (ELS)	TGAI (99.7)	Sheepshead Minnow (*C. variegatus*)	**34-d NOAEC = 530 LOAEC = 1,200**	**51459428 Supplemental**	Effects at LOAEC Length ↓4% Dry Weight ↓11% Wet Weight ↓13% Larger, but not statistically significant, decreases in weight, as well as a 10% decrease in hatching success, were observed at the lowest test level, 350 µg a.i./L.
Freshwater Invertebrates (Water-Column Exposure)					
Acute	TGAI (99.7)	Water Flea (*Daphnia magna*)	**48-h EC_{50} > 27,000**	**51459432 Acceptable**	Lethargy in 100% at highest concentration tested. Endpoint may be approaching functional solubility.
	SYN510275 (Metabolite) (99)	Water Flea (*D. magna*)	48-h EC_{50} > 102,000	51459433 Acceptable	Practically Nontoxic
Chronic	TGAI (99.7)	Water Flea (*D. magna*)	**21-d NOAEC = 660 LOAEC = 1,400**	**51459436[1] Acceptable**	Effects at LOAEC Length ↓4% # Live Offspring↓18% Successful Birth Rate ↓15% Time to first brood ↑5%
Estuarine/Marine Invertebrates (Water-Column Exposure)					
Acute	TGAI (99.7)	Eastern Oyster (*Crassostrea virginica*)	**96-h IC_{50} = 290**	**51459434 Supplemental**	Highly Toxic Shell deposition
		Mysid (*Americamysis bahia*)	96-h LC_{50} > 8,000	51459469 Acceptable	

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)	MRID or ECOTOX No./ Classification	Comments
Chronic	TGAI (99.7)	Mysid (*A. bahia*)	**28-d NOAEC = 160 LOAEC = 310**	**51459435[1] Supplemental**	Time to first brood ↓17% at LOAEC
Freshwater Invertebrate (Sediment Exposure)					
Subchronic	TGAI (99.7)	Freshwater Amphipod (*Hyalella azteca*)	10-d OC-Normalized Sediment: NOAEC = 3,500,000 µg a.i./kg -OC LOAEC > 3,500,000 µg a.i./kg-OC PW: NOAEC = 7,700 LOAEC > 7,700	51459443 Acceptable	
Subchronic	TGAI (99.7)	Midge (*Chironomus dilutus*)	**10-d OC-Normalized Sediment: NOAEC = 230,000 µg a.i./kg -OC LOAEC = 450,000 µg a.i./kg-OC** **PW: NOAEC = 410 LOAEC = 940**	**51459444[1] Acceptable**	Survival ↓21% at LOAEC
Estuarine/ Marine Invertebrates (Sediment Exposure)					
Subchronic	TGAI (99.7)	Estuarine/ Marine Amphipod (*Leptocheirus plumulosus*)	**10-d OC-Normalized Sediment: NOAEC = 1,600,000 µg a.i./kg -OC; LOAEC > 1,600,000 µg a.i./kg-OC** **PW: NOAEC = 4,500; LOAEC > 4,500**	**51459445 Acceptable**	

TGAI=Technical Grade Active Ingredient; TEP= Typical end-use product; a.i.=active ingredient
>Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011b).
< Less than values designate non-definitive endpoints where growth, reproductive, and/or mortality effects are observed at the lowest tested concentration.
[1] This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant biologically relevant effects were observed.

Table 3-5. Terrestrial Animal Toxicity Endpoints for Cyclobutrifluram

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value*	MRID or ECOTOX No./ Classification	Comments
Birds (Surrogates for Terrestrial Amphibians and Reptiles)					
Acute Oral	TGAI (99.7)	Bobwhite Quail (*Colinus virginianus*)	**14-d LD_{50} > 2000 mg a.i./kg-bw**	**51459413 Acceptable**	Practically Nontoxic
		Mallard (*Anas platyrhynchos*)	14-d LD_{50} > 2000 mg a.i./kg-bw	51459414 Acceptable	Practically Nontoxic Regurgitation observed
		Canary (*Serinus canaria*)	14-d LD_{50} > 2000 mg a.i./kg-bw	51459415 Acceptable	Practically Nontoxic

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value*	MRID or ECOTOX No./ Classification	Comments
Sub-acute dietary	TGAI (99.7)	Bobwhite Quail (*C. virginianus*)	8-d LC_{50} > 5259 mg a.i./kg diet	51459422 Acceptable	Practically Nontoxic
		Mallard (*A. platyrhynchos*)	**8-d LC_{50} > 5245 mg a.i./kg diet**	**51459421 Acceptable**	Practically Nontoxic
Chronic	TGAI (99.7)	Bobwhite Quail (*C. virginianus*)	**21-week NOAEC = 1899 LOAEC > 1899 mg a.i./kg-diet**	**51459419 Acceptable**	No treatment related effects
		Mallard (*A. platyrhynchos*)	22-week NOAEC = 1935 LOAEC > 1935 mg a.i./kg-diet	51459420 Acceptable	No treatment related effects
Mammals					
Acute Oral	TGAI (80.3)	Laboratory Rat (*Rattus norvegicus*)	**14-d LD_{50} = >5000 mg a.i./kg-bw**	**51460005 Acceptable**	Practically Nontoxic
Chronic (2-generation reproduction)	TGAI (80.3)	Laboratory Rat (*R. norvegicus*)	**17-week NOAEL = 43.1 LOAEL > 43.1 mg a.i./kg-bw/day**	**51460033 Acceptable**	No treatment related effects to apical endpoints
Terrestrial Invertebrates					
Acute contact & oral (adult)	TGAI (99.7)	Honey bee (*Apis mellifera*)	**Contact: 48-hr LD_{50} > 200 µg a.i./bee** **Oral: 48-hr LD_{50} > 72.23 µg a.i./bee**	**51459447 Supplemental**	Practically Nontoxic
Chronic oral (adult)	TGAI (99.7)	Honey bee (*Apis mellifera L.*)	**10-day NOAEL = 5.9 LOAEL = >5.9 µg a.i./bee/day**	**51459451 Supplemental**	No treatment related effects
Acute oral (larval)	TGAI (99.7)	Honey bee (*Apis mellifera carnica*)	**72-hr LD_{50} > 30.9 µg a.i./bee**	**51459452 Supplemental**	Practically Nontoxic
Chronic oral (larval)	TGAI (99.7)	Honey bee (*Apis mellifera L.*)	**22-day NOAEL = 0.16 LOAEL = 0.428 µg a.i./larva/day**	**51459453[1] Supplemental**	<u>Effects at LOAEL</u> Day 15 Mortality ↑41% Adult Emergence ↓41%
Residues in Pollen and Nectar	TEP (38.1%)	Cucumber (*Cucumis sativus*)	DT_{50} not calculable (Mean maximum: Pollen = 0.241 mg/kg; Nectar = 0.0123 mg/kg)	51459450 Supplemental	Not suitable for comparison to proposed uses, due to treatment stage (17-18 days after planting) and tested crop.

Table 3-6. Aquatic Plant Toxicity Endpoints for Cyclobutrifluram

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value (µg a.i./L)	MRID or ECOTOX No./ Classification	Comments
Aquatic Plants and Algae					
Vascular	TGAI (99.7)	Duckweed (*Lemna gibba*)	**7-day IC_{50} = 11,000** **7-day NOAEC = 570**	**51459446** **Acceptable**	Frond Yield at LOAEC ↓9%
Non-vascular	TGAI (99.7)	Green Algae (*Raphidocelis subcapitata*)	**96-hour IC_{50} = 7,000** **96-hr NOAEC = 3,600**	**51459438** **Acceptable**	Effects at LOAEC: AUC ↓77% Cell Density ↓78%, Growth Rate ↓28%
		Marine Diatom (*Skeletonema costatum*)	96-hour IC_{50} > 13,000 96-hr NOAEC = 4,900	51459441 Acceptable	AUC at LOAEC ↓11% IC_{50} may be approaching functional solubility.
		Cyanobacteria (*Anabaena flos-aquae*)	96-hour IC_{50} > 24,000 96-hr NOAEC = 24,000	51459440 Acceptable	IC_{50} may be approaching functional solubility.
		Freshwater Diatom (*Navicula pelliculosa*)	96-hour IC_{50} > 17,000 96-hr NOAEC < 1,300	51459442[1] Supplemental*	Effects at LOAEC: Yield ↓28% Growth Rate ↓8% AUC ↓23% IC_{50} may be approaching functional solubility.
	SYN510275 (Metabolite) (99)	Green Algae (*R. subcapitata*)	96-hour IC_{50} > 103,000 96-hr NOAEC = 103,000	51459439 Acceptable	

TGAI=Technical Grade Active Ingredient; a.i.=active ingredient

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

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

*For qualitative use only.

[1] This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant biologically relevant effects were observed.

Table 3-7. Terrestrial Plant Toxicity Endpoints for Cyclobutrifluram

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value (lb a.i./A)	MRID or ECOTOX No./ Classification	Comments
Terrestrial and Wetland Plants					
Seedling Emergence	TEP (38.7)	4 monocots 6 dicots	Dicots (All): IC_{25} >0.80*/>0.81 NOAEC = 0.80*/0.81 **Monocots (Ryegrass): IC_{25} >0.80 NOAEC = 0.27**	**51459460 Acceptable**	Dicots: No effects at the highest concentration tested. Monocots: Emergence (↓26%) Survival (↓26%)
Vegetative Vigor	TEP (38.7)	4 monocots 6 dicots	Dicots (All): IC_{25} >0.80 NOAEC = 0.80 Monocots (All): IC_{25} >0.80 NOAEC = 0.80	51459461 Acceptable	Dicots & Monocots: No effects at the highest concentration tested.

TEP= Typical end-use product; a.i.=active ingredient

*The highest test level for sugar beet was 0.80 lb a.i./A, while the rest of the dicot group had the highest test level at 0.81 lb a.i./A.

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

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

Table 3-11. Surface Water EECs for Cyclobutrifluram (using PWC version 2.001)

Use Site	Scenario for Max. EEC2	Surface Water EECs (µg/L)			Pore water EECs (µg/L)		Sediment (µg/kg dry sdmt.)	
		1-Day	21-Day	60-Day	Peak	21- Day	Peak	21-Day
Ornamentals, Soil[1]	MI Nursery	14.69	14.43	14.19	13.73	13.73	211.6	211.6
Turf grass, foliar	PA Turf	12.66	12.36	11.98	11.08	11.06	170.74	170.43
Lettuce, soil	Veget. Market Region 8-B	5.14	4.97	4.71	4.22	4.17	64.95	64.20
Cotton, seed	Cotton Region 8-B	4.15	4.01	3.83	3.38	3.38	52.09	52.05
Soybean, seed	Soybean, Region 8-B	2.41	2.32	2.20	1.92	1.90	29.59	29.23

[1] The highest exposures for ornamentals as presented here are for outdoor soil planted ornamental plants.

2 Veget.= Vegetable. Where applicable, the region listed is the HUC-2 region with the highest predicted EECs.

Table 3-12. Acute and Chronic Aquatic Vertebrate Risk Quotients

Use Sites	1-in-10 Yr EEC (µg/L)		Risk Quotient (RQ)			
			Freshwater (FW)		Estuarine/Marine (E/M)	
	Daily Mean	60-day Mean	Acute[1,3]	Chronic[2,4]	Acute[1,3]	Chronic[2,4]
			LC_{50} = 11,000 µg a.i./L	NOAEC = 1,900 µg a.i./L	LC_{50} > 18,000 µg a.i./L	NOAEC = 530 µg a.i./L
Cotton, seed	4.2	3.8	<0.01	<0.01	NC	0.01
Soybean, seed	2.4	2.2	<0.01	<0.01	NC	<0.01
Lettuce, soil	5.1	4.7	<0.01	<0.01	NC	0.01
Turf grass, foliar	13	12	<0.01	0.01	NC	0.02
Ornamentals, soil	15	14	<0.01	0.01	NC	0.03

EEC=estimated environmental concentration; NC = not calculated due to non-definitive toxicity endpoint

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

[1] The EECs used to calculate these RQs are based on the 1-in-10-year peak 1-day average value from **Table 3-11.**

[2] The EECs used to calculate these RQs are based on the 1-in-10-year 60-day average value from **Table 3-11.**

[3] Measured LC_{50} from acute toxicity test with FW Fathead Minnow (*Pimephales promelas*; MRID 51459425) or E/M Sheepshead Minnow (*Cyprinodon variegatus*; MRID 51459426).

[4] Measured NOAEC from chronic toxicity test with Fathead Minnow (*P. promelas*; MRID 51459429) or E/M Sheepshead Minnow (*C. variegatus*; MRID 51459428).

Table 3-13. Acute and Chronic Aquatic Invertebrate (Water-Column) Risk Quotients

Use Sites	1-in-10 Yr EEC (µg/L)		Risk Quotient (RQ)				
			Freshwater (FW)		Estuarine/Marine (E/M)		
	Daily Mean	21-day Mean	Acute[1,3]	Chronic[2,4]	Acute[1,3]		Chronic[2,4]
			EC_{50} >27,000 µg a.i./L	NOAEC = 660 µg a.i./L	IC_{50} = 290 µg a.i./L*	LC_{50} >8000 µg a.i./L	NOAEC = 160 µg a.i./L
Cotton, seed	4.2	4.0	NC	0.01	0.01	NC	0.03
Soybean, seed	2.4	2.3	NC	<0.01	0.01	NC	0.01
Lettuce, soil	5.1	5.0	NC	0.01	0.02	NC	0.03
Turf grass, foliar	13	12	NC	0.02	0.04	NC	0.08
Ornamentals, soil	15	14	NC	0.02	0.05	NC	0.09

EEC=estimated environmental concentration; NC = not calculated due to non-definitive toxicity endpoint

The LOC for acute risk to non-listed species is 0.5 or the chronic risk LOC is 1.0. *Italicized* values exceed the LOC for acute risk to listed species of 0.05. The endpoints listed in the table are the endpoints used to calculate the RQ.

*Based on shell deposition study.

[1] The EECs used to calculate this RQ are based on the 1-in-10-year peak 1-day average value from **Table 3-11**.

[2] The EECs used to calculate this RQ are based on the 1-in-10-year 21-day average value from **Table 3-11.**

[3] Measured EC_{50}/IC_{50}/LC_{50} from Acute toxicity test with FW Water Flea (*Daphnia magna*; MRID 51459432) or E/M Eastern Oyster (*Crassostrea virginica*; MRID 51459434) or E/M Saltwater Mysid (*Americamysis bahia*; MRID 51459469).

[4] Measured NOAEC from Chronic toxicity test with FW Water Flea (*Daphnia magna*; MRID 51459436) or E/M Saltwater Mysid (*Americamysis bahia*; MRID 51459435).

Table 3-14. Aquatic Invertebrate (Sediment) Risk Quotients

Use Site	1-in-10 Yr EEC Pore Water (µg/L)/ Bulk Sediment (µg/kg-OC)[2]			Risk Quotients					
				Freshwater			Estuarine/marine		
				Acute	Chronic[1]		Acute	Chronic[1]	
	Daily Mean (PW)	21-day Mean		LC/EC_{50} > 27,000 µg a.i./L^3	NOAEC = 410 µg a.i./L^4	NOAEC = 230,000 µg a.i./kg-$OC^{2,5}$	LC/EC_{50} = 290 µg a.i./L^{3}*	NOAEC = 4,500 µg a.i./L^4	NOAEC = 1,600,000 µg a.i./kg-$OC^{2,5}$
		PW	BS						
Cotton, seed	3.4	3.4	1301	NC	0.01	0.01	0.01	<0.01	<0.01
Soybean, seed	1.9	1.9	731	NC	<0.01	<0.01	0.01	<0.01	<0.01
Lettuce, soil	4.2	4.2	1605	NC	0.01	0.01	0.01	<0.01	<0.01
Turf grass, foliar	11	11	4261	NC	0.03	0.02	0.04	<0.01	<0.01
Ornamentals, soil	14	14	5289	NC	0.03	0.02	0.05	<0.01	<0.01

EEC=estimated environmental concentration; NC = not calculated due to non-definitive toxicity endpoint

The LOC for acute risk to non-listed species is 0.5 or the chronic risk LOC is 1.0. *Italicized* values exceed the LOC for acute risk to listed species of 0.05. The endpoints listed in the table are the endpoints used to calculate the RQ.

*Based on shell deposition study.

[1] The EECs used to calculate this RQ are based on the 1-in-10-year 21-day average value from **Table 3-11**. The pore water EEC is listed first in µg/L and the organic-carbon normalized bulk sediment EEC is listed next in µg/kg-OC.

[2] The EECs used to calculate this RQ are based on OC-normalized values from **Table 3-11**. The bulk sediment EECs are divided by 0.04 to account for the 4% carbon content of the sediment for the EPA pond].

[3] Measured water-column LC_{50} from the most sensitive water-column toxicity test for FW (48-hr LC_{50} for Daphnid; MRID 51459432) and E/M (48-hr LC_{50} for Oyster; MRID 51459434).

[4] Measured porewater NOAEC from the sediment toxicity test for FW (10-day NOAEC for *Chironomus dilutus*; MRID 51459444) and E/M (10-day NOAEC for *Leptocheirus plumulosus*; MRID 51459445.

[5] Measured organic carbon normalized bulk-sediment NOAEC from the sediment toxicity test for FW (10-day NOAEC for *Chironomus dilutus*; MRID 51459444) and E/M (10-day NOAEC for *Leptocheirus plumulosus*; MRID 51459445.).

Table 3-15. Avian and Mammalian Dose-Based Estimated Environmental Concentrations (EECs) and mg a.i./ft2 EECs for Cyclobutrifluram Seed Uses

Crop	Animal Size	Maximum Application Rate (lb a.i./A)	Maximum Seed Application Rate (mg a.i./kg seed)	Avian Nagy Dose (mg a.i./kg-bw/day)	Mammalian Nagy Dose (mg a.i./kg-bw/day)	Available AI (mg a.i./ft^2)
Cotton[1]	Small	0.08	4496	1138	953	0.89
	Medium			649	658	
	Large			290	153	
Soybean[2]	Small	0.17[3]	990	251	210	1.7
	Medium			143	145	
	Large			64	34	

[1] Based on a default seeding rate of 18.9 lb seed/A

[2] Based on a default seeding rate of 166.7 lb seed/A

[3] T-REX estimated value based on default seeding rate. This value is higher than the maximum application rate specified in the label for soybean seed treatments. This discrepancy appears to be due to the default seeding rate in T-REX, which is used for T-REX calculations, being much higher than the seeding rates indicated by label use instructions.

Table 3-16. Acute Dose-Based, LD50/ft2 based and Chronic dose-based RQs for Birds and Mammals Exposed to Cyclobutrifluram Treated Seed

Crop	Risk Quotients (RQs)							
	Avian (LD_{50} >2000 mg a.i./kg-bw, NOAEC = 1899 mg a.i./kg-diet)				Mammalian (LD_{50} = >5,000 mg a.i./kg-bw, NOAEL = 43.10 mg a.i./kg-bw)			
	Animal Size	Acute Dose-Based	Acute LD_{50}/ft^2	Chronic	Animal Size	Acute Dose-Based	Acute LD_{50}/ft^2	Chronic
Cotton	20 g	NC	NC	**2.4**	15 g	NC	NC	**10**
	100 g	NC	NC		35 g	NC	NC	**8.6**
	1000 g	NC	NC		1000 g	NC	NC	**4.6**
Soybean	20 g	NC	NC	0.52	15 g	NC	NC	**2.2**
	100 g	NC	NC		35 g	NC	NC	**1.9**
	1000 g	NC	NC		1000 g	NC	NC	**1.0**

Bold values exceed acute LOC (0.5) and chronic LOC (1.0).

Chronic RQs are the same for all size classes since body weight toxicity endpoints are not scaled for avian species.

LD_{50}/ft^2 is the amount of pesticide estimated to kill 50% of exposed animals in each square foot of applied area.

Table 3-17. Summary of Dietary[2] and Dose-based[3] EECs as Food Residues for Birds, Reptiles, Terrestrial-Phase Amphibians and Mammals[4]

Food Type	Dietary-Based EEC (mg/kg-diet)	Dose-Based EEC (mg/kg-body weight)					
		Birds			Mammals		
		Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Romaine Lettuce (0.089 lb a.i./acre, 1x)							
Short grass	21	24	14	6.2	20.37	14.08	3.26
Tall grass	9.8	11	6.4	2.9	9.33	6.45	1.50
Broadleaf plants/small insects	12	14	7.8	3.5	11.46	7.92	1.84
Fruits/pods/seeds (dietary only)	1.3	1.5	0.87	0.39	1.27	0.88	0.20
Arthropods	8.4	9.5	5.4	2.4	7.98	5.51	1.28
Seeds (granivore)[1]	NA	0.34	0.19	0.09	0.28	0.20	0.05
Ornamentals (0.187 lb a.i./acre, 2x, 14-day interval)							
Short grass	78.89	89.85	51.24	22.94	75.22	51.99	12.05
Tall grass	36.16	41.18	23.48	10.51	34.47	23.83	5.52
Broadleaf plants/small insects	44.38	50.54	28.82	12.90	42.31	29.24	6.78
Fruits/pods/seeds (dietary only)	4.93	5.62	3.20	1.43	4.70	3.25	0.75
Arthropods	30.90	35.19	20.07	8.98	29.46	20.36	4.72
Seeds (granivore)[1]	NA	1.25	0.71	0.32	1.04	0.72	0.17
Turf (0.22 lb a.i./acre, 2x, 14-day interval)							
Short grass	92.81	105.71	60.28	26.99	88.49	61.16	14.18
Tall grass	42.54	48.45	27.63	12.37	40.56	28.03	6.50
Broadleaf plants/small insects	52.21	59.46	33.91	15.18	49.78	34.40	7.98
Fruits/pods/seeds (dietary only)	5.80	6.61	3.77	1.69	5.53	3.82	0.89
Arthropods	36.35	41.40	23.61	10.57	34.66	23.95	5.55
Seeds (granivore)[1]	NA	1.47	0.84	0.37	1.23	0.85	0.20

EEC=estimated environmental concentration

[1] Seeds presented separately for dose - based EECs due to difference in food intake of granivores compared with herbivores and insectivores. This difference reflects the difference in the assumed mass fraction of water in their diets.

[2](mg a.i./kg-diet), [3](mg a.i./kg-bw), [4](T-REX v. 1.5.2, Upper Bound Kenaga)

Table 3-20. Acute and Chronic RQ values for Birds, Reptiles, and Terrestrial-Phase Amphibians from Labeled Uses of Cyclobutrifluram (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Acute Dose-Based RQ[2] LD_{50} > 2000 mg a.i./kg-bw			Acute Dietary-Based RQ[3] LC_{50} > 5245 mg a.i./kg-diet	Chronic Dietary RQ[4] NOAEC = 1899 mg a.i./kg-diet
	Small (20 g)	Medium (100 g)	Large (1000 g)		
Romaine Lettuce (0.089 lb a.i./acre, 1x)					
Herbivores/Insectivores					
Short grass	NC	NC	NC	NC	0.01
Tall grass	NC	NC	NC	NC	0.01
Broadleaf plants	NC	NC	NC	NC	0.01
Fruits/pods/seeds	NC	NC	NC	NC	<0.01
Arthropods	NC	NC	NC	NC	<0.01
Granivores					
Seeds[1]	NC	NC	NC	N/A	N/A
Ornamentals (0.187 lb a.i./acre, 2x, 14-day interval)					
Herbivores/Insectivores					
Short grass	NC	NC	NC	NC	0.04
Tall grass	NC	NC	NC	NC	0.02
Broadleaf plants	NC	NC	NC	NC	0.02
Fruits/pods/seeds	NC	NC	NC	NC	<0.01
Arthropods	NC	NC	NC	NC	0.02
Granivores					
Seeds[1]	NC	NC	NC	N/A	N/A
Turf (0.22 lb a.i./acre, 2x, 14-day interval)					
Herbivores/Insectivores					
Short grass	NC	NC	NC	NC	0.05
Tall grass	NC	NC	NC	NC	0.02
Broadleaf plants	NC	NC	NC	NC	0.03
Fruits/pods/seeds	NC	NC	NC	NC	<0.01
Arthropods	NC	NC	NC	NC	0.02
Granivores					
Seeds[1]	NC	NC	NC	N/A	N/A

NC = not calculated due to non-definitive toxicity endpoint; N/A = Not applicable

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

[1] Seeds presented separately for dose - based RQs due to difference in food intake of granivores compared with herbivores and insectivores. This difference reflects the difference in the assumed mass fraction of water in their diets.

[2] Measured LD_{50} from acute toxicity test with Bobwhite quail (*Colinus virginianus*; MRID 51459413)

[3] Measured LC_{50} from acute toxicity test with Mallard (*Anas platyrhynchos*; MRID 51459421).

[4] Measured NOAEC from chronic toxicity test with Bobwhite quail (*Colinus virginianus*; MRID 51459419).

Table 3-21. Chronic RQ values for Mammals from Labeled Uses of Cyclobutrifluram (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Chronic Dose-Based RQ NOAEL = 43.10 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 862 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Romaine Lettuce (0.089 lb a.i./acre, 1x)				
Herbivores/Insectivores				
Short grass	0.21	0.18	0.10	0.02
Tall grass	0.10	0.08	0.05	0.01
Broadleaf plants	0.12	0.10	0.06	0.01
Fruits/pods/seeds	0.01	0.01	0.01	<0.01
Arthropods	0.08	0.07	0.04	0.01
Granivores				
Seeds[1]	<0.01	<0.01	<0.01	N/A
Ornamentals (0.187 lb a.i./acre, 2x, 14-day interval)				
Herbivores/Insectivores				
Short grass	0.79	0.68	0.36	0.09
Tall grass	0.36	0.31	0.17	0.04
Broadleaf plants	0.45	0.38	0.20	0.05
Fruits/pods/seeds	0.05	0.04	0.02	0.01
Arthropods	0.31	0.27	0.14	0.04
Granivores				
Seeds[1]	0.01	0.01	0.01	N/A
Turf (0.22 lb a.i./acre, 2x, 14-day interval)				
Herbivores/Insectivores				
Short grass	0.93	0.80	0.43	0.11
Tall grass	0.43	0.37	0.20	0.05
Broadleaf plants	0.53	0.45	0.24	0.06
Fruits/pods/seeds	0.06	0.05	0.03	0.01
Arthropods	0.37	0.31	0.17	0.04
Granivores				
Seeds[1]	0.01	0.01	0.01	N/A

N/A = Not applicable

The LOC for chronic risk is 1.0. The endpoints listed in the table are the endpoints used to calculate the RQ.

[1] Seeds presented separately for dose – based RQs due to difference in food intake of granivores compared with herbivores and insectivores. This difference reflects the difference in the assumed mass fraction of water in their diets.

[2] Measured NOAEL and NOAEC from 2-generation reproduction toxicity test with Laboratory rat (Rattus norvegicus; MRID 51460033).

Table 3-22. Acute and Chronic Risk Quotient (RQ) Values for Birds and Mammals Consuming Aquatic Prey that has Bioaccumulated Cyclobutrifluram based on the Maximum Exposure Scenario (TN Nursery) using the Kow [based] Aquatic Bioaccumulation Model (KABAM).

Wildlife Species	Acute		Chronic	
	Dose Based	Dietary Based	Dose-Based	Dietary-Based
Mammalian Species[1]				
fog/water shrew	NC	N/A	0.01	<0.01
rice rat/star-nosed mole	NC	N/A	0.01	<0.01
small mink	NC	N/A	0.01	<0.01
large mink	NC	N/A	0.01	<0.01
small river otter	NC	N/A	0.01	<0.01
large river otter	NC	N/A	0.01	<0.01
Avian Species[2]				
sandpipers	NC	NC	N/A	<0.01
cranes	NC	NC	N/A	<0.01
rails	NC	NC	N/A	<0.01
herons	NC	NC	N/A	<0.01
small osprey	NC	NC	N/A	<0.01
white pelican	NC	NC	N/A	<0.01

NC = not calculated due to non-definitive toxicity endpoint; N/A = Not applicable

[1] Based on a chronic, 2-generation dietary NOAEL of 43.1 mg/kg-bw/day for the Laboratory Rat (*Rattus norvegicus*; MRID 51460033)

[2] Based on a chronic reproduction NOAEC of 1899 mg/kg-diet for Bobwhite Quail (*Colinus virginianus*; MRID 51459419).

Table 3-23. Summary of Information on the Attractiveness of Registered Use Patterns for Cyclobutrifluram to Bees[1]

Crop Name	Honey Bee Attractive?[1,2]	Bumble Bee Attractive?[1, 2]	Solitary Bee Attractive?[1, 2]	Acreage in the U.S.	Notes
Cotton, (*Gossypium hirsutum*; *G. barbardense*))	Y (nectar)[1]	Yes[1]	Yes[1] (*Halictus, Anthophora, Xylocopa, Megachile, Nomia, Ptilothrix*)	7,664,400	Does not require bee pollination or use managed pollinators, but cotton is used by some beekeepers for honey production.
Lettuce (*Latuca sativa*)	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	259,100 Head, Leaf and Romaine	Does not require bee pollination or use managed pollinators; harvested prior to bloom; self-pollinating
Soybean, (*Glycine soja*)	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	75,869,000	Does not require bee pollination or use managed pollinators.
Residential turf	Yes	Yes	Yes	--	Potential bee attractive weeds on residential turf.
Ornamentals	Yes	Yes	Yes	--	Ornamentals are assumed to be attractive.

[1] USDA (2018) attractiveness rating indicates use pattern is opportunistically attractive to bees.

[1]USDA. 2018. Attractiveness of Agricultural Crops to Pollinating Bees for the Collection of Nectar and/or Pollen. Available at: https://www.usda.gov/sites/default/files/documents/Attractiveness-of-Agriculture-Crops-to-Pollinating-Bees-Report-FINAL-Web-Version-Jan-3-2018.pdf

Table 3-24. Default Tier I Adult, Acute Contact Risk Quotients for Honey Bees Foraging on Crops Treated with Cyclobutrifluram from BeeRex (ver. 1.0)

Use Pattern	Max. Single Application Rate (lb a.i./A)	Dose (µg a.i./bee per 1 lb a.i./A)	Cyclobutrifluram Contact Dose (µg a.i./bee)	Acute RQ[1]
Cotton; Soybean	0.085	2.7	0.23	NC
Ornamentals	0.187	2.7	0.50	NC
Turf	0.22	2.7	0.59	NC

NC = not calculated due to non-definitive toxicity endpoint

[1] Based on a 48-h acute contact LD50 of >200 µg a.i./bee for Cyclobutrifluram (MRID 51459447).

On the basis of acute contact exposure to adult honey bees, RQs could not be calculated due to the adult honey bee contact study resulting in a non-definitive endpoint due to lack of significant toxicity within the study.

Table 3-25. Tier 1 (Default) Oral Risk Quotients for Adult Nectar Forager and Larval Worker Honey Bees from BeeRex (ver. 1.0)

Use Pattern	Max. Single Appl. Rate (lb a.i./A)	Bee Caste/Task	Oral Dose (µg a.i./bee)	Acute Oral RQ[1]	Chronic Oral RQ[2]
Cotton; Soybean (seed)	0.085	Adult nectar forager	0.29	NC	0.05
		Larval worker	0.12	NC	0.77
Turf (foliar)	0.22	Adult nectar forager	7.1	NC	**1.2**
		Larval worker	3.0	NC	**19**
Ornamentals (soil)	0.187	Adult nectar forager	0.048	NC	0.01
		Larval worker	0.020	NC	0.13

NC = not calculated due to non-definitive toxicity endpoint

Bolded RQ value exceeds (or potentially exceeds) the acute risk LOC of 0.4 or chronic LOC of 1.0.

[1] Based on a 48-h acute oral LD_{50} of >72.23 µg a.i./bee for adults (MRID 51459447) and 72-h LD_{50} of >30.9 µg a.i./bee for larvae (MRID 51459452).

[2] Based on a 10-d chronic NOAEL of 5.9 µg a.i./bee/d for adults (MRID 51459451) and a 22-d chronic NOAEL of 0.16 µg a.i./bee/d for larvae (MRID 51459453).

Table 3-26. AgDRIFT™ Off-Field Risk Estimates for Cyclobutrifluram.

Bee Stage	Application Rate (lb a.i./A)	Application Method	Boom Height[1]	Droplet Size	Distance from Field to Point of Chronic LOC (ft)[2]
Adult (Foliar)	0.22	Ground	High	Fine to Medium/Coarse	3
			Low		3
Larval (Foliar)	0.22		High		10
			Low		7

[1]Low Boom height = 20 inches from the soil surface; High Boom height = 50 inches from the soil surface

[2]Distance to where RQ values drop below the chronic risk level of concern (LOC) of 1.0; based on an adult bee 10-d chronic NOAEL of 5.9 µg a.i./bee/d (MRID 51459451) and a larval bee 22-d chronic NOAEL of 0.16 µg a.i./larva/d (MRID 51459453).

Table 3-27. Non-Target Terrestrial Invertebrates

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value	MRID or ECOTOX No.	Comments
Earthworm Acute	TGAI (80.3)	Earthworm *(Eisenia andrei)*	14d Mortality & Growth NOAEC = 500 mg a.i./kg dw soil	51459470 Acceptable	↑68% Body weight change at the LOAEC
Earthworm Sub-Lethal Reproduction	TGAI (80.3)	Earthworm *(E. andrei)*	28d Mortality & Growth LC_{50} > 1000 mg a.i./kg dw soil NOAEC = 1000 mg a.i./kg dw soil 56d Reproduction EC_{50} = 536 mg a.i./kg dw soil NOAEC = 171 mg a.i./kg dw soil	51459471 Acceptable	↓23% # juveniles at the LOAEC
	TEP SC (38.1)	Earthworm *(E. andrei)*	28d Mortality & Growth LC_{50} > 1000 mg a.i./kg dw soil NOAEC = 1000 mg a.i./kg dw soil 56d Reproduction EC_{50} = 225 mg a.i./kg dw soil NOAEC = 118 mg a.i./kg dw soil	51459458 Acceptable	↓40% # juveniles at the LOAEC
	TEP FS (41.4)	Earthworm *(E. andrei)*	28d Mortality & Growth LC_{50} > 1000 mg a.i./kg dw soil NOAEC = 1000 mg a.i./kg dw soil 56d Reproduction EC_{50} = 279 mg a.i./kg dw soil NOAEC = 70.8 mg a.i./kg dw soil	51459459 Acceptable	↓21% # juveniles at the LOAEC
Parasitic Wasp Mortality & Reproduction	TEP SC (38.1)	Parasitic Wasp (*Aphidius rhopalosiphi*)	48h LC_{50} > 672 g a.i./ha *(0.60 lb a.i./A)* 11d Reproduction EC_{50} > 672 g a.i./ha NOAEC = 672 g a.i./ha	51459454 Supplemental	Residues on glass plates. ↑16% mortality in highest test level. Reproduction not measured in two lowest test levels. Study is suitable for quantitative use.

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value	MRID or ECOTOX No.	Comments
Mite Mortality & Reproduction	TEP SC (38.1)	Predatory Mite (*Typhlodromus pyri*)	7d Mortality LC_{50} > 672 g a.i./ha 14d Reproduction EC_{50} > 672 g a.i./ha NOAEC < 168 g a.i./ha *(0.15 lb a.i./A)*	51459455 Supplemental	Residues on glass plates. ↑12% mortality in second lowest test level; non-monotonic response. ↓46% eggs/female at third lowest test level. **Undefined NOAEC**. Reproduction not measured in two lowest test levels; inverse dose response in three highest levels. Study is suitable for qualitative use only.
Mite Mortality & Reproduction	TEP FS (41.4)	Predatory Mite (*Hypoaspis aculeifer*)	14d Mortality LC_{50} > 414 mg a.i./kg dw soil 14d Reproduction EC_{50} > 414 mg a.i./kg dw soil NOAEC = 414 mg a.i./kg dw soil	51459456 Supplemental	Artificial soil substrate No significant effects. Study is suitable for quantitative use.

(TGAI) Technical Grade Active Ingredient
(TEP) Typical End-Use Product
(SC) Suspension Concentrate
(FS) Flowable Soluble for seed treatment

Table 3-28. Estimated Environmental Cyclobutrifluram Concentrations for Soil Organisms.

Use Sites	App (lb a.i./ A)	Depth (cm)	Soil Bulk Density, g/cm^3	Wt of 15cm Acre layer (lbs)	Pesticide in Soil (mg/kg-soil; 15cm layer)
Turf	0.22	15	1.55	2073387	0.11
Ornamentals	0.187				0.090
Cotton or Soybean	0.085				0.041
Romaine Lettuce	0.089				0.043

[1] Abbreviations: **App** = Application; **cm** = centimeters; **wt** = weight

The bulk density assumption taken for a sandy loam soil from:
https://www.nrcs.usda.gov/sites/default/files/2022-11/Bulk%20Density%20-%20Soil%20Health%20Guide_0.pdf

Table 3-31. Dietary-Based Toxicity Endpoints for Honey Bees

Study Type		Toxicity Value (mg a.i./kg diet)			
		LD_{50}	NOAEC	LOAEC	MATC
Adult[1]	Acute	>3612			
	Chronic		388	>388	NC
Larval[2]	Acute	>933			
	Chronic		4.1	11	6.8

[1] Based on a 48-h acute oral study (MRID 51459447) and a 10-d chronic study for adult honey bees (MRID 51459451).

[2] Based on a 72-h acute study (MRID 51459452) and a 22-d chronic study for larval honey bees (MRID 51459453; Day 15 Mortality ↑33% and Adult Emergence ↓41% at the LOAEC).

Conclusions

- Given cyclobutrifluram's proposed uses and environmental fate properties, there is a likelihood of exposure to non-target terrestrial and/or aquatic organisms.

- The risk of chronic exposure is increased by persistence of parent shown in laboratory studies and by carry over of residues from year to year in field dissipation studies.

- When used in accordance with the label, such exposure may result in adverse effects upon the survival, growth, and reproduction of non-target terrestrial and aquatic organisms.

Conclusions

- There is a potential for direct adverse effects to non-target non-listed and listed mammals from chronic exposure to cyclobutrifluram as a result of proposed seed treatment uses.

- There is also potential dietary risk to non-listed and listed terrestrial invertebrates if exposed to cyclobutrifluram at application rates proposed for turfgrass or ornamentals (listed species only) on the product label.

- Potential risk to honey bees (and non-listed terrestrial invertebrates) is not expected to be of concern, as label language restricting application of the product when flowering plants are present minimizes the potential for honey bee dietary exposures to cyclobutrifluram.

Pesticide Risk Assessment and Management Continuum