UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
CHEMICAL SAFETY AND POLLUTION PREVENTION

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MEMORANDUM

Subject: 2016 Addendum for the Proposed Section 3 Registration of Transform™ WG and Closer™ SC (Sulfoxaflor) For Use on Various Crops, Turf, and Ornamentals

To: Gene Benbow, Risk Manager Reviewer
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Date: 2016.05.16 10:58:24 -04'00'
05/16/16

Through: Mah Shamim, Ph.D., Chief
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Mshamim 05/16/16

Please find attached the Environmental Fate and Effects Division's (EFED) review of the recently revised labels dated May 5, 2016 for the proposed Section 3 use of Transform® WG and Closer® SC (sulfoxaflor) on multiple crops. Since the 9th Circuit Court's decision regarding the prior registration of sulfoxaflor concerned the potential risks to bees, this assessment only focuses on bees. Potential risks to other taxa will be lower or equivalent to that described in the previous Section 3 assessment (D382619)[1], noting that the new labels contain a lower maximum single application rate of 0.09 lb a.i./A and a maximum annual rate of 0.266 lb a.i./A among all the proposed uses.

[1] http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2010-0889-0022

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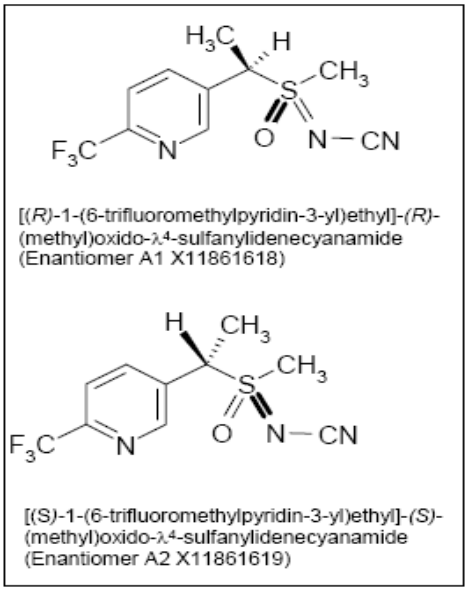
2016 Addendum to the Environmental Fate and Ecological Risk Assessment for Sulfoxaflor Registration



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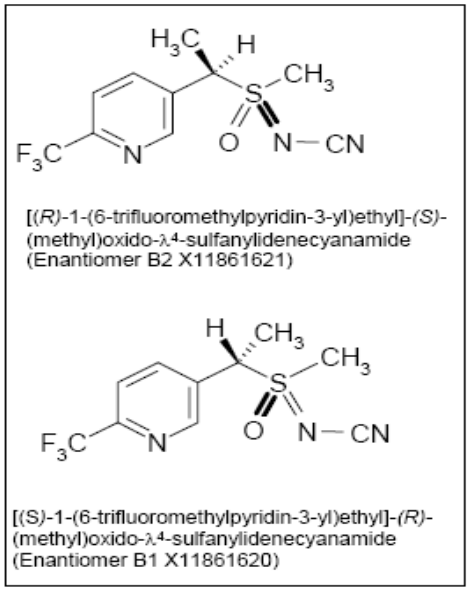
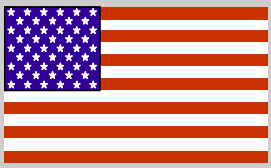
X11546257



Diastereomer 2
X11546258

Sulfoxaflor: A 50:50 Mixture of Diastereomer 1 and 2



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Contents

1. Executive Summary

This Addendum summarizes the ecological risks associated with the proposed Section 3 registration of Transform® WG and Closer® SC (active ingredient: sulfoxaflor) for use on various crops as a foliar spray and was conducted in accordance to revised labels dated May 5, 2016. The revised labels reflect numerous changes relative to the original EFED Section 3 assessment (D382619) that include: 1) removal of certain bee attractive crops (*e.g.*, citrus, cotton, cucurbits, soybean and strawberry; 2) prohibiting applications before or during bloom (*e.g.*, canola, stone fruits, pome fruits, *etc*.); and 3) prohibiting use on crops grown for seed production (*e.g.*, brassica, bulb vegetables, leafy vegetables, *etc*.). Since the 9th Circuit Court's decision regarding the prior registration of sulfoxaflor concerned the potential risks to bees, this assessment only focuses on bees. Potential risks to other taxa are lower or equivalent to that described in the previous Section 3 assessment (D382619)[2], noting that the new labels contain a lower maximum single application rate of 0.09 lb a.i./A (ground or aerial spray) and a maximum annual rate of 0.266 lb a.i./A among all the proposed uses.

On-Field Risks to Bees. Based on the proposed labels, acute and chronic risks to bees foraging on the treated field are not indicated. Lack of exposure of bees on the treated field is presumed since the proposed crops are either considered unattractive to bees, are harvested prior to bloom, or involve applications that are prohibited until after the bloom period of the crop.

Off-Field Risks to Bees. As with any foliar spray application, there is potential drift to areas adjacent to the treated field. A spray drift analysis indicates that the spatial extent of acute risks beyond the treated field is very limited (<1 – 12 feet beyond the treated field). In the absence of chronic Tier 1 data for individual bees, a bounding analysis was conducted using acute-to-chronic ratios. This analysis suggests that estimated chronic risks are also spatially limited beyond the treated field (2-46 feet, depending on modeling and toxicity assumptions). In addition to being spatially limited, available data suggest that the temporal extent of acute and chronic risks beyond the treated field is also limited to relatively short periods of time (*e.g.*, half of sulfoxaflor degrades in pollen and nectar within 9 days or less based on the vast majority of residue data). It is noted that the spray drift analysis is considered conservative due to assumptions that plants will be in bloom immediately next to the treated field and that bees will obtain 100% of their diet from this spatially limited area.

2. Risk Assessment Approach

Estimating risks to bees associated with the proposed Section 3 use of sulfoxaflor follows the Office of Pesticide Programs' (OPP's) published guidance entitled: "*Guidance for Assessing Pesticide Risks to Bees*" (USEPA 2014)[3]. This guidance presents an iterative, tiered process for assessing risks that considers multiple lines of evidence related to exposure and effects of pesticides to bees. In summary, this risk assessment process involves:

[2] http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2010-0889-0022

[3] USEPA *et al*. 2014. Guidance for Assessing Pesticide Risks to Bees. https://www.epa.gov/pollinator-protection/pollinator-risk-assessment-guidance

1. Estimating the potential for exposure of bees to the pesticide for each of the proposed uses;
2. Conducting a Tier 1 risk assessment based on default (high-end) exposure estimates for those uses where a reasonable potential for exposure exists;
3. Conducting a refined Tier 1 risk assessment based on measured residues in pollen and nectar; and,
4. Evaluating risks based on higher-tier (Tier 2 or Tier 3) colony level-effects data (as necessary).

3. Pesticide Exposure Potential of Bees

The first step in this process involves a qualitative assessment of the potential for exposure of bees to the pesticide. The exposure potential of bees is determined by the application method, timing, location (*e.g.*, indoor vs. outdoor), attractiveness of the crop to bees, agronomic practices (*e.g.*, timing of harvest), the availability of alternative forage sources and label restrictions regarding applications during the crop bloom period. Primary routes of exposure include interception of spray droplets (contact) and ingestion of contaminated pollen and nectar (oral).

Based on the labels submitted to the Agency on May 5, 2016, the proposed uses of sulfoxaflor involve ground or aerial foliar spray applications with medium or coarser spray nozzles (as defined by the American Society of Agricultural and Biological Engineers; ASABE). For each of the proposed crops or crop groups, information on their attractiveness to bees, maximum application rates, and label restrictions regarding the blooming period is summarized in **Table 1**. Information on the crop attractiveness was derived from the U.S. Department of Agriculture (USDA 2015[4]).

[4] USDA. 2015. Attractiveness of Agricultural Crops to Pollinating Bees for the Collection of Nectar and/or Pollen. http://www.ree.usda.gov/ree/news/Attractiveness_of_Agriculture_crops_to_pollinating_bees_Report-FINAL.pdf

Table 1. Summary of Crop Attractiveness to Honey Bees (HB) and Bumble Bees (BB) and Proposed Application Rates for Sulfoxaflor

<table>
<tr><th>Crop or Crop Group</th><th>Bee Attractiveness[1] and Agronomic Practices</th><th>Bloom Restrictions[2]</th><th>Max. Non-Bloom Appl. Rate[3]</th></tr>
<tr><td>Brassica leafy vegetables</td><td rowspan="2">High, but usually harvested before bloom (except for small acreage used for seed production)</td><td rowspan="4">Applications not allowed for seed production</td><td rowspan="9"><u>CLOSER</u>™
0.09 x 2 (consecutive) @ 7d (0.266)

<u>TRANSFORM</u>™
0.086 x 2 (consecutive) @ 7d (0.266)</td></tr>
<tr><td>Bulb vegetables*</td></tr>
<tr><td>Leafy vegetables (except Brassica) and watercress</td><td rowspan="3">Moderate to High for some members, but usually harvested before bloom (except for small acreage used for seed production)</td></tr>
<tr><td>Leaves of root and tuber vegetables</td></tr>
<tr><td>Root and tuber vegetables (1A & 1B)</td></tr>
<tr><td>Pome fruits</td><td>High (apples require managed bee pollination)</td><td rowspan="4">Only post bloom applications are allowed</td></tr>
<tr><td>Small fruit vine climbing (except fuzzy kiwi fruit) and low growing berry (except strawberry)</td><td>Moderate to High (blueberry, blackberry, raspberry require managed pollination)</td></tr>
<tr><td>Stone fruits</td><td>High (cherries require managed bee pollination)</td></tr>
<tr><td>Tree nuts and pistachio</td><td>High (requires managed pollination; almond)</td></tr>
<tr><td>Turf Grass (commercial only)</td><td>Not attractive</td><td>N/A</td></tr>
<tr><td>Ornamentals</td><td>High (assumed)</td><td>Only post bloom applications are allowed</td><td><u>CLOSER</u>™
0.09 x 2 (consecutive) @ 14 d (0.266)
<u>TRANSFORM</u>™
0.086 x 2 (consecutive) @ 14 d (0.266)</td></tr>
<tr><td>Fruiting vegetables and okra</td><td>Moderate (HB) High (BB) (managed pollination for seed production)</td><td>Only post bloom applications are allowed</td><td><u>CLOSER</u>™
0.07 x 2 (consecutive) @ 7 d (0.266)
<u>TRANSFORM</u>™
0.071 x 2 (consecutive) @ 7 d (0.266)</td></tr>
<tr><td>Potatoes (1C and 1D)</td><td>Moderate (BB only)</td><td rowspan="2">Only post bloom applications are allowed</td><td rowspan="2"><u>CLOSER</u>™
0.07 x 2 (consecutive) @ 14 d (0.266)

<u>TRANSFORM</u>™
0.071 x 2 (consecutive) @ 14 d (0.266)</td></tr>
<tr><td>Succulent, edible podded, dry beans</td><td>Moderate to High</td></tr>
<tr><td>Barley, triticale, wheat</td><td>Not attractive</td><td>N/A</td><td><u>CLOSER</u>™
0.043 x 2 / @ 14 d (0.086)
<u>TRANSFORM</u>™
0.047 x 2 / @ 14 d (0.09)</td></tr>
</table>

Crop or Crop Group	Bee Attractiveness[1] and Agronomic Practices	Bloom Restrictions[2]	Max. Non-Bloom Appl. Rate[3]
Canola	**High** (commercial pollination used for hybrid seed production)	**Only post bloom applications are allowed**	**CLOSER™ & TRANSFORM®** **0.023** x 2 @ 14 d (0.046)

[1] Bee attractiveness based on USDA (2015)
[2] N/A = bloom application restrictions are not applicable because crop is not considered bee attractive
[3] Maximum single application rate in bold (lb a.i./A); max. # of consecutive apps; minimum appl. interval, and total annual application rate in parentheses.
* label for CLOSER specifies no more than 3 applications/year and no restrictions on consecutive applications

3.1 Potential for On-Field Exposure

Based on the information summarized **Table 1** and USDA's assessment of crop attractiveness to bees, **the proposed uses of sulfoxaflor are not expected to result in significant exposure of bees on the treated field.** This conclusion is reached based on the following considerations:

1. **The crops are not considered attractive to bees** (*e.g.*, barley, triticale, wheat, turf grass);

2. **The crops are harvested before bloom and no application is allowed for seed production** (*e.g.*, brassica, leafy vegetables, bulb vegetables, root/tubers, leaves of root/tubers (except potato); or

3. **The crops are attractive but applications are only allowed after bloom (***e.g.*, canola, ornamentals pome fruits, potato, stone fruits, tree nuts/pistachio, small fruit vine climbing & low growing berry [except strawberry & kiwi], and succulent, edible & podded dry beans).

3.2 Potential for Off-Field Exposure (Spray Drift)

The OPP bee risk assessment guidance primarily focuses on exposures and risks of bees on the treatment site. However, with outdoor spray applications, there is the potential for off-site spray drift and subsequent exposure of bees that may be foraging on blooming plants adjacent to the treated site. Therefore, off-site exposure of bees (oral and contact) as a result of spray drift is also considered possible for all of the proposed uses of sulfoxaflor.

4. Tier 1 Risk Estimation (Default Exposure)

By design, the initial (default) Tier 1 assessment relies on conservative (high end) estimates of exposure via contact and oral routes. For contact exposure, only the adult (forager) life stage is considered since this is the relevant life stage for honey bees. Furthermore, toxicity protocols have only been developed for acute exposures via the contact route. For the oral route, exposure

estimates for bees are compared to acute and chronic toxicity endpoints for both adult and larval bees. These toxicity endpoints are defined by laboratory exposures to groups of individual bees.

4.1 Summary of Tier 1 Bee Toxicity Data

For sulfoxaflor, the Tier 1 laboratory toxicity database is complete for contact exposure and for acute larval and adult oral exposure. Acceptable data are not available for estimating chronic effects of sulfoxaflor on larval and adult honey bees. In order to estimate the uncertainty associated with the lack of chronic effects data for adult bees, an acute-to-chronic ratio approach was used, as described in **Section 9**. It is noteworthy that larval honey bees are much less acutely sensitive to oral exposure (7-d LD_{50} > 0.2 µg a.i./bee) compared to adults LD_{50} (48-h): 0.0515 ug a.i./bee. Compared to honey bees, sulfoxaflor appears much less toxic on an acute contact basis to bumble bees, but is of similar acute oral toxicity. Details of the Tier 1 toxicity test results with sulfoxaflor are found in the previous Section 3 new chemical risk assessment (D382619).

Table 2. Tier 1 toxicity test results for sulfoxaflor and bees

Taxa	Species	Type of Toxicity (Purity)[1]	Toxicological Endpoint	MRID
Terrestrial Invertebrates	Honey bee, adult (*Apis mellifera)*	Acute (contact) TGAI	LD_{50} (72-h): 0.379 ug a.i./bee	47832102 (Acceptable)
		Acute (contact) TEP: GF-2032-SC	**LD_{50} (48-h): 0.130 ug a.i./bee**	47832419 (Acceptable)
		Acute (contact) TEP: GF-2372-WG	LD_{50} (48-h): 0.224 ug a.i./bee	47832511 (Acceptable)
		Acute (oral) TGAI	LD_{50} (48-h): 0.146 ug a.i./bee	47832103 (Acceptable)
		Acute (oral) TEP: GF-2032-SC	**LD_{50} (48-h): 0.0515 ug a.i./bee**	47832417 (Acceptable)
		Acute (oral) X11719474	LD_{50} (96-h): >100 ug a.i./bee	47832107 (Acceptable)
		Acute (oral) X11721061	LD_{50} (48-h): >104 ug a.i./bee	48445809
		Acute foliar residue (TEP: GF-2372-WG)	24-h aged residue mortality: 14% (0.089 lb ai/A or 100 g ai/ha) 15% (0.178 lb ai/A or 200 g ai/ha)	47832512 (Acceptable)
		Acute foliar residue (TEP: GF-2032-SC)	3-h aged residue mortality: 4% (200 g ai/ha)	47832420 (Acceptable)
	Honey bee, larvae (*Apis mellifera)*	**Acute, single dose (TGAI)**	**LD_{50} (7-d): >0.2 µg a.i./bee**	48755602 (Supplemental)
		Chronic, repeated dose (TGAI)	NOAEC (7-d): 0.02 µg a.i./bee; LOAEC (7-d) = 0.2 µg a.i./bee	48755603 (Supplemental)
	Bumble bee, adult (*Bombus terrestris)*	Acute (contact) (TEP: GF-2032-SC)	LD_{50} (72-h): 7.55 µg a.i./bee	47832418 (Supplemental)

Taxa	Species	Type of Toxicity (Purity)[1]	Toxicological Endpoint	MRID
		Acute (oral) (TEP: GF-2032-SC)	LD_{50} (72-h): 0.027 µg a.i./bee	47832418 (Supplemental)
The most sensitive endpoints shown in **bold** are used for risk estimation.				

4.2 On-Field Risk (Contact and Oral Exposure)

As discussed previously in **Section 3.1**, exposure of bees on the treated field is not expected. Therefore, **the potential for risk to bees potentially foraging for pollen and nectar on the treated field is considered highly unlikely.**

4.3 Off-Field Risk (Contact With Spray Droplets)

In addition to bees foraging on the treated field, bees may also be foraging on blooming plants adjacent to the treated fields. In these situations, bees may become exposed through interception of pesticide spray droplets that drift off site during application. In order to estimate the potential contact exposure of bees to sulfoxaflor when foraging on plants adjacent to treated fields, AgDRIFT (version 2.1.1) was run based on available label information. For ground and aerial (non-ULV) applications, the label specifies that only medium or coarser spray nozzles shall be used. Furthermore, the label specifies a boom height of ≤4 ft for ground applications and ≤10 feet for aerial applications. For wind speed, the labels prohibit application above a wind speed of 10 mph.

Results of AgDRIFT modeling for off-site deposition of spray droplets at the maximum proposed application rate of **0.09 lb a.i./A** for CLOSER™ are shown in **Table 3**. Since the drift of ground and aerial sprays declines exponentially with distance from the treated field, the highest off-field exposures occur at the near edge of treated fields. Based on AgDRIFT modeling with the maximum application rate of 0.09 lb a.i./A and the Tier 1 acute contact risk assessment presented earlier, the acute risk LOC is exceeded for bees potentially foraging in sites ranging up to **2 to 12 feet** from the treated field, depending on the application method. For this analysis, "medium to coarse" spray nozzles with a median droplet diameter of 341 µm was assumed.

Table 3. Equivalent Sulfoxaflor Application Rates Predicted by AgDRIFT at Various Distances from the Application Site for the Maximum Application Rate of 0.09 Lb A.I./A. and Distance from Treated Field Beyond Where the Acute Risk Level of Concern for Bees (Contact Exposure) is Exceeded.

Method	Droplets	Dv0.5 (µm)	Distance from the field and point estimate of application rate (lb a.i./A)					Distance From Field Edge Where the Acute Risk LOC is Exceeded[3] (ft)
			10 ft	20 ft	40 ft	80 ft	150 ft	
Ground[1]	M/C	341	0.0041	0.0022	0.0013	0.0007	0.0004	2
Aerial[2]	M to C	341	0.0205	0.0142	0.0096	0.0053	0.0024	12

Table Notes:
M = medium spray nozzle, C = coarse spray nozzle, (M to C assumes a median droplet diameter of 341 µm)
[1] Boom height = 4.2 ft,
[2] boom height = 10 ft, wind speed = 10 mph, spray volume 3 gal/A
[3] Distance to LOC of 0.4 which equates to an application rate of 0.019 lb a.i./A for CLOSER™ based on a 48-h acute contact LD_{50} of 0.130 μg a.i./bee for (MRID 47832419) and a contact dose of 2.7 μg a.i./bee per 1 lb a.i./A.

Based on the acute contact toxicity of CLOSER™, the acute risk LOC is met at an application rate of 0.019 lb a.i./A. Using all of the application rates of CLOSER™ which exceed this rate, the distance from the field edge where the acute risk LOC of 0.4 would be exceeded was determined using AgDRIFT (**Table 3**). The other formulated product (TRANSFORM™) is roughly 50% less toxic on an acute contact exposure basis than CLOSER™; therefore, the distances at which the acute contact risk LOC is exceeded will be shorter than those shown in **Table 4** for CLOSER™.

Table 4. Distance from the Treated Field Where the Acute Risk LOC (Contact Exposure) is Exceeded for Various Application Rates of Sulfoxaflor as Determined by AgDRIFT

Method	Droplets	Dv0.5 (µm)	Distance From Field Edge Where the Acute Contact Risk LOC is Exceeded[3] (ft)			
			0.023 lb ai/A	0.043 lb ai/A	0.07 lb ai/A	0.09 lb ai/A
Ground[1]	M/C	341	<1	<1	2	2
Aerial[2]	M to C	341	<1	<1	5	12

Table Notes:
M = medium spray nozzle, C = coarse spray nozzle, (M to C assumes a median droplet diameter of 341 µm)
[1] Boom height = 4.2 ft
[2] Boom height = 10 ft, wind speed = 10 mph, spray volume 3 gal/A
[3] Distance (round to nearest ft) to LOC of 0.4 which equates to an application rate of 0.019 lb a.i./A for CLOSER™ based on a 48-h acute contact LD_{50} of 0.130 μg a.i./bee for (MRID 47832419) and a contact dose of 2.7 μg a.i./bee per 1 lb a.i./A..

4.4 Off-Field Risk (Contact With Residues On Foliage)

Bees may come into dermal contact with pesticide residues that have deposited onto foliage when they are foraging on attractive plants adjacent to the treated field. For sulfoxaflor, data are

available from two studies that examined the toxicity of residues on treated foliage. These studies were conducted according to the Office of Chemical Safety and Pollution Prevention (OCSPP) test guideline 850.3020, as summarized in the previous Section 3 risk assessment (D382619). The toxicity of residues on foliage studies assess the toxicity of aged residues on treated alfalfa. Based on aged residues of the CLOSER™ formulation (GF-2032-SC) on alfalfa after application at 200 g/ha (0.18 lb a.i./A), less than 5% mortality occurred following 3 to 24 hours of exposure (MRID 47832420). With the TRANSFORM™ formulation (GF-2372-WG) at the same application rate, up to 15% mortality occurred following exposure to alfalfa aged from 3-24 hours (MRID 47832512). Collectively, these studies suggest that aged residues of these two sulfoxaflor formulations result in low mortality to honey bees via dermal contact with treated foliage, *i.e.*, the compounds exhibit low "residual toxicity". It is further noted that the application rate used in these studies (0.18 lb a.i./A) is double the maximum single application rate of sulfoxaflor proposed for this registration (0.09 lb a.i./A).

4.5 Off-Field Risk from Oral Exposure (Pollen and Nectar)

Bees may also become exposed to sulfoxaflor which has been deposited on (or translocated into) pollen and nectar of blooming plants adjacent to treated fields. In order to provide an estimate of the potential oral exposure of bees to sulfoxaflor when foraging on plants adjacent to treated fields, AgDRIFT (version 2.1.1) was run as described previously in **Table 4** for the acute contact exposures. Based on this AgDRIFT modeling and default (high end) estimates of exposure for adult nectar foragers (the highest exposed type of honey bee), the acute risk LOC is exceeded from **16 to 361 feet** beyond the edge of the treated field, depending on the application rate and application method (**Table 5**). Since these RQ values exceed the LOC using default (high end) exposure assumptions, they are refined further in **Section 5** using available information on residues of sulfoxaflor in pollen and nectar of applicable crops.

Table 5. Distance from the Treated Field Edge Where the Acute Risk LOC Is Exceeded for Adult Nectar Foragers (Default, Oral Exposure) as Determined Using AgDRIFT

Method	Droplets	Dv0.5 (µm)	Distance From the Treated Field Edge Where the Acute Contact Risk LOC is Exceeded[3] (ft)			
			0.023 lb ai/A	0.043 lb ai/A	0.07 lb ai/A	0.09 lb ai/A
Ground[1]	M/C	341	16	36	66	89
Aerial[2]	M to C	341	135	210	295	361

Table Notes:
M = medium spray nozzle, C = coarse spray nozzle (M to C assumes a median droplet diameter of 341 µm)
[1] boom height = 4.2 ft;;
[2] boom height = 10 ft, wind speed = 10 mph, spray volume 3 gal/A;
[3] distance (round to nearest ft) to LOC of 0.4 which equates to 0.0007 lb ai/A for default (high end) oral exposure.

5. Refined Tier 1 Risk Assessment

The Tier 1 risk assessment summarized in **Section 4** reflects default assumptions of exposure estimates of honey bees to the pesticide. By design, the initial Tier 1 risk assessment reflects simplified, high end estimates of exposure in order to quickly identify uses which pose minimal risk to bees. However, LOC exceedances that are based on the default (high end) estimates of exposure in **Section 4** do not necessarily mean that risk will occur. In such cases, refinement of default estimates of exposure may be conducted using more realistic estimates of exposure that reflect the residues from actual use patterns of the chemical. Acute contact risks are based on the highest measured value of acute contact exposure reported for honey bees in various field trials based on the work of Koch and Weisser (1997)[5]. Currently, EPA does not have standard methods for refining screening-level acute contact exposure estimates. For oral exposure, refinement of Tier 1 risk estimates is possible based on consideration of different bee castes and tasks (each differing in their nectar and pollen consumption rates) and consideration of measured values of pesticide residues in pollen and nectar. **Section 5.1** presents the findings of the refined on-field and off-field risk estimates for acute, oral exposure of bees to sulfoxaflor. As previously discussed, acceptable Tier 1 toxicity data are not available from which to estimate chronic toxicity of sulfoxaflor to adult or larval honey bees. The uncertainty associated with this lack of data is characterized in Section 4.

5.1 Off-Field Risk from Oral Exposure (Refined)

For sulfoxaflor, pollen and nectar residue data are available from multiple studies including a field residue study with cotton (MRID 48755606), pumpkin (MRID 48755601), and *Phacelia* (MRID 48446601 and 48445806). Maximum reported residues of sulfoxaflor in various plant and hive matrices are shown in **Table 6**. Among the available residue studies, the highest residues reported in pollen and nectar resulted from the cotton study. Furthermore, the cotton study also included measurements made directly from foraging bees (*i.e.*, pollen collected by bees) returning to the hive, which is considered a more representative measure of exposure of honey bee colonies compared to the other matrices (*e.g.*, pollen collected directly from flowers) in which residues were measured. For these reasons, the residue values measured in pollen and nectar from foraging bees in the cotton study were considered most appropriate among the available data for further refining the estimates of oral exposure of bees to sulfoxaflor. Details of these studies are provided in the previous Section 3 risk assessment (D382619).

[5] Koch, H. and P. Weisser. 1997. Exposure of honey bees during pesticide application under field conditions. *Apidologie*, 28: 439-447.

Table 6. Maximum Reported Residues (ppm) of Sulfoxaflor in Plant and Hive Materials from Various Field Studies

Application Rate (lb a.i./A)	Plant Pollen	Plant Nectar	Plant Tissue	Forager Nectar*	Forager Pollen*	Comb Pollen	Comb Larvae	MRID
Cotton								
1 x 0.045	1.26			0.13	0.22	0.03	<0.01	48755606
2 x 0.045	2.54			0.05	0.83	0.04	0.01	
2 x 0.089	6.66			0.07	2.78	1.19	0.03	
2 x 0.134 [c]	2.61			1.01	2.23	0.04	0.08	
Phacelia								
1 x 0.021			0.52[b]	0.05	0.29			48446601
1 x 0.043			1.48[b]	0.09	0.81			
Phacelia								
1 x 0.006						0.06[a]		48445806
1 x 0.012						0.04[a]		
1 x 0.021			1.76[b]			0.61[a]		
1 x 0.045						0.23[a]		
1 x 0.088						1.01[a]		
Pumpkin								
1 x 0.022	0.08	0.03	0.20[b]					48755601
1 x 0.089	0.38	0.03	1.27[b]					

[a] Samples taken 7 days after treatment rather than immediately after treatment

[b] Whole plant samples in study MRID 48446601, flower samples in study MRID 48445806, leaf tissue in study MRIID 48755601.

c Not considered in the current risk assessment since the single application rate (0.134 lb a.i./A) exceeds the maximum single rate for the proposed Section 3 (0.09 lb a.i./A).

* Used for refining default estimates of oral exposure of bees to sulfoxaflor. Shaded cells indicate no data are available for the applicable matrix.

For the three treatments from the cotton residue study that correspond to currently proposed label rates summarized in **Table 6** (1 x 0.045, 2 x 0.045 and 1 x 0.089 lb a.i./A), a total of 132 individual samples of forager-collected pollen and nectar (66 paired samples) were obtained during the 10-day exposure during which time the hives remained in the tunnels **(Table A-1, Appendix A)**. For each of these 66 paired samples of residues in pollen and nectar, an acute oral RQ value was calculated based on consumption rates for adult nectar foragers (highest nectar exposure) and adult nurse bees (highest pollen exposure). Of the 132 acute RQ values calculated, only 4 exceed the acute risk LOC of 0.4 (**Table A-2, Appendix A**). The highest acute oral RQ value determined from these paired residue values is **0.72** for adult nectar foragers (Day 1, 1 x 0.045 lb ai/A treatment) and **0.72** for nurse bees (Day 0, 2 x 0.089 lb ai/A treatment). These acute oral RQ values slightly exceed the acute risk LOC of 0.4. Notably, the maximum acute RQ value for larval bees (0.08) does not exceed the acute risk LOC.

However, these RQ values assume that bees are foraging on the treated field, which is not expected to occur. Therefore, AgDRIFT modeling was conducted to estimate the distance from the treated field where the acute risk LOC of 0.4 would be exceeded. Bees may be foraging near the edges of these fields due to the presence of weeds or other attractive plants. The maximum

acute oral RQ of **0.72** was assumed to occur at the edge of the treated field. To estimate the corresponding reduction in this RQ as a function of distance from the treated field, this RQ was multiplied by the proportion of the on-field application rate estimated using AgDRIFT at various distances from the treated field edge (see **Table 3**) for each of the modeling scenarios. The results, shown in **Table 7**, indicate that the acute, oral RQ values for adult bees are below the acute risk LOC of 0.4 at **less than 1 foot** from the edge of the treated field regardless of modeling scenario chosen. Notably, the spatial extent to which the acute oral RQ may be exceeded adjacent to the treated field appears to be very small relative to the spatial extent of floral resources that would likely be available to bees further away from the treated field.

Table 7. Refined Tier 1 Acute, Oral RQ Values for Honey Bees at Varying Distances Off the Treated Field

Method	Droplets	Dv0.5 (µm)	Refined Maximum Acute Oral RQ at Varying Distances from the Treated Field					Distance From the Treated Field Edge Where the Acute Oral Risk LOC is Exceeded[3] (ft)
			10 ft	20 ft	40 ft	80 ft	150 ft	
Ground[1]	M/C	341	0.03	0.02	0.01	0.01	0.00	< 1
Aerial[2]	M to C	341	0.16	0.11	0.08	0.04	0.02	< 1

Table Notes:
M = medium spray nozzle, C = coarse spray nozzle, (M to C assumes a median droplet diameter of 341 µm)
[1] boom height = 4.2 ft
[2] boom height = 10 ft, wind speed = 10 mph, spray volume 3 gal/A
[3] distance (rounded to nearest ft) to LOC of 0.4 which equates to an estimated drift fraction of 56% beyond the field edge (i.e., a 56% reduction of the refined on-field RQ of 0.72).

6. Tier 2 Risk Characterization

The Tier 2 characterization of pesticide risks to bees involves evaluating effects of the pesticide on the entire colony. This is important to risk assessment because effects at the individual level may not result in similar (if any) effects at the colony level. In addition, evaluating effects at the colony level integrates multiple mechanisms by which a toxicant can affect the proper functioning of a colony (*e.g.*, behavior abnormalities, navigation, and learning) which may not be indicated by individual-level effects data.

As described previously, no acute or chronic risks are expected on the treated fields because of lack of exposure based on the lack of crop attractiveness to bees, agronomic practices and label restrictions for application only after the bloom period. However, there was exceedance of the acute risk LOC of 0.4 at short distances beyond the treated field (up to 12 feet for contact exposure and about 1 foot for oral exposure) for adult bees.

Based on label information described earlier, the predicted spray drift application rate of sulfoxaflor at 10 feet beyond the field margin would range from 0.005 lb a.i./A (assuming 0.023 lb a.i./A applied on the field) to 0.021 lb a.i./A (assuming 0.09 lb a.i./A applied on the treated field). Furthermore, there would be an expected exponential decline in these application rates with increasing distance from the treated field (**Table 4**).

As described in the previous Section 3 risk assessment, a total of 6 Tier 2 semi-field (tunnel) studies were submitted as part of the original new chemical registration. In these studies, effects observed on mortality, flight activity and behavioral abnormalities were short-lived (3 days or less). No sustained effects were observed on parameters such as forager mortality, flight activity, behavior abnormalities and hive strength at the application rates predicted at 10 feet or more beyond the field margin. It is noted that the application rates predicted within 10 feet of the field margin are at the low end of the rates evaluated in the submitted Tier 2 semi-field studies and rates at 20 feet are typically below the tested rates. Therefore, exposure considered in the Tier 2 tunnel studies are most applicable to regions immediately adjacent to the downwind portion of the treated field margin. Short-term effects on brood were not evident compared to controls; however, due to deficiencies in the study execution and/or design, the potential effects on brood over longer-time periods could not be conclusively determined.

7. Ecological Incident Reports

According to EPA's Ecological Incident Information System, one ecological incident was reported to EPA on 1/2/2014 that purportedly involved three insecticides: acephate, dichrotophos, and sulfoxaflor. A beekeeper in Dunklin County, MO stated from June through August, crops (including watermelon) were treated with pesticides, including Bidrin [dichrotophos], acetate, and sulfoxaflor as well as tank mixes of a variety of chemical products. The beekeeper reported that over 1,000 hives were affected by the pesticide use, which is listed as "incapacitation" in the EIIS database. There is no information on how many other pesticides may have been use, the legality of the use, the timing of pesticide application, presence or absence of other potential stressors (*e.g., Varroa, Nosema*) or data confirming that pesticide exposure actually occurred (*e.g.*, residues of pesticides in bees or the hive). Use of the pesticides was not confirmed independently. Given the limited information associated with this incident report and the apparent application of multiple pesticides, linking these reported effects to any one pesticide is not possible. No other incidents potentially associated with sulfoxaflor use over the past several years (either from Section 18 emergency uses on cotton, sorghum, alfalfa or from the previously registered Section 3) have been reported to the Agency.

8. Environmental Persistence of Sulfoxaflor in Bee Relevant Matrices

In addition to the spatial scale associated with off-field risks to bees described earlier (*e.g.*, 12 feet or less beyond the field edge for acute risk), it is also important to consider the temporal scale of risks (*i.e.*, how long bees may be exposed to sulfoxaflor). To characterize the temporal scale of risk, available data were evaluated on how long it takes for sulfoxaflor residues in pollen and nectar to dissipate. Specifically, dissipation half-life values (DT_{50}) were determined for sulfoxaflor residues measured in pollen and nectar from the cotton tunnel study (**Table 8 and Figure 1**). The median and 90^{th} percentile DT_{50} values of sulfoxaflor in cotton pollen and nectar are 2.3 and 8.6 days, respectively. These values indicate that sulfoxaflor has a relatively short persistence in cotton pollen and nectar.

Table 8. Compilation of dissipation half-life values for sulfoxaflor in cotton pollen and nectar

Application Number [1]	Application Rate (lb a.i./A)	DT_{50} (days)
Pollen Collected From Plants		
1	0.045	< 1
1	0.045	3.3
2	0.045	1
1	0.089	1.3
2	0.089	2.5
1	0.134	n.d.
2	0.134	5.5
Pollen Collected from Forager Bees		
1	0.045	4
1	0.045	2.6
2	0.045	1.7
1	0.089	2.3
2	0.089	11.6
1	0.134	1.2
2	0.134	69
Nectar Collected From Forager Bees		
1	0.045	2.1
1	0.045	2.1
2	0.045	1.7
1	0.089	2
2	0.089	6.6
1	0.134	8.3
2	0.134	6.9

[1] Number refers to the first or second consecutive application (MRID 48755606)

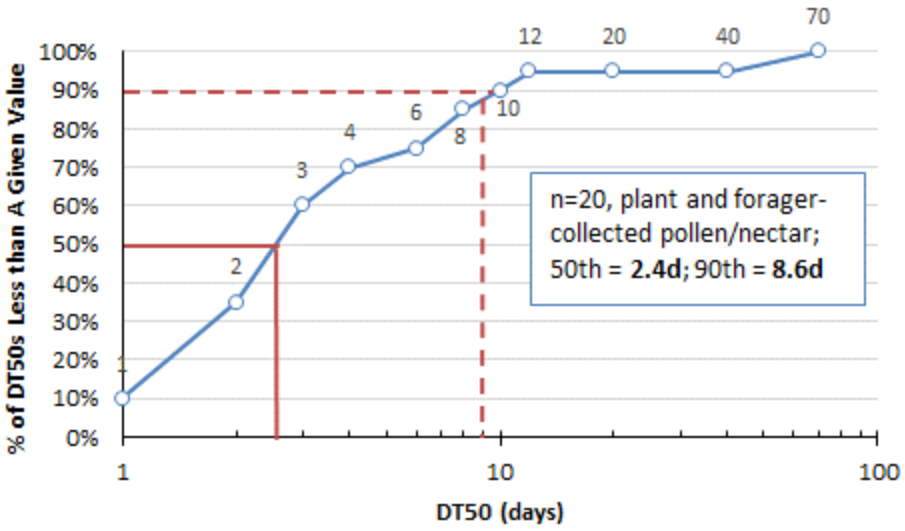


Figure 1. Cumulative frequency of DT50 values for sulfoxaflor in cotton pollen and nectar (MRID 48755606)

Although these data are for only one crop, a similar rapid decline in sulfoxaflor residues is observed in *Phacelia* pollen and nectar (MRID 48476601) where approximately 10% of the residues measured on day 0 remained by day 6. DT_{50} values were not determined because only three measures were available over time (days 0, 5 and 6).

9. Uncertainty Associated with Lack of Tier 1 Chronic Data for Bees

Although the potential for chronic (Tier 1) risks to individual bees foraging immediately adjacent to treated fields is not known due to lack of chronic adult Tier 1 data, a bounding analysis was conducted to estimate the uncertainty associated with lack of chronic toxicity data. This bounding analysis relies on the use of "acute-to-chronic ratios" (ACRs) derived from other nicotinic acetylcholine receptor (AChR) agonists to estimate a chronic No Observed Adverse Effect Level (NOAEL) for adult bees. The ACR is determined as the ratio of the acute oral LD_{50} to the chronic oral NOAEC for adult bees. Data for AChR agonists are considered most applicable to sulfoxaflor given similarities in the mode of action in insects.

Currently, data from which to derive ACRs for oral exposure of adult bees with AChR agonists are available for imidacloprid, clothianidin, and flupyradifurone **(Table B-1 of Appendix B)**. The calculated ACR values are 24.4 (imidacloprid), 10.3 (clothianidin) and 2.6 (flupyradifurone) with an overall mean ACR of 12.4. Using a mean ACR value of 12.4, a "central tendency" estimate of **0.0041 µg a.i./bee/d** was determined the adult chronic oral NOAEL. Using the maximum ACR of 24.4, an adult chronic oral NOAEL of **0.0021 µg a.i./bee/d** was determined and was subsequently used for calculating an "upper bound" estimate of chronic risk.

The estimated NOAEL of 0.0021 and 0.0041 µg a.i./bee/d were used to calculate upper bound and central tendency estimates of chronic Tier 1 risks, respectively, to adult nurse bees and nectar foragers. Nurse bees and nectar foragers consume the largest amounts of pollen and nectar, respectively, and would provide the greatest estimates of risk. Using each set of daily average concentrations sulfoxaflor in cotton pollen and nectar (**Table A-1 of Appendix A**) combined with the estimated NOAEL of 0.0021 µg a.i./bee/d, maximum chronic oral RQ values of **10.0** (nurse bees) and **8.8** (nectar foragers) are calculated as upper bound estimates of risk[6] Similarly, using the mean estimated NOAEL of 0.0041 µg a.i./bee/d and the same set of residue data, maximum chronic oral RQ values of **5.1** (nurse bees) and **4.5** (nectar foragers) are calculated as central tendency estimates of risk.

However, these chronic oral RQ values assume that bees are foraging on the treated field, which is not expected to occur. Therefore, AgDRIFT modeling was conducted to estimate the distance from the treated field where the chronic risk LOC of 1.0 would be exceeded. The maximum chronic RQ values described previously were assumed to occur at the edge of the treated field. To estimate the corresponding reduction in these RQ values as a function of distance from the treated field, each RQ was multiplied by the proportion of the on-field application rate estimated using AgDRIFT at various distances from the treated field edge (see **Table 3**) for each of the modeling scenarios. This analysis indicates that the potential for chronic (Tier 1) oral risks bees foraging adjacent to the treated fields would extend from **2-14 feet** beyond the treated field assuming a central tendency estimate of the chronic oral NOAEL (**Tables B-2 and B-3 of Appendix B**) and label restrictions on ground and aerial application. Potential chronic oral risks to adult bees would extend from **4-46 feet** beyond the treated field assuming the lower estimate of the chronic NOAEL (0.0021 µg a.i./bee/d; **Tables B-4 and B-5 of Appendix B**).

Although not without important caveats, this bounding analysis suggests that chronic Tier 1 risks may be of concern over a relatively small distance beyond the treated (2-46 feet, depending on modeling and toxicity assumptions). Importantly, the use of an ACR value to estimate chronic NOAEL introduces uncertainty into the risk estimate due to the considerable variability observed in the ACR values (range: 2.6 to 24.4). However, this bounding analysis is also considered highly conservative because it assumes that bees would obtain 100% of their diet from the relatively narrow contaminated area beyond the treated fields. Furthermore, the duration of exposure is likely to be relatively short based on the relatively short persistence of sulfoxaflor in pollen and nectar described previously.

10. Risk Assessment Conclusions, Assumptions, and Uncertainty

In consideration of multiple lines of evidence described in the previous sections, the following risk conclusions are reached for bees.

[6] As indicated in the Agency's recently published bee risk assessment with imidacloprid, use of daily average residues of pesticides is considered appropriate for estimating chronic Tier 1 risks to bees https://www.regulations.gov/#!docketBrowser;rpp=25;so=DESC;sb=postedDate;po=0;dct=SR;D=EPA-HQ-OPP-2008-0844)

1. **Acute and chronic risks on the treated field are not indicated.** For all of the proposed uses, acute and chronic risks to bees are considered low for bees potentially foraging on the treated field since significant exposure is not expected. Lack of exposure is presumed since crops are considered unattractive to bees, are harvested prior to bloom, or because applications are prohibited until after the bloom period of the crop.

2. **The spatial extent of acute risks beyond the treated field is very limited.** For all of the proposed uses of sulfoxaflor, acute oral and contact risk to bees which may forage immediately adjacent to the treated field during (or shortly after) application is limited to <1 – 12 feet beyond the treated field. Therefore, a spray drift buffer of 12 feet would be expected to mitigate acute risk to bees that may be foraging in this zone adjacent to treated fields.

3. **A bounding analysis suggests that estimated chronic risks are also spatially limited beyond the treated field.** A bounding analysis using estimated values of chronic toxicity to adult bees suggests that chronic Tier 1 risks may be of concern over a relatively small distance beyond the treated (2-46 feet, depending on modeling and toxicity assumptions).

4. **Temporal extent of acute and chronic risks beyond the treated field is limited**. Data on the persistence of sulfoxaflor in pollen and nectar suggests that residues will degrade relatively quickly (90% of the half-life values are approximately 9 days or less and 50% are approximately 2 days or less).

A number of assumptions and uncertainties are noted in the preceding risk assessment. These include:

1. **Off-Field Diet/Forage Habitat.** Off-field (Tier 1) risk assessment assumes that bees will be foraging in the spray drift zone adjacent to the treated field and that they obtain 100% of their diet from blooming plants in this zone. This assumption likely overestimates exposure and off-field risk because plants will not always be in bloom, and when they are in bloom, not all plants will be attractive to bees. Furthermore, honey bees often forage opportunistically on a variety of forage sources across the landscape (up to 5 miles from the hive).

2. **Residue Profile in Pollen and Nectar.** Refined risk estimates for oral exposure used for estimating on-field and off-field risks assume that residues of sulfoxaflor in pollen and nectar of flowering plants are equivalent to the maximum residues measured in pollen and nectar of cotton, which occurred within two days of foliar application. Among the three plant species for which residue data are available, the greatest residues in pollen and nectar were observed with cotton. Furthermore, foliar applications to cotton were made during the blooming period which would tend to maximize residues in pollen and nectar for this crop. Since not all plants inhabiting the acute and chronic spray drift zone beyond the field edge will be blooming, residues in non-blooming plants will be subject to dissipation prior to the bloom period which will lead to reduced residues during bloom (median foliar dissipation half-life = 2.3 days). However, since the species of plant adjacent to the treated field cannot be predicted with certainty, it is possible that

sulfoxaflor residues in cotton could be higher or lower than residues in blooming plants adjacent to the treated field immediately following pesticide application.

3. **Lack of Tier 1 Chronic Toxicity Data.** No Tier 1 risk assessment was conducted to assess chronic exposures because acceptable chronic Tier 1 data are not available for sulfoxaflor for adult or larval bees. If sulfoxaflor has a similar toxicity profile as imidacloprid in terms to its ACR, then the chronic (Tier 1) risk could potentially extend to 46 feet beyond the treated field (aerial applications). If sulfoxaflor has a toxicity profile similar to the mean ACR of imidacloprid, clothianidin, and flupyradifurone, then chronic (Tier 1) risk could potentially extend up to 14 feet beyond the treated field. It is noted that OPP has only recently been requiring chronic Tier 1 bee toxicity data since the publication of its bee risk assessment guidance in 2014 as more reliable test protocols have been developed for such tests.

11. Additional Recommended Data

Based on the proposed uses of sulfoxaflor, which are not expected to result in exposure of bees on the treated field and are expected to result in very limited off-field exposure, additional data pertaining to bees is not requested at this time. It is noted, however, that additional chronic Tier 1 data would help to reduce uncertainty in the bounding analysis of spray drift for estimating chronic risk. These additional Tier 1 data (and possibly higher tier exposure and effects data) would likely be needed in the future in order to evaluate any new (proposed) uses of sulfoxaflor that result in significant exposure of bees.

Appendix A

Forager-Collected Pollen and Nectar Residues of Sulfoxaflor and Associated Acute Oral RQs From the Cotton Tunnel Study (MRID 48755606).

Table A-1. Forager-Collected Pollen and Nectar Residues from the Cotton Tunnel Study (MRID 48755606)

Application Rate (lb a.i./A)	Day	Forager-Collected Pollen (µg ai/kg)			Forager-Collected Nectar (µg ai/kg)		
		H1	H2	Pollen Average	H1	H2	Nectar Average
0.045	0	127.40	187.40	157.40	32.67	21.70	27.19
---	1	**122.00**	144.80	133.40	**126.40**	1.51	63.96
---	2	150.40	52.27	101.34	8.32	2.05	5.18
---	3	222.30	81.86	152.08	5.00	0.64	2.82
---	4	120.10	72.60	96.35	5.00	1.29	3.15
---	5	102.40	33.68	68.04	16.05	0.28	8.16
---	6	66.40	68.61	67.51	8.05	1.05	4.55
---	7	18.66	37.63	28.15	3.95	0.82	2.39
---	8	32.24	55.96	44.10	3.02	0.72	1.87
---	9	29.88	58.37	44.13	1.93	0.07	1.00
---	10	49.22	12.63	30.93	1.64	0.16	0.90
0.045	0	225.90	173.00	199.45	9.53	8.68	9.11
---	1	124.10	224.50	174.30	21.21	16.68	18.95
---	2	96.70	125.40	111.05	29.71	8.39	19.05
---	3	143.80	271.50	207.65	15.51	11.23	13.37
---	4	81.74	32.62	57.18	11.10	3.70	7.40
0.045	5	829.50	192.40	510.95	48.97	44.96	46.97
---	6	229.10	296.00	262.55	26.46	14.38	20.42
---	7	271.80	145.00	208.40	41.96	8.70	25.33
---	8	84.01	146.90	115.46	14.63	7.09	10.86
---	9	68.00	32.23	50.12	8.03	5.36	6.69
---	10	55.89	83.13	69.51	6.28	4.55	5.41
0.089	0	**2782.00**	512.20	1647.10	**73.78**	2.52	38.15
---	1	242.60	350.10	296.35	25.94	22.67	24.31
---	2	250.80	298.60	274.70	11.89	19.33	15.61
---	3	99.52	116.00	107.76	8.59	3.59	6.09
---	4	191.90	102.60	147.25	3.94	16.96	10.45
0.089	5	796.60	1146.00	971.30	22.87	21.86	22.37
---	6	393.60	400.00	396.80	21.97	33.65	27.81
---	7	320.20	2262.00	1291.10	12.80	19.74	16.27
---	8	255.20	371.30	313.25	8.85	31.46	20.16
---	9	113.20	317.00	215.10	5.21	11.54	8.38
---	10	117.80	1323.00	720.40	10.24	35.52	22.88

H1 = hive 1, H2 = hive 2 (two hives per tunnel); values in bold indicate the paired residue values that resulted in the highest acute oral RQ to nectar foragers and nurse bees

Table A-2. Acute oral RQ values calculated for Nurse Bees and Nectar Foragers Based on the Cotton Tunnel Study (MRID 48755606)

Application Rate (lb a.i./A)	Day	Nurse Bee Acute Oral RQ		Nectar Forager Acute Oral RQ	
		H1	H2	H1	H2
0.045	0	0.11	0.09	0.19	0.12
---	1	0.37	0.03	**0.72**	0.01
---	2	0.05	0.02	0.05	0.01
---	3	0.06	0.02	0.03	0.00
---	4	0.04	0.02	0.03	0.01
---	5	0.06	0.01	0.09	0.00
---	6	0.03	0.02	0.05	0.01
---	7	0.01	0.01	0.02	0.00
---	8	0.01	0.01	0.02	0.00
---	9	0.01	0.01	0.01	0.00
---	10	0.01	0.00	0.01	0.00
0.045	0	0.07	0.06	0.05	0.05
---	1	0.08	0.09	0.12	0.09
---	2	0.10	0.05	0.17	0.05
---	3	0.07	0.08	0.09	0.06
---	4	0.05	0.02	0.06	0.02
0.045	5	0.29	0.16	0.28	0.26
---	6	0.11	0.09	0.15	0.08
---	7	0.16	0.05	0.24	0.05
---	8	0.06	0.05	0.08	0.04
---	9	0.03	0.02	0.05	0.03
---	10	0.03	0.03	0.04	0.03
0.089	0	**0.72**	0.10	**0.42**	0.01
---	1	0.12	0.13	0.15	0.13
---	2	0.08	0.11	0.07	0.11
---	3	0.04	0.03	0.05	0.02
---	4	0.05	0.07	0.02	0.10
0.089	5	0.21	0.27	0.13	0.12
---	6	0.13	0.17	0.12	0.19
---	7	0.09	**0.48**	0.07	0.11
---	8	0.07	0.15	0.05	0.18
---	9	0.04	0.09	0.03	0.07
---	10	0.05	0.34	0.06	0.20

H1 = hive 1, H2 = hive 2 (two hives per tunnel); RQ values in bold/shaded cells exceed the acute risk LOC of 0.4

Appendix B

Bounding Analysis of the Potential for Chronic (Tier 1) Oral Risks to Adult Bees

Table B-1. Data Considered for Estimation of the Adult Chronic Oral NOAEL for Sulfoxaflor.

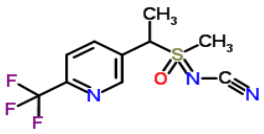
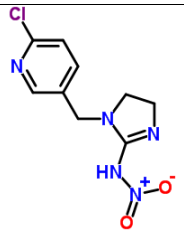
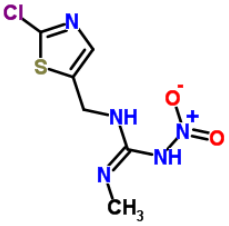
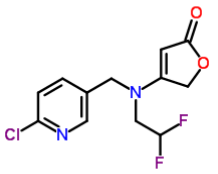
Chemical (IRAC Class) [ACR]	Structure	MW (g/mol)	Kow	Vapor Pressure	Aerobic Soil DT50	Acute & Chronic Adult Endpoints[1]
Sulfoxaflor (4C)		277	6	Low	Rapid (2-8 d)	**LD_{50} =0.0515 µg ai/bee/d** (MRID 47832417) Estimated Chronic NOAEL = 0.0021 - 0.0041 µg ai/bee/d (using Max ACR of 24.4 and mean ACR of 12.4, respectively)
Imidacloprid (4A) **(ACR=24.4)**		255	3.7	Low	200 d to > 1 yr	**LD_{50} =0.0039 µg ai/bee/d** (MRID 42273003) **Chronic NOAEL = 0.00016 µg ai/bee/d** (MRID 49750601)
Clothianidin (4A) **(ACR =10.3)**		250	1.1	Low	> 1 year	**LD_{50} =0.0037 µg ai/bee/d** (MRID 45422426) **Chronic NOAEL = 0.00036 µg ai/bee/d** (MRID 48414901)
Flupyradifurone (4D) **(ACR = 2.6)**		288	1.2	Low	35 d- >1 yr	**LD_{50} =1.2 µg ai/bee/d** (MRID 48843722) **Chronic NOAEL = 0.464 µg ai/bee/d** (MRID 48843762)

Table B-2. Upper Bound Estimates of Chronic (Tier 1) Risks to Adult Nurse Bees

Method	Droplets	Dv0.5 (µm)	Upper Bound Chronic RQs for Nurse Bees @ spray drift distances from the field edge					Distance to chronic LOC [3]
			10 ft	20 ft	40 ft	80 ft	150 ft	
Ground[1]	M/C	341	0.46	0.25	0.15	0.08	0.06	5
Aerial[2]	M to C	341	**2.3**	**1.6**	**1.1**	0.59	0.27	46

Table Notes:
M = medium spray nozzle, C = coarse spray nozzle, (M to C assumes a median droplet diameter of 341 µm)
1 boom height = 4.2 ft, On-Field Chronic RQ of 10.0 estimated using max. ACR of 24.4
2 boom height = 10 ft, wind speed = 10 mph, non-volatile rate 0.09 lb a.i./A, spray volume 3 gal/A
3 distance to LOC of 1.0 which equates to a 10% drift fraction based on a maximum estimated chronic oral RQ of 10.0 for nurse bees with an estimated chronic adult NOAEL of 0.0021 ug a.i./bee/d.

Table B-3. Upper Bound Estimates of Chronic (Tier 1) Risks to Adult Nectar Foragers

Method	Droplets	Dv0.5 (µm)	Upper Bound Chronic RQs for Nectar Foragers @ spray drift distances from the field edge s					Distance to chronic LOC [3]
			10 ft	20 ft	40 ft	80 ft	150 ft	
Ground[1]	M/C	341	0.40	0.22	0.13	0.07	0.05	4
Aerial[2]	M to C	341	**2.0**	**1.4**	0.94	0.52	0.24	35

Table Notes:
M = medium spray nozzle, C = coarse spray nozzle, (M to C assumes a median droplet diameter of 341 µm)
1 boom height = 4.2 ft, On-Field Chronic RQ of 5.1 estimated using max. ACR of 24.4
2 boom height = 10 ft, wind speed = 10 mph, non-volatile rate 0.09 lb a.i./A, spray volume 3 gal/A
3 distance to LOC of 1.0 which equates to an 11.3% drift fraction based on a maximum estimated chronic oral RQ of 8.8 for nectar foragers with an estimated chronic adult NOAEL of 0.0021 ug a.i./bee/d.

Table B-4. Central Tendency Estimates of Chronic (Tier 1) Risks to Adult Nurse Bees

Method	Droplets	Dv0.5 (µm)	Central Tendency Chronic RQ for Nurse Bees @ spray drift distances from the field edge					Distance to chronic LOC [3]
			10 ft	20 ft	40 ft	80 ft	150 ft	
Ground[1]	M/C	341	0.23	0.13	0.07	0.04	0.03	2
Aerial[2]	M to C	341	**1.2**	0.80	0.54	0.30	0.14	14

Table Notes:
M = medium spray nozzle, C = coarse spray nozzle, (M to C assumes a median droplet diameter of 341 µm)
1 boom height = 4.2 ft, On-Field Chronic RQ of 4.5 estimated using max. ACR of 24.4
2 boom height = 10 ft, wind speed = 10 mph, non-volatile rate 0.09 lb a.i./A, spray volume 3 gal/A
3 distance to LOC of 1.0 which equates to a 19.6% drift fraction based on a maximum estimated chronic oral RQ of 5.1 for nurse bees with an estimated chronic adult NOAEL of 0.0041 ug a.i./bee/d.

Table B-5. Central Tendency Estimates of Chronic (Tier 1) Risks to Adult Nectar Foragers

Method	Droplets	Dv0.5 (µm)	Central Tendency Chronic RQ for Nectar Foragers @ spray drift distances from the field edge					Distance to chronic LOC [3]
			10 ft	20 ft	40 ft	80 ft	150 ft	
Ground[1]	M/C	341	0.21	0.11	0.07	0.04	0.03	2
Aerial[2]	M to C	341	**1.0**	0.71	0.48	0.27	0.12	11

Table Notes:
M = medium spray nozzle, C = coarse spray nozzle, (M to C assumes a median droplet diameter of 341 µm)
1 boom height = 4.2 ft, On-Field Chronic RQ of 10.0 estimated using max. ACR of 24.4
2 boom height = 10 ft, wind speed = 10 mph, non-volatile rate 0.09 lb a.i./A, spray volume 3 gal/A
3 distance to LOC of 1.0 which equates to a 22% drift fraction based on a maximum estimated chronic oral RQ of 4.5 for nectar foragers with an estimated chronic adult NOAEL of 0.0041 ug a.i./bee/d.