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WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

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MEMORANDUM

SUBJECT: Dimethenamid/Dimethenamid-p: Draft Ecological Risk Assessment for Registration Review

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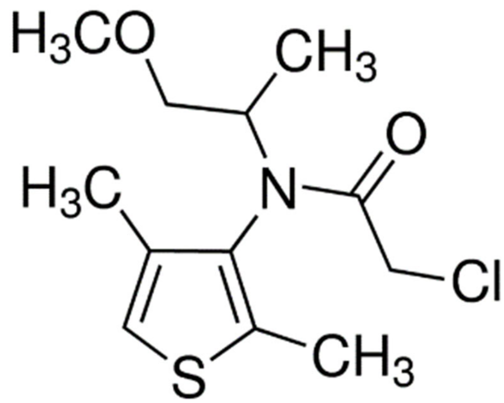
The Environmental Fate and Effects Division (EFED) completed the draft ecological risk assessment in support of the Registration Review of the herbicide, dimethenamid and dimethenamid-p.

Draft Ecological Risk Assessment for the Registration Review of Dimethenamid and Dimethenamid-p



Dimethenamid and Dimethenamid-p
CAS Nos: 87674-68-8, 163515-14-8
USEPA PC Codes: 129051, 120051

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1 Executive Summary

1.1 Overview

This Draft Risk Assessment (DRA) examines the potential ecological risks associated with labeled uses for the amide herbicides dimethenamid (unresolved isometric mixture) and dimethenamid-p (s-isomer). Dimethenamid was first registered in the United States in 1993 and both forms are used as a selective and systemic herbicide registered for the control of sedges, annual grasses, and broadleaf weeds in a wide range of agricultural and non-agricultural use sites. Since 2000, all new crop use registrations have been with dimethenamid-p. Major agricultural use sites of these herbicides include crops such as field corn, grain sorghum, soybean, dry beans, peanuts, potatoes, and a variety of other field crops described in the use sites section of this document. The major non-agricultural use sites include landscape and ground maintenance areas, tree plantations, turf-grass areas, golf courses, commercial ornamental production sites and grass grown for seed. According to the classification of herbicides, dimethenamid/dimethenamid-p belongs to the family of chloroacetamide herbicides.

This risk assessment uses a streamlined approach to focus on the taxa of primary risk concern based on previously completed risk assessments, and taxa for which additional data have become available (terrestrial invertebrates). Taxa of focus in this assessment are the terrestrial invertebrates (*i.e.,* pollinators). For other taxa, the risk conclusions are summarized in this document based on previous risk assessments, and for birds and mammals, an update for the granular risk characterization is included.

The residue of concern (ROC) for these assessments is for parent, dimethenamid/ dimethenamid-p. Based on available data for a variety of taxa, dimethenamid/ dimethenamid-p is more toxic to non-target species than its environmental transformation products.

Additionally, the focus of the assessment is on the enriched dimethenamid-p isomer. This is primarily because most of the current use going forward is for dimethenamid-p. Additionally, the two ingredients have similar use patterns and environmental fate and toxicity values. Therefore, a bridging approach was used previously, and continues to be used, to gather information for a single assessment to cover both isomers. The bridging strategy for the environmental fate and ecotoxicity data is to use dimethenamid-p data, when available, and to fill any gaps with racemic dimethenamid data. For data in which studies for both dimethenamid-p and the racemic dimethenamid mixture are available, only dimethenamid-p is used. This is the same approach that was outlined at the problem formulation stage.

Risk Conclusions Summary

Aquatic Taxa
Dimethenamid/Dimethenamid-p residues may persist in aquatic environments. However, when modelling the maximum use patterns, the estimated exposure concentrations (EECs) are 2-3 orders of magnitude below the toxicity endpoints for fish and aquatic invertebrates and all RQs are below the LOC. Therefore, the risk from dimethenamid/dimethenamid-p is low for aquatic animals. For aquatic plants, there is risk identified with RQs ranging from 1.3-3.6 and 0.86-2.3 for vascular and non-vascular plants, respectively.

Terrestrial Taxa
In the terrestrial environment, there are acute LOC exceedances for birds (RQs ranged from <0.01-0.8), although, the RQ of 0.8 is noted to be specific to the 20-gram bird feeding on short grass. For further characterization, when considering the mean EECs, there are no LOC exceedances. Chronic/sublethal risk was assessed for birds using the reproduction study. With a NOAEC of 360 mg a.i./kg-diet, the RQs ranged from 0.09-1.5 (with exceedances from the short grass dietary items). The endpoint is based on a 6.6% body weight reduction at the 900 mg a.i./kg diet. For further characterization, when using the concentration where the effects were observed (*i.e.,* the LOAEC value), there were no exceedances. Therefore, in both cases, risk is identified but may be limited in scope.

For mammals, risk from acute exposure is low. For sublethal/chronic risk, there are LOC exceedances based on body weight effects (dose based RQs ranged from 0.03-9.4). For further characterization, if using the concentration where effects were observed (LOAEC), there would be exceedances (RQs are 1 and 2.3 for rates of 0.98 and 1.5 lb a.i./A, respectively), thus, there is a potential risk identified.

Based on acute contact exposure to adult honeybees, RQs range from 0.028- 0.043 for rates of 1 and 1.5 lb a.i./A, respectively, thus, contact risk to adult bees is low. Based on acute oral studies, for adult honeybees, dimethenamid-p acute exposure resulted in a non-definitive (*e.g.,* > 100 µg a.i./bee) endpoint, thus, RQs were not calculated. For larval worker honeybees, acute RQs range from 0.256-0.38 and are below the LOC, thus, acute risk to larval stage bees is low.

On a chronic exposure basis, oral exposure to larval worker honeybees results in LOC exceedances (RQs=2.16 and 3.24). For adult honey bees, chronic RQs were not calculated due to a non-definitive endpoint (*i.e.,* a "less than" NOAEL of <2.46 µg a.i./bee/d), however, if using the lowest test concentration as a proxy, the EECs range from approximately 13 -20 times higher than the toxicity endpoint (and LOC). Therefore, based on these analyses, both life stages (adult and larval) have a potential for effects. This assessment is limited to Tier 1 data so further refinement/risk description is not available.

Terrestrial Plants
Dimethenamid-p is a systemic herbicide and with aerial and ground applications at rates up to 1.5 lbs a.i./A. There are LOC exceedances with RQs ranging from 2.3-130.

1.2 Environmental Fate and Exposure Summary

The major route of dissipation for both isomers is through soil metabolism, with an aerobic soil half-life of 7-41 days (MRIDs 44332261, 41596532, 44083204, 44083203, and 44083202) and an anaerobic soil half-life of 54 days from a single study (MRID 41706801). Major transformation products formed under aerobic soil metabolism include oxalamide and sulfonate. If the compound were to reach surface water, it may persist because it is stable to hydrolysis at pHs 5, 7, and 9 (MRID 44332258) and persistent to aqueous photolysis (half-life of 51 days) (MRID 44332259). Aerobic aquatic metabolism data are not available. Volatilization from soil or water is not expected to be a major dissipation route for dimethenamid-P and it is not expected bioaccumulate. Batch equilibrium data (Koc 90-474) (MRIDs 44332263, 42034806) suggest that both isomers are considered mobile to moderately mobile based on FAO mobility classification (FAO, 2000).

Terrestrial field dissipation studies indicate that dimethenamid dissipates with estimated half-life values between 8-41 days. Dimethenamid and its two transformation products (oxalamide and sulfonate) were observed to leach up to a depth of 30 cm. The two transformation products were generally observed at greater depths than dimethenamid (MRIDs 42266202, 42266203, 42266204, 42266205).

1.3 Ecological Effects Summary

Given the similarity in toxicity between dimethenamid and dimethenamid-p, this assessment uses a bridging approach (with a focus on dimethenamid-p, if available). For the purpose of summarizing the ecotoxicity data, this assessment uses the term “dimethenamid-p” as a general reference to both compounds, while the toxicity tables indicate the specific isomer used in the study. As noted earlier, the enriched dimethenamid-p isomer and racemic dimethenamid (R/S isomer) are considered approximately equivalent in toxicity, except for plants, where dimethenamid-p is of greater toxicity.

Aquatic Ecotoxicity Data
For aquatic animals, dimethenamid-p is classified as “moderately toxic” to freshwater (FW) fish and estuarine/marine (E/M) invertebrates and as “slightly toxic” to E/M fish and FW invertebrates. On a chronic exposure basis, the FW fish NOAEC of 0.12 mg a.i./L is based on reduced larval growth in rainbow trout at 0.24 mg a.i./L. Chronic data are not available for E/M fish or invertebrates. For FW invertebrates, the NOAEC is 1.4 mg a.i./L based on reduced survival (68% reduction) and growth in daphnids at 2.51 mg a.i./L.

Non-vascular aquatic plants were more sensitive than vascular aquatic plants, with an EC_{50} value of 0.014 mg a.i./L (based on reductions of cell density for green algae) and EC_{50} values of 0.0089 mg a.i./L (based on reductions in frond biomass in *Lemna gibba*) for vascular plants.

Terrestrial Ecotoxicity Data
For birds, dimethenamid-p is classified as "slightly toxic" to birds on an acute oral basis. On a subacute dietary basis, data are available for the mallard duck, bobwhite quail, and a passerine species [Canary (*Serinus canaria*)] and for all three species tested, dimethenamid-p is classified as "practically non-toxic" with a non-definitive endpoint (*e.g.,* LC_{50} >5000 mg a.i./kg-diet). A reproductive toxicity study with bobwhite quail had NOAEC/LOAEC values of 360/900 mg a.i./kg-diet, respectively, based on male body weight reductions at study termination (6.6%). For mammals, dimethenamid-p is classified as "moderately toxic" to "slightly toxic" depending on if a carrier is used (LD_{50}s ranged 480-2400). In a mammalian reproduction study with the rat, the NOAEC is 500 mg a.i./kg diet based on body weight effects at 2000 mg a.i./kg diet.

The available data for terrestrial plants exposed to TGAI (96.5% a.i.), indicate that dimethenamid-p exposure to seeds in treated soils resulted in reduced shoot length with an EC_{25} of 0.0059 and 0.0064 lbs a.i./A, for monocots and dicots, respectively. Exposure to plant foliage resulted in a monocot EC_{25} of 0.026 lb a.i./A and a dicot EC_{25} of 0.12 lb a.i/A.

For terrestrial invertebrates, dimethenamid-p is classified as "practically non-toxic" to adult bees on an acute exposure basis (acute oral and contact). For larval stage bees, the 72-hour acute oral LD_{50} is 53 µg a.i./bee and, thus, also, "practically non-toxic" to larval stage bees on an acute exposure basis. In a 10-day chronic exposure study with adult honey bees, a NOAEL was not established (LOAEL <2.455 µg a.i./bee) as there was a 15% reduction in food consumption and mortality (8%) at the lowest treatment level. The chronic larval NOAEL/LOAEL is 6.3/13 µg a.i./bee based on 50% mortality (day 22-emergence) at 13 µg a.i./bee.

1.4 Identification of Data Needs

The environmental fate database is complete. The following data would be helpful in order to conduct a full-pollinator assessment. These data are described under the *Guidance for Assessing Pesticide Risks to Bees* (USEPA, 2014).

- Non-guideline (Tier II): Semi-field testing for pollinators (tunnel or colony feeding studies)
- Non-guideline (Tier II): Field trial of residues in pollen and nectar
- OCSPP 850.3040 (Tier III): Field testing for pollinators
  (pending risks identified in Tier II studies)

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

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC for Non-listed Species	Additional Information/ Lines of Evidence
Freshwater Fish	Acute	<0.01-0.1	No	The EECs have been refreshed to reflect the latest modelling guidance. All RQs are below the LOC. The risk conclusions are the same as in past assessments-Low risk to fish and aquatic invertebrates.
	Chronic	0.8-0.2	No	
Estuarine/ Marine Fish	Acute	<0.01	No	
	Chronic	No Data	-	
Freshwater Invertebrates	Acute	<0.01	No	
	Chronic	0.01-0.02	No	
Estuarine/ Marine Invertebrates	Acute	<0.01-0.01	No	
	Chronic	No Data	-	
Aquatic plants	Non-vascular	0.86-**2.3**	Yes	Aquatic plant exceedances for nearly all of the uses and monitoring data provides line of evidence for potential exposure.
	Vascular	1.3-**3.6**	Yes	
Mammals	Acute	Foliar:<0.01-0.49 Granular:0.04-0.99	No	Chronic: RQ exceedances based on body weight effects (the RQ range depends on body size and feed items; exceedance includes small-large mammals for most diet types). However, for characterization, if using the LOAEC, the RQs are 1 and 2.3 for rates of 0.98 and 1.5 lb a.i./A, respectively.
	Chronic	Foliar: 0.03-**9.4**	Yes (foliar)	
Birds	Acute	Foliar:<0.01-**0.8** Granular:0.01-**1.0**	Yes (foliar)	Acute: For the turf use pattern only, the acute RQ of 0.8 is specific for the 20g bird feeding on short grass. There are no exceedances based on the mean EECs. Granular RQ exceeds LOC but overall risk is low based on the number of granules required. Chronic: Risk is based on a 6.6% body weight reduction at 900 mg a.i./kg diet. No exceedances using LOAEC.
	Chronic	Foliar: 0.09-**1.5**	Yes (foliar)	
Terrestrial Invertebrates[2]	Acute Adult	Oral: Not calculated Contact: 0.03-0.04	No	The 10-day chronic oral toxicity test for adult honey bees resulted in a non-definitive endpoint with reductions in food consumption through the lowest concentration. *Comparing the EECS to the lowest test concentration, there a potential for effects with EECs 13-20 X greater than the lowest test concentration. Only Tier I data. No residue data to refine exposure. Timing of some crop uses may preclude exposure during flowering crop stage. Several attractive crops registered.
	Chronic Adult	Not calculated	Likely* (foliar)	
	Acute Larval	0.256-0.38	No	
	Chronic Larval	**2.2-3.2**	Yes (foliar)	

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC for Non-listed Species	Additional Information/ Lines of Evidence
Terrestrial Plants	N/A	Foliar: **1.5-130** Granular: 0.01-**127**	Yes (foliar and granular)	Runoff is the driver for plant risk. Several plant incidents reported.

Level of Concern (LOC) Definitions:
Terrestrial Animals: Acute=0.5; Chronic=1.0; Terrestrial invertebrates=0.4
Aquatic Animals: Acute=0.5; Chronic=1.0
Plants: 1.0
[1] RQs reflect exposure estimates for parent and maximum application rates allowed on labels.
[2]RQs for terrestrial invertebrates are applicable to honey bees, which are also a surrogate for other species of bees. Risks to other terrestrial invertebrates (e.g., earthworms, beneficial arthropods) are only characterized when toxicity data are available.

2 Introduction

This Draft Risk Assessment (DRA) examines the potential ecological risks associated with labeled uses of dimethenamid and dimethenamid-p on non-target organisms. The DRA uses the best available scientific information on the use, environmental fate and transport, and ecological effects of dimethenamid and dimethenamid-p. The general risk assessment methodology is described in the *Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs* ("Overview Document")(USEPA, 2004). Additionally, the process is consistent with other guidance produced by the Environmental Fate and Effects Division (EFED) as appropriate. When necessary, risks identified through standard risk assessment methods are further refined using available models and data. This risk assessment incorporates the available exposure and effects data and most current modeling and methodologies.

3 Problem Formulation Update

As part of the Registration Review (RR) process, a detailed Problem Formulation (USEPA, 2016) for this DRA was published to the docket in April, 2016. The following sections summarize the key points of the Problem Formulation and discusses key differences between the analysis outlined there and the analysis conducted in this DRA.

As summarized in the Problem Formulation, based on previous risk assessments, potential risks associated with the use of dimethenamid/dimethenamid-p include risks to terrestrial and aquatic plants, birds and mammals, and risk to terrestrial invertebrates was uncertain without data. Since the Problem Formulation was completed, the following data have been submitted:

- Fate and Exposure Data
    - Water Independent Laboratory Validation and Environmental Chemistry Method (OCSPP 850.6100; 50362703, 50362702)

  - Sediment Independent Laboratory Validation and Environmental Chemistry Method (OCSPP 850.6100; 50362706, 50362701)

- Ecotoxicity Data
  - Honey Bee Larvae Acute Oral Study (Non-guideline / OECD TG237, Tier I).
  - Honey Bee Larvae Chronic Oral Toxicity Study (Non-guideline, Tier I).
  - Honey Bee Adult Chronic Oral Toxicity Study (Non-guideline, Tier I).

These new data for pollinators are described in more detail in the effects characterization **(Section 0)**.

3.1 Mode of Action for Target Pests

Dimethenamid and dimethenamid-p belong to the chloroacetamide group of herbicides (protein synthesis inhibitors) and are used for control of germinating seeds and very small emerged seedlings of many annual grasses and few small-seeded broadleaf species. Treated seeds usually germinate, but the seedlings either do not emerge from the soil or emerge and exhibit abnormal growth due to inhibition of cell elongation and cell division. Chloroacetamides have been reported to inhibit the synthesis of lipids, fatty acids, leaf waxes, terpenes, flavonoids, and proteins as well interfere with hormone regulation in plants. Uptake of chloroacetamide herbicides is primarily through the shoots (especially monocots) and roots (especially dicots). The primary anatomical sites of action are the developing leaves beneath the coleoptile and the apical and intercalary meristems near the coleoptilar mode. In addition, chloroacetamides are metabolized in plants and it is noted that dimethenamid and dimethenamid-p have a unique sulfur- containing phenyl ring.

3.2 Label and Use Characterization

3.2.1 Label Summary

<u>Dimethenamid</u>

Dimethenamid is currently registered for use on corn, dry beans/peas, onions, peanuts, sorghum, soybeans, and sweet corn. Dimethenamid is also currently registered for several non-agricultural uses including use in landscape or grounds maintenance, ornamental production, and turf-grass (*e.g.,* golf courses, institutional turf). Registered formulations for dimethenamid are emulsifiable concentrates and a granular. Current formulated products for dimethenamid-p are a soluble concentrate, emulsifiable concentrates, and granulars.

Based on current labels, the maximum single application rate ranges from 0.07659 to 1.5 pounds of active ingredient per acre (lb a.i./acre). Up to two applications per year are allowed for some uses; however, it should be noted that for some uses the number of applications per year or maximum annual application rate is not specified.

Dimethenamid-p

Use in beans (dry), sugar beets, corn (field, pop, seed, sweet), garlic, hops, horseradish, onions (bulb and green) peanut, potato and other root and tuber vegetables, shallots, sorghum, soybean, winter squash and perennial grasses grown for seed, sod farms. Non-ag uses include: landscaped ornamentals (in residential, commercial, and institutional settings), golf courses, prairie grass/naturalized areas, common areas in residential developments, in commercial nurseries, for establishment and /or maintenance of tree plantations (christmas tree, conifer/hardwood seedling nurseries etc.), rights-of way, vegetation filter strips, windbreaks, shelterbelts, and fallow land.

Based on current labels, the maximum single application rate ranges from 0.2 to 1.5 pounds of active ingredient per acre (lb a.i./acre). Up to two applications per year are allowed for some uses (a SLN for popcorn has up to 5 applications at the 0.2 lb a.i. rate). A complete list of all current dimethenamid and dimethenamid-p uses and how EFED currently understands the uses is presented in Table 3-1 and Table 3-2. This table was developed based on the label data information provided to EFED by the Biological and Economic Analysis Division (BEAD) and updates and clarifications were provided from the registrant. EFED notes that many of the rates are specified as “per season” rather than “per year”, thus, unless otherwise noted, the number of seasons per year is assumed to be one.

Table 3-1. Summary of the Maximum Labeled Use Patterns for Dimethenamid-p

Crop/Site	Timing; Application Type; Method/ Equipment	Maximum Single Application Rate by Formulation	Maximum Application Rate		Maximum Application Number		PHI (days)[b]	MRI (days)[b]	Geog. Restrictions [c]	Comments
		(lb/A)	Per Year lb/A	Per CC[a] lb/A	Per Year	Per CC[a]				
AGRICULTURAL FALLOW/ CONSERVATION RESERVE	Preplant, preemergence, postemergence; (aerial, ground)	0.98[EC]	--	0.98	NS	1,2*	NS	14; 30		*Split applications may be made with a minimum 14 days between applications, but do not exceed the maximum seasonal cumulative amount of 0.98 lb a.i./A/
	Preplant, pre-emergence; (soil incorporation)									Incorporate to a maximum depth of 2 inches.
	Pre-emergence - Burndown (aerial/ground)	0.39[EC]	--	0.98	NS	2	NS	30	Allowed in South Dakota	South Dakota SLN (SD150003)
BEANS, DRIED-TYPE, LENTILS, GARBANZO	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground) Preplant, Pre-Emergence; (soil incorporation)	0.98[EC]	--	0.98	NS	1,2*	70	--	Not for use in CA	*Split applications may be made with a minimum 14 days between applications, but do not exceed the maximum seasonal cumulative amount of 0.98 lb a.i./A/
										Incorporate to a maximum depth of 2 inches.
BEETS	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	0.98[EC]	--	0.98	NS	1,2*	60	14*		* Split applications may be made at minimum of 14 days between apps. If two applications are made, apply 1/2 to 2/3 of rate during first application; then the remainder during second application.
	Preplant, Pre-Emergence (soil incorporation)									Incorporate to a maximum depth of 2 inches.

Crop/Site	Timing; Application Type; Method/ Equipment	Maximum Single Application Rate by Formulation	Maximum Application Rate		Maximum Application Number		PHI (days)[b]	MRI (days)[b]	Geog. Restrictions [c]	Comments
		(lb/A)	Per Year lb/A	Per CC[a] lb/A	Per Year	Per CC[a]				
CORN	Fall, Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	0.98[EC] Sweet corn 0.84	--	1.125	(see note re. sweet corn)	1,2*	NS	14*		* Split applications may be made (applied preplant, preemergence, or postemergence) up to seasonal maximum rate 1.1 lb a.i./A. Second application (postemergence, layby). On some labels-rates vary by soil type. Note: Sweet corn may have two CC per yr in Florida
	Burndown (aerial, ground)	0.36[EC]	--	0.79	NS	2	NS	30	South Dakota	SD150003
		0.20[EC]	--	0.99	NS	5	NS	14	South Dakota	Specific for popcorn
COTTON	Fall, Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	0.98[EC]	--	1.45	NS	1, 2*	NS	14*	Not for use in CA	*May be applied as split applications when the initial and sequential applications are made early postemergence. If a split postemergence application is use, do not apply more than a maximum cumulative amount of 1.45 lb a.i./A in a cropping season.

Crop/Site	Timing; Application Type; Method/ Equipment	Maximum Single Application Rate by Formulation	Maximum Application Rate		Maximum Application Number		PHI (days)[b]	MRI (days)[b]	Geog. Restrictions [c]	Comments
		(lb/A)	Per Year lb/A	Per CC[a] lb/A	Per Year	Per CC[a]				
GRASSES GROWN FOR SEED	Preplant, preemergence, postemergence, postharvest; (aerial, ground)	0.98[EC]	0.98	NS	1	NS	NS	--	No uses in states east of the Miss. River	Cool season: apply up to 0.98 lb a.i./A to postharvest grass. Warm season: to postharvest grass during the fall, winter dormancy, or after the first seed harvest/cutting. Do not apply to warm-season grass after greenup before the first seed harvest/cutting.
	Preplant, Pre-Emergence; (soil incorporation, bulk fertilizer)									Incorporate to a maximum depth of 2 inches.
ONION, GARLIC, SHALLOTS	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	0.98[EC]	--	0.98	NS	1,2*	NS	14*	Not for use on green onions in CA **	*Split applications may be made at minimum of 14 days between apps (up to a max of 1.1 lb a.i.). **Green onions may have multiple crop cycles throughout the year in (e.g., FL, TX)
	Preplant, Pre-Emergence; (soil incorporation)									Incorporate to a maximum depth of 2 inches.
PEANUTS	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	0.98[EC]	--	0.98	NS	1,2*	NS	14*--	Not for use in CA	*Split applications may be made at minimum of 14 days between apps (up to a max of 0.98 lb a.i.).
	Preplant, Pre-Emergence, (soil incorporation)									Incorporate to a maximum depth of 2 inches.
POTATO; ROOT AND TUBER; HORSRADISH,	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	0.98[EC]	--	0.98	NS	1	40	--	Not for use in CA	Single application only

Crop/Site	Timing; Application Type; Method/ Equipment	Maximum Single Application Rate by Formulation	Maximum Application Rate		Maximum Application Number		PHI (days)[b]	MRI (days)[b]	Geog. Restrictions [c]	Comments
		(lb/A)	Per Year lb/A	Per CC[a] lb/A	Per Year	Per CC[a]				
HOPS, TURNIP, SWEET POTATO, RADISH, RUTABEGA	Preplant, Pre-Emergence; (soil incorporation)								for sweet potato	Incorporate to a maximum depth of 2 inches.
HOPS	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	0.98[EC]	--	0.98	NS	1	60	--	For use in ID, OR, WA	Single application only
	Preplant, Pre-Emergence; (soil incorporation)									Incorporate to a maximum depth of 2 inches.
SORGHUM	Preplant, Pre or Post-Emergence; (aerial, ground)	0.98[EC]	--	0.98	NS	1,2*	NS	NS		*Single or split application; no split information given.
	Preplant, Pre-Emergence; (soil incorporation)									Incorporate to a maximum depth of 2 inches.
	Pre-emerg.-Burndown (aerial/ground)	0.39[EC]	--	0.98	NS	NS [2]	NS	14	Allowed in South Dakota	SD150003
SOYBEANS	Fall, Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	0.98[EC]	--	1.125	NS	1,2*	60	NS, 14*	Not for use in CA (some labels)	May be applied as two split applications, not to exceed a seasonal total of 1.125lb ai /A. No more than ½ during the first application (applied preplant, preemergence, or postemergence); then apply the remainder during the second application (postemergence).

Crop/Site	Timing; Application Type; Method/ Equipment	Maximum Single Application Rate by Formulation	Maximum Application Rate		Maximum Application Number		PHI (days)[b]	MRI (days)[b]	Geog. Restrictions [c]	Comments
		(lb/A)	Per Year lb/A	Per CC[a] lb/A	Per Year	Per CC[a]				
	Preplant, Pre-Emergence; (soil incorporation)									Incorporate to a maximum depth of 2 inches.
	Pre-Emerg.-Burndown; (ground, impregnated fertilizer)	0 .59[EC]	--	0.79	NS	NS [2]	NS	30	Allowed in South Dakota	SD150003
SUGARBEETS	Preplant, Pre-Emergence, Early late/late post-emergence; broadcast (aerial and ground)	0.98[EC]	--	1.1	NS	1,2*	60,95	14*		May be applied in a single application or two split applications not to exceed a seasonal total of 1.1 If two applications are made, apply no more than 0.75lb a.i./A during the first application (Normal Timing: 2 true-leaf to 8 true-leaf stage); then the remainder applied during Extended Timing (9-leaf to 12-leaf true-leaf stage).
	Preplant, Pre-Emergence; (soil incorporation)									Incorporate to a maximum depth of 2 inches.
SQUASH; PUMPKIN	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	0.98[EC]	0.98	--	1	NS	90	--	Use only in WA and OR	
	Preplant, Pre-Emergence, soil incorporation									Incorporate to a maximum depth of 2 inches.
SOD, TURF AND ORNAMENTALS,	Weed emergence; broadcast; backpack/hand	1.5 [EC]	3.0	--	4	4	NS	42 35 (turf)		

Crop/Site	Timing; Application Type; Method/ Equipment	Maximum Single Application Rate by Formulation	Maximum Application Rate		Maximum Application Number		PHI (days)[b]	MRI (days)[b]	Geog. Restrictions [c]	Comments
		(lb/A)	Per Year lb/A	Per CC[a] lb/A	Per Year	Per CC[a]				
FORESTRY, NON-AG UNCULTIVATED	Weed emergence; broadcast; ground spreader	1.5 [G]	--	3.0	NS	2	NS	150	No more than 1.125 in NY	

[a] Reported as per crop cycle or per season
[b] PHI – Preharvest Interval; MRI – Minimum Retreatment Interval
[c] Several labels (34704-1044, 7969-156, 7969-239, 7969-372) state "This product is not for sale, distribution, or use in Nassau or Suffolk counties in New York state" or similar language.
Note: Some labels state, soil restrictions such as "do not apply to coarse soil classified as sand with less than 3% organic matter (as determined by soil tests, if not known) and where depth to groundwater is 30 feet or less".

Table 3-2. Dimethenamid Label Summary (Active registrations: 7969-144 and 7969-147)

Crop/Site	Timing; Application Type; Method/ Equipment	Maximum Single Application Rate	Maximum Application Rate		Maximum Application Number		MRI (days)[b]	Comment
		(lb/A)	Per Year lb/A	Per CC[a] lb/A	Per Year lb/A	Per CC[a] lb/A		
BEANS, DRIED-TYPE	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	1.5	1.5	1.5	2	2	NS	
CORN (ALL OR UNSPECIFIED, POP & SWEET)	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	1.5	1.5	1.5	2	2	NS	
CORN (FIELD)	Fall, Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	1.5	1.5	1.5	2	2	NS	Sweet corn may have 2 crop cycles in a year (in FL)

Crop/Site	Timing; Application Type; Method/ Equipment	Maximum Single Application Rate	Maximum Application Rate		Maximum Application Number		MRI (days)[b]	Comment
		(lb/A)	Per Year lb/A	Per CC[a] lb/A	Per Year lb/A	Per CC[a] lb/A		
GRASSES GROWN FOR SEED	Weed preemergence, broadcast (ground)	1.5	1.5	1.5	2	2	NS	Do not allow livestock to graze in treated areas. Do not feed treated commodities to livestock
LENTILS	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	1.5	1.5	1.5	2	2	NS	
PEANUTS (UNSPECIFIED)	Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	1.5	1.5	1.5	2	2	NS	
SORGHUM	Preplant, Pre-Emergence; broadcast (aerial and ground)	1.5	1.5	1.5	2	2	NS	
SOYBEANS (UNSPECIFIED)	Fall, Preplant, Pre- or Post-Emergence; broadcast (aerial and ground)	1.5	1.5	1.5	2	2	NS	

[a]Reported as per crop cycle or per season; [b] PHI – Preharvest Interval; MRI – Minimum Retreatment Interval

3.2.2 Usage Summary

Usage

Based on the BEAD chemical profile for Registration Review[1], use of dimethenamid has declined steadily since 1999, with stabilization in 2011. According to the BEAD Screening Level Usage Analysis (SLUA)[2], between 2005-2014, the crops with the highest pounds a.i. applied annually is corn (1.6 million pounds) followed by sorghum (200,000 pounds) and the average percent crop treated (PCT) for all crops screened was ≤5%. For non-agricultural uses, approximately 22,000 lbs. a.i. of dimethenamid was reportedly used in the professional turf management and horticultural segments (53% nursery/greenhouse, 29% golf course, 14% institutional turf, and 4% lawn care operators)[1.]

In contrast, the use of dimethenamid-p in terms of both pounds a.i. applied and total acres treated, has steadily increased since 2001 with a substantial increase since 2011[1]. According to the BEAD Screening Level Usage Analysis (SLUA)[3], from 2005-2014, the primary use sites are corn (~1.6 million lbs a.i.), sorghum (300,000 lbs a.i.), and soybeans (200,000 lbs a.i.)and the average percent crop treated (PCT) for all crops screened ranged from 5-20%. Data for dimethenamid-p usage on non-agricultural sites are not available.

4 Residues of Concern

In this risk assessment, the stressors are those chemicals that may exert adverse effects on non-target organisms. Collectively, the stressors of concern are known as the Residues of Concern (ROC). The ROC usually includes the active ingredient, or parent chemical, and may include one or more degradates that are observed in laboratory or field environmental fate studies. Degradates may be included in, or excluded from, the ROC based on submitted toxicity data, percent formation relative to the application rate of the parent compound, modeled exposure, and structure-activity relationships (SARs). Structure-activity analysis may be qualitative, based on retention of functional groups in the degradate, or they may be quantitative, using programs such as ECOSAR, the OECD Toolbox, ASTER, or others.

There are several transformation products that may form in the environment. Major transformation products formed under aerobic soil metabolism include oxalamide (M23) and sulfonate (M27) for both dimethenamid and dimethenamid-p. Additional transformation products formed under anaerobic conditions are M3 (dechlorinated parent), M10 (methyl sulfone derivative of M3), and M13 (methyl sulfoxide derivative of M3).

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[1] BEAD Chemical Profile for Registration Review: Dimethenamid/Dimethenamid-p

[2] Screening Level Use Analysis. Dimethenamid. January 15, 2016.

[3] Screening Level Use Analysis. Dimethenamid-p. January 19, 2016.

Toxicity data for oxalamide (M23) and sulfonate (M27) are provided in **APPENDIX B**. The aquatic toxicity studies for oxalamide (M23) and sulfonate (M27), show these transformation products are practically nontoxic to freshwater fish (rainbow trout, *Oncorhynchus mykiss*) and invertebrates (daphnia, *Daphnia magna*) on an acute exposure basis. Furthermore, based on the data, M23 and M27 are at least three orders of magnitude less acutely toxic to freshwater green algae (*Pseudokirchneriella subcapitata*) than dimethenamid-p. For mammals, both M23 and M27 are less toxic than dimethenamid-p on an acute exposure basis (*e.g.,* LD_{50} values for both compounds are >5000 mg a.i./kg-bw), based on the available acute oral data. Apart from these taxa, the acute toxicity of M23 and M27 to other plant and animal groups is not known. However, the available data are sufficient to understand the degradate toxicity to aquatic and terrestrial organisms for the purpose of risk assessment. Therefore, after reviewing the parent and available degradate toxicity and exposure profiles, dimethenamid / dimethenamid-p (parent) is considered as the only residue of concern for the ecological assessment. The exposure values (*i.e.,* the EECs) for the registration review ecological assessment will be based on exposure to the parent alone.

5 Environmental Fate Summary

The environmental fate summary of dimethenamid-p is based on laboratory studies of the enriched s-isomer when available. Bridging studies show, however, that fate properties of the racemic mixture are similar to those of the s-isomer alone, and so data from studies of r,s-dimethenamid are included in this discussion (D337970). In some instances, there are no fate data available for dimethenamid-p, so this risk assessment is performed by bridging information obtained from previously submitted studies for the registration of racemic dimethenamid.

Table 5-1 summarizes the physical chemical properties of dimethenamid-p enriched s-isomer. Based upon batch equilibrium data (K_{oc} 90-474; MRID 44332263) dimethenamid and dimethenamid-p are considered mobile to moderately mobile based on FAO mobility classification (FAO, 2000). Binding to soil correlates with the organic carbon content of the soil. Dimethenamid-p is highly soluble and is not expected to dissipate through volatilization.

No data have been submitted to EPA on the mobility of dimethenamid and dimethenamid-p transformation products; however, based on chemical structure, many of the transformation products are expected to be more mobile than the parent compounds. Based on estimates from EPISuite and information provided in an EFSA Scientific Report {EFSA, 2005 #952}, oxalamide and sulfonate are expected to be highly mobile to mobile. A prospective groundwater study (MRID 42034806) confirms the dimethenamid and its transformation products (oxalamide and sulfonate) leach through the soil profile.

Average steady state bioconcentration factors (BCFs) for dimethenamid (both r and s isomers as the uptake of individual isomers was not tracked) residues were 20 for the edible tissues, 100 for the nonedible tissues, and 57 for the whole fish (MRID 41596535). The depuration half-life for whole body was 10.7 days with approximately 80% of the residues eliminated 14 days after exposure ceased. As such, dimethenamid is not expected to bioconcentrate.

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

<table>
<tr><th>Parameter</th><th colspan="3">Value[1]</th><th>Source/
Comment</th></tr>
<tr><td>Molecular Weight (g/mole)</td><td colspan="3">275.59</td><td>--</td></tr>
<tr><td>Water Solubility at 25ºC mg/L</td><td colspan="3">1449</td><td>MRID 44332214</td></tr>
<tr><td>Vapor Pressure (torr)</td><td colspan="3">1.88×10^{-5} torr, 25 °C</td><td>MRID 44332215</td></tr>
<tr><td>Henry's Law Constant at 20ºC (atm-m^3/mole)</td><td colspan="3">8.52×10^{-8}</td><td>Estimated[1] from vapor pressure and water solubility at 20ºC.</td></tr>
<tr><td>Octanol-water Partition Coefficient (K_{ow}) at 25ºC (unitless)</td><td colspan="3">K_{OW}=141</td><td>MRID 41596511</td></tr>
<tr><td rowspan="2">Sorption</td><td colspan="2">K_d</td><td>K_{OC}</td><td rowspan="2">MRID 44332263 / 44332263.
Mobile to Moderately Mobile
(FAO classification system);</td></tr>
<tr><td colspan="2">1.2, 1.4, 2,0, 2.1, 2.1, 2.5, 2.5, 3.0, 6.6, and 13.5 mL/g
mean = 3.69 mL/g</td><td>90, 101, 105, 123, 129, 212, 247, 393, 396, and 474 mL/g_{oc}
mean= 227 mL/g_{oc}</td></tr>
<tr><td rowspan="2">Steady State Bioconcentration Factor (BCF)</td><td>Species</td><td>Value</td><td>Depuration Half-Life</td><td rowspan="2">MRID 41596535</td></tr>
<tr><td>Bluegill Sunfish</td><td>20x (edible)
100x (inedible)
57x (whole)</td><td>10.7 Days</td></tr>
</table>

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

Table 5-2 summarizes representative degradation half-life values from laboratory degradation data for dimethenamid-p based on the NAFTA kinetics guidance (NAFTA, 2012). These values often are different from the actual time to 50 percent decline of the residues as degradation kinetics were often biphasic with the rate of degradation slowing over time. The representative degradation half-life is designed to provide an estimate of degradation for biphasic degradation curves that will not overestimate degradation when assuming a single first-order decline curve in modeling.

Table 5-2. Summary of Environmental Fate Parameters for Dimethenamid-p

Study	System Details	Representative Half-life (days)[1]	Source/ Study Classification/Comment
Abiotic Hydrolysis	pH 5, 7, 9; 20ºC	Stable	MRID 44332258, MRID 41596531, Acceptable
Aqueous Photolysis	pH 7, 25ºC	51.4	MRID 44332259. Supplemental

Study	System Details	Representative Half-life (days)[1]	Source/ Study Classification/Comment
	40°N light/dark adjusted		
Soil Photolysis	Elliot Clay Loam, 22°C, pH 6.4 40°N light/dark adjusted	89.4	MRID 44332260 Acceptable
Aerobic Soil Metabolism[2]	Elliot Clay Loam	13.5 (IORE)	MRID 44332261 Acceptable, 41596532 Acceptable, 44083204 Supplemental, 44083203 Supplemental, 44083202 Acceptable
	Kenyon Loam	40.6 (SFO)	
	German Soil 2.2	12.8 (SFO)	
	German Soil 2.3	13.2 (SFO)	
	Clay Loam Soil	7.7 (SFO)	
Anaerobic Soil Metabolism[2]	Kenyon Loam	54 days (SFO)	MRID 41706801 Acceptable
Aerobic Aquatic Metabolism	--	--	Insignificant hydrolysis, no Data Available. Model input value will use 2x aerobic soil metabolism
Anaerobic Aquatic Metabolism[2]	Dryden Lake sediment, 25°C	35.1 (SFO)	MRID 42367201 Acceptable Only one half-life value is available – application of a 3x factor will be applied to the single anaerobic aquatic metabolism half-life value for modeling purposes.

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

[1] The value used to estimate a model input value is the calculated SFO DT_{50}, T_{IORE}, or the or the 2nd DT_{50} from the DFOP equation. The model chosen is consistent with that recommended using the, *Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media* (NAFTA, 2012). Some values were calculated using natural log transformed data to estimate the SFO half-life (designated with SFO-LN).

[2] Values are bridged with racemic dimethenamid fate studies.

In summary, laboratory studies indicate that dimethenamid and dimethenamid-p half-lives range from approximately 1 to 6 weeks in soils. Both isomers are stable to hydrolysis at pH 5, 7, and 9 at 20 °C (MRIDs 44332258 and 41596531), but dimethenamid-p exhibits some photolysis in water with a half-life of approximately 50 days (MRID 42266207 and 44332259). Phototransformation products including compound 1, M3, and M9, were observed in low concentrations (<5%). An anaerobic aquatic metabolism study indicated both isomers may be moderately persistent with a half-life of 35 days.

Dimethenamid-p undergoes aerobic soil metabolism with half-lives ranging from 7 to 41 days. In a comparative aerobic soil metabolism study the half-life values (approximately 8 days) for dimethenamid and dimethenamid-p were determined to also be within this range (MRID

44083203). In another study, the estimated half-life value for dimethenamid is 41 days (MRID 41596532). Because isomers were not resolved in the latter study it is unclear if the R isomer is more stable than the S isomer or if the relative difference in the estimate half-life value calculated in the two different studies is an artifact of the variability between soil systems. Anaerobic soil metabolism studies showed a slightly longer metabolism (54 days), however the data were highly variable during the aerobic phase and the isomers were also not resolved.

Oxalamide (14.8% at DAT 90; MRID 41596532) and sulfonate (9.0% at DAT 21; MRID 44083202) are major transformation products of dimethenamid and dimethenamid-p in soil under aerobic conditions. These compounds are more persistent than dimethenamid but are not expected to accumulate in the soil. Carbon dioxide is also a major (29.2% at DAT 182; MRID 44332261) transformation product observed in aerobic soil metabolism studies.

It is unclear if the extraction procedures in the metabolism studies were adequate for both dimethenamid-p and its transformation products. The formation of unextracted residues was observed in several studies. Unextracted residues reached a maximum of 23.4% at DAT 120 and decreased to 11.3 by study termination at DAT 182 in one aerobic soil metabolism study (MRID 44332261). In another aerobic soil study, unextracted residues were observed at concentrations greater than 40% when considering residues fractioned between fulvic and humic soil components. These residues were also observed to slightly decrease at the end of the study.

Terrestrial field dissipation studies (**Table 5-3)** indicate that dimethenamid dissipates with calculated half-life values between 8-41 days. This is consistent with results from the laboratory studies. Dimethenamid, oxalamide and sulfonate were observed to leach up to a depth of 30 cm. The two transformation products were generally observed at greater depths than dimethenamid.

Table 5-3. Summary of Field Dissipation Data for Dimethenamid-p

System Name	DT_{50}[1]	Source/ Classification
Missouri	8	MRID 42266204 Supplemental
North Carolina	8	MRID 42266202 Supplemental
Indiana soil	14	MRID 42266203 Supplemental
Indiana soil	43	MRID 42266205 Supplemental

[1] The value used to estimate a model input value is the calculated SFO DT_{50}, T_{IORE}, or the 2nd DT_{50} from the DFOP equation. The model chosen is consistent with that recommended using the, *Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media* (NAFTA, 2012). Some values were calculated using natural log transformed data to estimate the SFO half-life (designated with SFO-LN).

6 Ecotoxicity Summary

Ecological effects data are used to estimate the toxicity of dimethenamid/dimethenamid-p to surrogate species. The ecotoxicity data for dimethenamid/dimethenamid-p and the associated products have been described in multiple ecological risk assessments (USEPA, 2010, 2014) and in a Draft Problem Formulation for Registration Review (USEPA, 2016, DP Barcode D430251). As noted in previous assessments, the toxicity of the two isomeric compounds (dimethenamid/ dimethenamid-p) are generally considered equivalent and the assessment strategy is to use the enriched isomer (dimethenamid-p), when available, and fill any data gaps by bridging with data from the racemic form. The data for both forms are summarized in Section 6.1 and Section 6.2**.** Studies for terrestrial invertebrates (Tier 1 data) and an acute dietary study with a passerine were received since the Problem Formulation and the results of these studies are described briefly in this section**.**

Table 6-1 and Table 6-2 summarizes the most sensitive measured toxicity endpoints available across taxa. These endpoints are not likely to capture the most sensitive toxicity endpoint for a particular taxon but capture the most sensitive endpoint across tested species for each taxa. All studies in this table are classified as acceptable or supplemental. Non-definitive endpoints are designated with a greater than or less than value. Values that are based on newly submitted data are designated with an N footnote associated with the MRID number in tables.

6.1 Aquatic Toxicity

For aquatic animals, dimethenamid-p is classified as "moderately toxic" to freshwater (FW) fish and marine/estuarine (E/M) invertebrates and as "slightly toxic" to marine/estuarine fish and freshwater invertebrates. On a chronic exposure basis, the FW fish NOAEC of 0.12 mg a.i./L is based on a modest reduction in larval growth (4%) in rainbow trout at 0.24 mg a.i./L (reduced hatch success, time to swim up, and reduced survival and growth at the next concentration of 0.95 mg a.i./L). Chronic data are not available for E/M fish or invertebrates. For FW invertebrates, the NOAEC is 1.36 mg a.i./L based on reduced survival (68%) and growth in daphnids at 2.51 mg a.i./L.

Plants were generally more sensitive with aquatic non-vascular plant EC_{50} values of 0.014 mg a.i./L (based on cell density for green algae) and EC_{50} values of 0.0089 mg a.i./L (based on reductions in frond biomass in *Lemna gibba*) for vascular plants. Table 6-1 presents the most sensitive toxicity endpoints used to estimate risk to aquatic receptors from exposure of dimethenamid-p or the racemic mixture.

Table 6-1 Aquatic Toxicity Endpoints Selected for Risk Estimation for Dimethenamid/Dimethenamid-p

Taxonomic Group	Study Type	Species	Toxicity Endpoint Value Used in the Assessment	Toxicity Classification and Reference	Dimethenamid R/S-toxicity for comparison (same test species)
Freshwater Fish	Acute	Rainbow trout *(Oncorhynchus mykiss)*	LC_{50} = 6.3 mg a.i./L; Slope=Not available NOAEC = 3.7 mg a.i. /L	*Moderately toxic* MRID 44332227 (Acceptable)	LC_{50}=2.6 mg a.i./L-Static MRID 41596550
	Chronic	Rainbow trout *(Oncorhynchus mykiss)*	NOAEC = 0.12 mg a.i./L[1] LOAEC = 0.24 mg a.i./L, based on reduced growth of larvae	MRID 42336605 (Acceptable) **[Dimethenamid R/S]**	Data from racemic mixture bridged to dimethenamid-p.
Freshwater Invertebrates	Acute	Water flea *(Daphnia magna)*	EC_{50} = 12 mg a.i./L (immobility); Slope: 15 NOAEC = 3.4 mg a.i./L	*Slightly toxic* MRID 44332229 (Acceptable)	EC_{50}=16 mg a.i./L MRID 41596551
	Chronic	Water flea *(Daphnia magna)*	NOAEC = 1.36 mg a.i./L[2] LOAEC = 2.51 mg/L, based on reduced survival (68%) and growth	MRID 43914301 (Acceptable) **[Dimethenamid R/S]**	Data from racemic mixture bridged to dimethenamid-p.
Estuarine/ Marine Fish	Acute	Sheepshead minnow *(Cyprinodon variegatus)*	LC_{50} = 12 mg a.i./L NOAEC = 5.3 mg a.i./L	*Slightly toxic* MRID 44332230 (Acceptable)	LC_{50}=4.27 mg a.i./L MRID 42336603
	Chronic	Waived (USEPA 2006, DP 275547)[3]			
Estuarine/ Marine Invertebrates	Acute	Saltwater mysid *(Mysidiopsis bahia)*	LC_{50} = 3.2 mg a.i./L NOAEL = 1.2 mg a.i./L	*Moderately toxic* MRID 44332231 (Supplemental-age of test organisms was not reported)	LC_{50} = 4.8 mg a.i./L MRID 42336604
	Chronic	Waived (USEPA 2006, DP 275547)[3]			
Aquatic Plants	Non-vascular	Green algae *(Selenastrum capricornutum)*	EC_{50} = 0.014 mg a.i./L; cell density NOAEC = 0.0021 mg/L	MRID 44332253 (Acceptable)	EC_{50}=0.018 mg a.i./L MRID 42034804
	Vascular	Duckweed (*Lemna gibba*)	EC_{50} = 0.0089 mg a.i./L; frond biomass NOAEC = 0.0012 mg/L	MRID 44332257 (Acceptable)	EC_{50}=0.016 mg a.i./L MRID 42034805

[1] Previous assessment used a NOAEC of 0.3 based on an ACR estimation for the toxicity of dimethenamid-p.

[2] Previous assessment used a NOAEC 1.02 based on an ACR estimation for the toxicity of dimethenamid-p.

[3] Data waived due to no LOC exceedances for freshwater fish and invertebrates. Highest EECs were well below the lowest endpoint (i.e., chronic rainbow trout).

6.2 Terrestrial Toxicity

Dimethenamid-p is classified as “slightly toxic” to birds on an acute oral basis (LD_{50}=1068 mg a.i./kg-bw; bobwhite quail). Data are available for mallard, bobwhite quail and a passerine [Canary (*Serinus canaria*)] on a subacute dietary basis, and for all three species tested, dimethenamid-p is classified as “practically non-toxic” with a non-definitive endpoint (*e.g.,* LD_{50}

>5000 mg/kg-diet). In a 20-week reproductive toxicity study on the Northern bobwhite quail, the NOAEC and LOAEC were 360 and 900 mg a.i./kg-diet, based on effects observed on male body weight reductions (6.6%).

Dimethenamid-p is classified as "moderately toxic" to "slightly toxic" to mammals depending on if a carrier is used in the dosing (LD_{50}s ranged 480-2400). In a reproduction study, the NOAEC is 500 mg a.i./kg diet, based on body weight effects at 2000 mg a.i./kg diet in parent and offspring (noting a large dose spacing).

The available data for terrestrial plants exposed to TGAI (96.5% a.i.), indicate that seeds exposed to dimethenamid-p in treated soils (seedling emergence study) resulted in reduced shoot length with an EC_{25} of 0.0059 and 0.0064 lbs a.i./A, for monocots and dicots, respectively. Exposure to foliage (vegetative vigor study) resulted in an EC_{25} of 0.026 lb a.i./A based on reduced shoot length for monocots and reductions in shoot length for dicots (EC_{25}=0.12 lb a.i/A).

Dimethenamid-p is classified as "practically non-toxic" to adult bees on an acute exposure basis (acute oral and contact). For larval stage bees, the 72-hour acute oral LD_{50} is 53 µg a.i./bee and, thus, also, "practically non-toxic" to larval stage bees on an acute exposure basis. In a 10-day chronic exposure study with adult honeybees, a NOAEL was not established (LOAEL <2.455 µg a.i./bee) as there was a 15% reduction in food consumption and mortality (8%-not statistically significant) at the lowest treatment level. The chronic larval NOAEL/LOAEL is 6.3/13 µg a.i./bee based on 50% mortality (day 22-emergence) at 13 µg a.i./bee.

6-2. Terrestrial Toxicity Endpoints Selected for Risk Estimation for Dimethenamid /Dimethenamid-p

Study Type	Species	Toxicity Endpoint Value	Reference (Classification)	Dimethenamid R/S-toxicity for comparison (same test species)
Mammals				
Acute Oral	Laboratory rat	LD_{50} = 2400 mg a.i./kg-bw LD_{50} =480 mg a.i./kg-bw (no carrier)	MRID 41596536 Slightly toxic MRID 44097603 Moderately toxic	LD_{50}=1570 mg a.i./kg-bw MRID 41662409 LD_{50}=500 mg a.i./kg-bw MRID 44097602
Acute Inhalation	Laboratory rat	LC_{50} = 2.2 mg a.i./L	MRID 44332235	LC_{50}=4.99 mg/L MRID 41662411
Chronic Reproduction	Laboratory rat	NOAEC = 500 mg a.i./kg diet; LOAEC =2000 mg a.i./kg diet based on reduced body weight of parent and offspring. No reproductive effects.	MRID 41615905 **[Dimethenamid R/S]**	Data from racemic mixture bridged to dimethenamid-p.
Birds (Surrogates for Terrestrial Amphibians and Reptiles)				

Study Type	Species	Toxicity Endpoint Value	Reference (Classification)	Dimethenamid R/S-toxicity for comparison (same test species)
Acute Oral	Bobwhite Quail *(Colinus virginianus)*	LD_{50} = 1068 mg a.i./kg bw; slope=6 NOAEL < 292 mg a.i./kg-bw, based on reduced body weight	MRID 44332224 Slightly toxic (Acceptable)	LD_{50}=1908 mg a.i./kg-bw) MRID 41596546
Subacute Dietary	Bobwhite Quail and Mallard *(same results)*	LC_{50} = >5620 mg/kg-diet; NOAEL = 1780 mg/kg-diet based on reduced body weight.	MRID 44332225/ 44332226 Practically non-toxic (Acceptable)	LC_{50} >5620 mg a.i./kg diet Bobwhite quail Mallard MRID 41596547 and 41596548
	Canary *(Serinus canaria)*	LC_{50} = >5000 mg/kg-diet; No-mortality concentration-1250 mg a.i.-diet	N-MRID 49506001 (Acceptable)	
Chronic	Bobwhite Quail *(Colinus virginianus)*	NOAEC=360 mg a.i./kg-diet, based on terminal male body weight reduction (6.6%) at 900 mg a.i./kg-diet.	MRID 43925801 (Acceptable) **[Dimethenamid R/S]**	Data from racemic mixture bridged to dimethenamid-p.
Terrestrial Invertebrates				
Acute Contact (96-hour)	Honeybee *(Apis mellifera)*	LD_{50} = 94 µg a.i./bee	MRID 41662418/ 41823901 Practically non-toxic (Acceptable) **[Dimethenamid R/S]**	Data from racemic mixture bridged to dimethenamid-p.
Acute Oral		LC_{50}=>100 µg a.i./bee		
Chronic oral (adult)	Honeybee (*Apis mellifera*)	**NOAEL**: <2.455 µg a.i./bee **LOAEL**: 2.455 Based on a 15% reduction in food consumption at the lowest dose and mortality (8%*)	N-50362704 (Supplemental - Qualitative) NOAEL not established. No analytical verification. Age of bees=2-3d.	Other comments: *Mortality was not statistically significant, although, the 95% confidence intervals of all treatment levels did not overlap with the control. Dose response was apparent (*e.g.,* 0, 8, 10, 12, 32, and 95% mortality in the control, 2.5, 4.6, 8.7, 15.4, and 30.5 µg a.i./bee/day treatments, respectively).
Acute oral (larval)	Honeybee (*Apis mellifera*)	**72-hr LD_{50}:** 53 µg a.i./bee **NOAEL:** 40 **LOAEL**: 80 (100% mortality)	N-50362705 Acceptable	Comments: The dose response is not apparent at the three lower doses [*e.g.,* 8.3% mortality (controls) and 8.3, 13.9, 8.3, 100, and 100% at 10, 20, 40, 80, 161 µg ai/larva, respectively]. Three lowest concentrations showed deviations to normal food consuming behavior.

Study Type	Species	Toxicity Endpoint Value	Reference (Classification)	Dimethenamid R/S-toxicity for comparison (same test species)
Chronic oral (larval)	Honeybee (*Apis mellifera)*	**Day 8 NOAEL/LOAEL:** 13/25 µg a.i./bee based on 39% mortality at LOAEL. **Day 15 NOAEL/LOAEL:** 13/25 based on 33% mortality **Day 22 NOAEL/LOAEL:** 6.3/13 based on 50% mortality at LOAEL	N-50631302 Acceptable	Dose response is not apparent at the three lower doses.
Foliage Residue	No Data			
Semi-field study or full field study)	No Data			
Terrestrial Plants				
Seedling Emergence (Tier II-TGAI)	Monocot – ryegrass	EC_{25} = 0.0059 lb/A; based on shoot length. NOAEC = 0.0025 lb a.i./A	MRID 44332252 (Acceptable)	EC_{25}=0.06 lb a.i./A for reduced weight (sorghum). NOAEC not established for sorghum (*i.e.,* <0.05 lb a.i./A) MRID 42034802
	Dicot – lettuce	EC_{25} = 0.0064 lb/A; based on shoot length NOAEC = 0.0048 lb/A		
Vegetative Vigor (Tier II)	Monocot – ryegrass	EC_{25} = 0.026 lb/A, based on shoot weight NOAEC = 0.021 lb/A	MRID 44332252 (Acceptable)	$EC_{25=}$ 0.22 lb a.i./A (cucumber fresh weight), NOAEC not established (*i.e.,* <0.047 lb a.i./A) MRID 42034803
	Dicot – cucumber	EC_{25} = 0.12 lb/A; based on shoot length NOAEC = 0.084 lb/A		

6.3 Incident Data

The Incident Data System (IDS) provides information on the available ecological pesticide incidents, including those that have been aggregately reported to the EPA. The incident database was queried on November 7, 2019 and the results are summarized below in **Tables 6-3- 6.5**. All reported incidents were to plants and there have been no new incidents reported since the problem formulation.

6-3. Ecological Incident Information System v. 2.1.1 (EIIS)- Dimethenamid-p

PC Code	Incident ID	Use Site	Certainty	State	Total Magnitude	Product	Year
120051	I011838-056	Peanut	Possible	NC	80 acres	Outlook	2001
120051	I014702-030	Corn, field	Possible*	IA	385 acres	Guardsman	2003
120051	I014796-001	Corn, sweet	Possible*	WA	145 acres	Outlook	2003
120051	I014796-002	Corn, sweet	Possible*	WA	515	Outlook	2003
120051	I022217-030	Corn, sweet	Possible	MN	100% of 62 acres	Outlook	2010
120051	I023082-040	Corn, field	Possible	IA	100% of 80 acres	Guardsman Max	2011
120051	I024202-018	Corn, field	Possible	IA	100% of 80 acres	Guardsman Max	2012
120051	I026914-002	Field	Possible	KY	350 acres	Verdict	2014

6-4. Ecological Incident Information System v. 2.1.1 (EIIS)- Dimethenamid

PC Code	Incident ID	Use Site	Certainty	State	Total Magnitude	Product	Year
129051	I005880-008	Agricultural area	Possible	WI	10 ACRES	FRONTIER	1997
129051	I005880-009	Agricultural area	Possible	WI	Unknown	FRONTIER	1997
129051	I005880-012	Agricultural Area	Possible	WI	Unknown	FRONTIER	1997
129051	I005880-017	Agricultural Area	Possible	WI	Unknown	FRONTIER	1997
129051	I005880-018	N/R	Possible	WI	Unknown	FRONTIER	1997
129051	I005880-020	Agricultural Area	Possible	WI	Unknown	FRONTIER	1997
129051	I005880-024	Agricultural Area	Possible	WI	Unknown	FRONTIER	1997
129051	I005880-030	N/R	Possible	WI	Unknown	FRONTIER	1997
129051	I005880-037	Agricultural Area	Possible	WI	N/R	FRONTIER	1997
129051	I005880-038	Agricultural Area	Possible	WI	Unknown	FRONTIER	1997
129051	I005880-041	Agricultural Area	Possible	WI	Unknown	FRONTIER	1997
129051	I010274-002	Agricultural Area	Possible	WI	Unknown	FRONTIER	2000
129051	I010837-067	N/R	Possible	IL	ALL	FRONTIER	2000
129051	I010927-001	CORN	Possible*	IA	ALL	GUARDSMAN	2000
129051	I011838-055	N/R	Possible	NC	10 acres	Frontier	2001
129051	I012457-006	Peanut	Possible	NC	26 acres	Frontier	2001
129051	I012457-007	Peanut	Possible	NC	55.3 acres of 63.5	Frontier	2001
129051	I012457-011	Peanut	Possible	NC	114 acres of 135	Frontier	2001
129051	I012684-009	Peanut	Possible*	NC	114.2 acres	Frontier	2001

*Incident was reported as associated with a registered use, otherwise, the legality was reported as “undetermined”.

6-5. Office of Pesticide Program’s Aggregate Database (both registered ingredients)

PC Code	Ingredient Name	Sum	WB	PB	ONT
120051	Acetamide,2-chloro-N-(2,4-dimethyl-3-thienyl)-N-(2-methoxy-1-methyleth	25	0	25	0
120051	Chloro-N-{(1-methyl-2-methoxy)ethyl}-N-(2,4-dimethyl-thien-3-yl) aceta	8	0	8	0
Specified 120051	dimethenamid-P	97	0	97	0
120051	dimethenamid-P (ISO accepted common name)	49	0	49	0
129051	Dimethenamid	78	0	78	0
129051	Dimethenamid (ISO published common name)	5	0	5	0
ONT=other non-target; PB= Plant Damage; WB=wildlife minor					

7 Analysis Plan

7.1 Overall Process

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

7.2 Modeling

Various models are used to calculate aquatic and terrestrial EECs (see **Table 7-1**). The specific models used in this assessment are discussed further below. While the aquatic exposure has been adequately characterized for all registered uses in previous risk assessments, there has been a policy change in spray drift values that have slightly changed the EECs. Due to this change, the surface water EECs were recalculated using PWC (**Table 8-2**). For avian and mammalian risk, terrestrial EECs were verified and summarized using the T-REX model. Terrestrial plants have also been previously assessed at the maximum rates and this assessment provides a summary/verification using the TERRPLANT model. For terrestrial invertebrate risk, honey bee EECs were determined using the Bee-REX model. The AGDRIFT model was also used to characterize potential exposure to bees off the treatment site resulting from spray drift.

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

Environment	Taxa of Concern	Exposure Media	Exposure Pathway	Model(s) or Pathway
Aquatic	Vertebrates/ Invertebrates (including sediment dwelling)	Surface water and sediment	Runoff and spray drift to water and sediment	PWC version 1.52[1]
	Aquatic Plants (vascular and nonvascular)			
Terrestrial	Vertebrate	Dietary items	Ingestion of residues in/on dietary items as a result of direct foliar application	T-REX version 1.5.2[2] (Granular assessment only; Foliar risk previously assessed)
	Plants	Spray drift/runoff	Runoff and spray drift to plants	TERRPLANT version 1.2.2
	Bees and other terrestrial invertebrates	Contact Dietary items	Spray contact and ingestion of residues in/on dietary items as a result of direct application	BeeREX version 1.0
All Environments	All	Movement through air to aquatic and terrestrial media	Spray drift	AgDRIFT version 2.1.1 (Spray drift)

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

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

8 Aquatic Organisms Risk Assessment

8.1 Aquatic Exposure Assessment

8.1.1 Modeling

Surface water aquatic modeling was simulated using the Pesticide in Water Calculator (PWC version 1.52). Chemical input parameters used in modeling are presented in **Table 8-1** and were calculated for parent alone**.** Input parameters specific to the application scenario are specified in Table 8-1 based on the use information described in **Section 3.** Input parameters were selected in accordance with EFED's guidance documents (USEPA, 2009; USEPA, 2010b; USEPA, 2012a; USEPA, 2013a; USEPA, 2013b; USEPA, 2014a; USEPA, 2014b; USEPA and Canada, 2013).

Table 8-1. Aquatic Modeling Input Parameters for Dimethenamid-p

Parameter (units)	Value (s)	Source	Comments
K_d (mL/g)	3.6	MRID 44332263	Average of 9 values for parent.
Water Column Metabolism Half-life (days) at 20°C	53	--	Dimethenamid and dimethenamid-p show insignificant hydrolysis – 2x the aerobic soil metabolism half-life model input value is used for the aerobic aquatic metabolism half-life value for modeling purposes.
Benthic Metabolism Half-life (days) at 20°C	105	MRID 42367210	Only one half-life value is available – application of a 3x factor was applied to the single anaerobic aquatic metabolism half-life value for modeling purposes.
Aqueous Photolysis Half-life (days)@ pH 7	51.4	MRID 44332259	Adjusted half-life value reflects average natural sunlight multiplied by two to account for a 12-h light/12-h dark cycle; the light intensity used in the experiment was reported to be 1.88 times greater than the natural sunlight.
Hydrolysis Half-life (days)	0	MRID 44332258	No significant degradation observed at 25°C for pH 5, 7, and 9.
Soil Half-life (days) at 20°C	26.5	MRID 49734002 41596530 44083203 44083202	Represents the 90 percent upper confidence bound on the mean of 5 representative half-life values from aerobic soil metabolism studies.
Molecular Weight (g/mol)	275.6	--	--
Vapor Pressure (Torr) at 25°C	1.88×10^{-5}	--	Vapor pressure for parent
Solubility in Water (mg/L)	1449	MRID 44332214	25°C and pH 7, measured value for parent

Pesticide in Water Calculator scenarios are used to specify soil, climatic, and agronomic inputs in PRZM, and are intended to result in high-end water concentrations associated with a particular crop and pesticide within a geographic region. Each PWC scenario is specific to a vulnerable area where the crop is commonly grown. Soil and agronomic data specific to the location are built into the scenario, and a specific climatic weather station providing 30 years of daily weather values is associated with the location. Use pattern input parameters for the max use on turf is the same as those used in previous assessments (D376718, D376727, D376736).

Table 8-2. Surface Water EECs for Dimethenamid (Estimated Using PWC version 1.52)

Use Site	Annual App Rate	1-in-10 year EEC						
	lbs a.i./A, App type	Water Column µg/L			Pore-Water µg/L		Bulk Sediment µg/kg-oc	
		1-day	21-day	60-day	1-day	21-day	1-day	21-day
Turf, PATurfstd	3, ground	12.1	11.2	10.3	6.98	6.95	691	688
Turf, FLTurfstd	3, ground	11.3	10.2	9.03	5.93	5.90	587	584
Corn	0.98, aerial	18.2	16.7	14.3	8.34	8.28	826	820
Corn Split	1.125, aerial	20.7	18.9	16.1	9.48	9.43	939	934
Cotton	0.98, aerial	23.9	22.3	19.2	13.3	13.3	1317	1317
Cotton, split	1.45, aerial	**31.9**	**28.9**	**23.6**	14.5	14.4	1436	1426
Sorghum	0.98, aerial	16.3	14.9	12.4	7.73	14.9	765	1475
Sorghum Split	1.125, aerial	17.3	15.9	13.3	8.19	8.13	811	805
Soybean	0.98, aerial	19.3	18.4	15.6	8.88	8.81	879	872
Soybean Split	1.125, aerial	21	19.4	17	9.91	9.84	981	974

Maximum EECs are shown in bold.
[1] The benthic conversion factor is 3.96 and the fraction organic carbon (foc) is 0.04 in the EPA pond

8.1.2 Monitoring

The following databases and sources were searched for monitoring information on dimethenamid and several degradates in November 2019:

- Water Quality Portal (USEPA *et al.*)[4]
- National Stream Quality Accounting Network Database[5]
- California Department of Pesticide Regulation Surface Water Database[6] (CADPR, 2004)
- USGS/EPA Reservoir Monitoring Program

Monitoring data for dimethenamid and several degradates are available through the U.S. Geological Survey National Water Quality Assessment database (NAWQA). Dimethenamid was not an analyte in the USGS/EPA Reservoir Monitoring Program and is not found in the California Department of Pesticide Regulation Surface Water Database (California DPR SURF) or the USGS National Stream Quality Accounting Network database (NASQAN).

The NAWQA program is designed to catalog the quality of U.S. water resources by collecting surface water and groundwater data in selected watersheds. Dimethenamid and several of its degradates are represented in this database, although they were not constituents in the

[4] https://www.waterqualitydata.us/
[5] https://www2.usgs.gov/science/cite-view.php?cite=266
[6] http://www.cdpr.ca.gov/docs/emon/surfwtr/surfdata.htm

standard pesticide schedule and so may have followed different sampling patterns. Between October 2000 and July 2019, dimethenamid was tested for in 3300 surface water samples from 229 sites in 37 states. Dimethenamid was detected at above the reporting level in 2506 surface water samples (76%) from 196 sites. The greatest detection of 7.0 ppb was measured at sites in Nebraska and in Kansas, while most of the other detections ranged from 0.02 to 2.0 ppb. This maximum detection concentration is approximately 3-fold lower than the maximum expected EECs from surface water modeling (**Table 8-2**).

The database of groundwater data was much smaller, with only 15 sites tested from July 2008 to March 2018. Dimethenamid was detected in 9 of the groundwater samples (60%) with a range of 0.007 to 0.08 ppb.

Studies may not be specifically targeted at dimethenamid use areas and the frequency of sample collection in all studies was not adequate to ensure the capture of peak concentrations. Peak concentrations are likely higher. Monitoring data are useful in that they provide some information on the occurrence of dimethenamid in the environment under existing usage conditions. However, the measured concentrations should not be interpreted as reflecting the upper end of potential exposures unless they were collected in areas with frequent sampling and where usage was occurring. Absence of detections from non-targeted monitoring cannot be used as a line of evidence to indicate exposure is not likely to occur because it is often collected in areas where the pesticide is not used. However, monitoring data are a useful line of evidence to explore whether exposure in the environment is occurring at the levels of the modeled EECs and whether monitoring shows that exposure is occurring at levels that are higher than toxicity endpoints.

8.2 Aquatic Organism Risk Characterization

8.2.1 Aquatic Vertebrates

On an acute and chronic exposure basis, there are no LOC exceedances for aquatic vertebrates (acute RQs <0.01; chronic RQs 0.08-0.20), thus, the risk to fish and aquatic phase amphibians is low.

Table 8-2. Risk Quotients for Aquatic Vertebrates

Use Sites (all aerial except for turf)	1-in-10 Yr EEC µg/L		Risk Quotient			
			Freshwater		Estuarine/Marine	
	Daily Avg	60-day Avg	Acute LC$_{50}$ (µg a.i./L)	Chronic NOAEC (µg a.i./L)	Acute LC$_{50}$ (µg a.i./L)	Chronic NOAEC (µg a.i./L)
			6300	120	12000	
Turf, PATurfstd	12.1	10.3	<0.01	0.09	<0.01	No Data
Turf, FLTurfstd	11.3	9.03	<0.01	0.08	<0.01	
Corn	18.2	14.3	<0.01	0.12	<0.01	
Corn Split	20.7	16.1	<0.01	0.13	<0.01	
Cotton	23.9	19.2	<0.01	0.16	<0.01	
Cotton, split	31.9	23.6	<0.01	0.20	<0.01	
Sorghum	16.3	12.4	<0.01	0.10	<0.01	
Sorghum Split	17.3	13.3	<0.01	0.11	<0.01	
Soybean	19.3	15.6	<0.01	0.13	<0.01	
Soybean Split	21	17	<0.01	0.14	<0.01	

8.2.2 Aquatic Invertebrates

On an acute and chronic exposure basis, there are no LOC exceedances (acute RQs <0.01-0.01; chronic RQs 0.01-0.02), thus, the risk to aquatic invertebrates is low.

Table 8-3. Risk Quotients for Aquatic Invertebrates

Use Sites (all aerial except for turf)	1-in-10 Yr EEC µg/L		Risk Quotient			
			Freshwater		Estuarine/Marine	
	Daily Ave	21-day Ave	Acute LC$_{50}$ (µg a.i./L)	Chronic NOAEC (µg a.i./L)	Acute LC$_{50}$ (µg a.i./L)	Chronic NOAEC (µg a.i./L)
			12000	1360	3200	
Turf, PATurfstd	12.1	11.2	<0.01	0.01	0.01	No Data
Turf, FLTurfstd	11.3	10.2	<0.01	0.01	0.01	
Corn	18.2	16.7	<0.01	0.01	0.01	
Corn Split	20.7	18.9	<0.01	0.01	0.01	
Cotton	23.9	22.3	<0.01	0.02	0.01	
Cotton, split	31.9	28.9	<0.01	0.02	0.01	
Sorghum	16.3	14.9	<0.01	0.01	0.01	
Sorghum Split	17.3	15.9	<0.01	0.01	0.01	
Soybean	19.3	18.4	<0.01	0.01	0.01	
Soybean Split	21	19.4	<0.01	0.01	0.01	

8.2.3 Aquatic Plants

Risk to aquatic vascular and non-vascular plants is identified. RQs range from 1.3-3.6 and 0.86-2.3 for vascular and non-vascular plants, respectively.

Table 8-4. Risk Quotients for Aquatic Plants

Use Sites (all aerial except for turf)	1-in-10 Year Daily Average EEC µg/L	Risk Quotients	
		Vascular	Non-vascular
		IC_{50} (µg a.i./L)	IC_{50} (µg a.i./L)
		8.9	14
Turf, PATurfstd	12.1	**1.36**	**0.86**
Turf, FLTurfstd	11.3	**1.27**	**0.81**
Corn	18.2	**2.04**	**1.30**
Corn Split	20.7	**2.33**	**1.48**
Cotton	23.9	**2.69**	**1.71**
Cotton, split	31.9	**3.58**	**2.28**
Sorghum	16.3	**1.83**	**1.16**
Sorghum Split	17.3	**1.94**	**1.24**
Soybean	19.3	**2.17**	**1.38**
Soybean Split	21	**2.36**	**1.50**

9 Terrestrial Vertebrates Risk Assessment

9.1 Terrestrial Vertebrate Exposure Assessment

Terrestrial wildlife exposure estimates are typically calculated for birds and mammals by emphasizing the dietary exposure pathway. Dimethenamid-p is applied via aerial and ground application methods (for the liquid formulations) and via ground spreader for the granular uses. Therefore, potential dietary exposure for terrestrial wildlife is based on consumption of residues on food items following spray (foliar) applications, and from possible dietary ingestion of the granular formulation. EECs for birds[7] and mammals from consumption of dietary items on the treated field were previously calculated using T-REX v.1.5.2. With no changes to the labels since the previous assessments, this assessment provides an abbreviated T-REX assessment to summarize the main use patterns. Additional characterization of the granular risk is added using a more realistic granular weight assumption (*e.g.,* 1 mg rather than 1 gram).

9.2 Terrestrial Vertebrate Risk Characterization

Risk to birds and mammals from the foliar and granular uses has been assessed at the maximum application rates. The highest exposure to birds and mammals is from the following application scenario (1.5 lb a.i./A applied two times with a 35-day interval). Terrestrial modelling is simpler than aquatic modelling because the modelling parameters are not site specific. This assessment is briefly providing an overview of the highest RQs.

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

Birds

Based on acute oral toxicity, the foliar acute RQs ranged from <0.01-0.80 (exceeding the LOC of 0.5). Acute dietary-based RQs were not calculated because the toxicity threshold was greater than the highest dose for the subacute dietary studies (>5000 mg a.i./kg-feed). With acute LOC exceedances for birds, the RQ of 0.8 is noted to be specific to the 20 gram birds feeding on short grass, thus, the exposure is limited in nature for birds, but, as a surrogate for terrestrial phase reptiles and amphibians, there is a potential risk identified. For further characterization, when considering the mean EECs, there are no LOC exceedances, thus, risk is identified but may be limited.

Chronic/sublethal risk was assessed for birds using the reproduction study. With a NOAEC of 360 mg a.i./kg-diet, the RQs ranged from 0.09-1.5 (with exceedances from the short grass dietary items). The endpoint is based on a 6.6% body weight reduction at the 900 mg a.i./kg diet. For further characterization, when using the concentration where the effects were observed (*i.e.,* the LOAEC value), there were no exceedances.

Mammals

Based on acute oral toxicity, using the LD50 for test material without the carrier (which is a lower endpoint from past), the foliar acute RQs ranged from <0.01-0.49, thus, there are no LOC exceedances for mammals. For sublethal/chronic risk, the dose based RQs ranged from 0.03-9.4 using dose based RQs.

Table 9-1. Upper bound Dose-based RQ for Mammals for Dimethenamid/Dimethenamid-p Foliar Uses

Primary Feeding Strategy →	**Herbivores and Omnivores**												**Insectivores**		
Animal Size →	Small				Med				Large				Small	Med	Large
Dietary Items → / Use(s) ↓	**Short Grass**	**Tall Grass**	**Broad-leaf Plants**	**Fruits, pods, seeds, *etc.***	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits, pods, seeds, *etc.***	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits, pods, seeds, *etc.***	**Arthropods**		
Corn, soybean, sorghum, cotton (Single max. rate 0.98 lb a.i./A)	4.1	1.9	2.3	0.3	3.5	1.6	2.0	0.2	1.9	0.9	1.1	0.1	1.6	1.4	0.7
Turf (2 at 1.5 lb a.i./A)	9.4	4.3	5.3	0.6	8.0	3.7	4.5	0.5	4.3	2.0	2.4	0.3	3.7	3.1	1.7

RQs for Granivores ranged from 0.03-0.13 (all below the LOC) and were omitted from the table for brevity.

Granular Risk

The T-REX model (version 1.5.2) was also used to estimate the terrestrial exposures associated with granular applications of dimethenamid-p as shown in **Table 9.2**.

Table 9-2. EEC for labeled uses of Dimethenamid-p (Granular-Formulation -0.75% AI)

Uses Represented	Single App Rate (lb a.i./A)	EEC (mg a.i./ft^2)
Turf	1.5	15.62

To assess acute risk to birds from exposure to granular formulations, EFED typically uses the LD_{50}-per-square-foot "RQ". This assessment calculates the amount of active ingredient available to the bird on one square foot of a treated field and compares that amount to the median lethal dose (LD_{50}). This assessment assumes that 100% of the granules are available on the surface. While there is an LOC exceedance for small birds, for further characterization, using an assumption of a 1 mg granule weight, a 20 gram bird would need to consume ~1000 granules to reach the LOC. While birds do consume grit, consumption of 1000 granules is beyond the expected intake. Risk to birds and mammals from the granular use is considered low.

Table 9-3. Acute RQs (LD_{50}-per-square foot) for terrestrial animals of different feeding classes exposed to dimethenamid-p to Granular Formulations (T-REX v. 1.5.2).

Animal Size →				
Taxa	**Max. Single Appl. Rate (lb a.i./A) ↓**	**Sm**	**Med**	**Lg**
Birds	1.5	1.02	0.16	0.01
Mammals		0.99	0.52	0.04

Bolded cells indicate that the RQ exceeds the acute LOC of 0.5.
[1] Using adjusted LD_{50} values of 769, 980, 1384 mg a.i/kg-bw for small, medium, and large birds, respectively. Mammals: adjusted LD_{50} values of 1054, 854, 369 mg a.i/kg-bw for small, medium, and large mammals, respectively.

Table 9-4. Estimation of the Number of Granules to Reach Toxicity Thresholds in Birds

Percent of a.i. in formulated product	0.75%
Weight of 1 granule in mg (not available from registrant-assumed value)	1
mg a.i./granule	0.0075
No. of granules needed to achieve LD50	2051.78
No. of granules needed to achieve the LOC of 0.5 (1/2 LD50)	1025.89

10 Terrestrial Invertebrate Risk Assessment

The list of crops to which dimethenamid/dimethenamid-p is applied is listed in **Table 10-1** along with the USDA pollinator attractive data (USDA, 2018) to identify which crops may represent direct exposure to pollinators on the field. Off-field assessments are conducted for foliar sprays regardless of whether the crop is attractive or not. Bees (both Apis and non-Apis) may be exposed on the field to the majority of crops via pollen, nectar, or both. Bees may be exposed off the field to all crops.

Table 10-1. Summary of Information on the Attractiveness of Registered Use Patterns for Dimethenamid-p to Bees

Crop Name	Honey Bee Attractive?[1,2]	Bumble Bee Attractive?[1, 2]	Solitary Bee Attractive?[1, 2]	Acreage in the U.S.	Notes
Beans	Y (pollen & nectar)[1]	Yes[1]	N/AV	77,200	Acreage is for snapbeans
Corn	N (nectar) & Y (pollen[1])	Yes[1]	Yes[1]	87,668,000	Wind pollinated, but can be visited during pollen shedding
Cotton	Y (nectar)[1] & N (pollen)	Yes[1]	Yes *Halictus, Anthophora, Xylocopa, Megachile, Nomia, Ptilothrix*	7,664,400	Used by some beekeepers for honey production
Grasses grown for seed	N (nectar) & Y (pollen[1])	No	No	35,328,000	Wind pollinated, source of pollen only when no other forage sources are available
Onion	Y (nectar & pollen)[1]	No	+ *Halictus, Nomia*	143,340	Only a small % of acreage is grown for seed. Managed pollinators only for seed
Garlic,	Y (nectar & pollen)[1]	NV	+*Halictus, Osmia*	23,900	
Peanuts	Y (pollen)[1] & Nectar- NV	Yes[1]	+ *Lasioglossum, Megachile, Anthidium, Nomia*	1,042,000	
Potato, sweet potato, root and tuber, etc.	N (nectar & (pollen)	Yes[1]	*Andrena*	1,052,000**	Does not use managed pollinators but requires pollination for breeding. Potatoes noted to be harvested after bloom. **Only small percentage of acreage for breeding
Hops	N (nectar) & Y (pollen[1])	No	No	35,224	
Sorghum	N (nectar) & Y (pollen[1])	NV	Yes[1]	6,910,000 Grain and Silage	

Soybeans	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	76 million	Bee pollination is not required, but soybean is used by some beekeepers for honey production
Sugarbeets	Y (nectar)[1] & N (pollen)	NV	Yes[1]	1,154,200	Only a small % of acreage is grown for breeding. Managed pollinators used for breeding.
Squash and pumpkin	Y (nectar & pollen)[1]	Yes[2]	Yes[1] *Agapostemon, Melissodes, Peponapis*	91,700 Pumpkins and Squash	
Ornamentals	Assumed	Assumed	Assumed	--	
Turf and Sod	N (nectar) & Y (pollen[1])	No	No	-	Wind pollinated, source of pollen only when no other forage sources are available. Note: Commercial sod is considered highly managed so less likely to be attractive to pollinators.

[1] attractiveness rating is a single "+", denoting a use pattern is opportunistically attractive to bees.
[2] attractiveness rating is a double "++" denoting a use pattern is attractive in all cases

10.1 Bee Tier I Exposure Estimates

Contact and dietary exposures are estimated separately using different approaches specific for different application methods. The Bee-REX model (Version 1.0) calculates default (*i.e.*, high end, yet reasonably conservative) EECs for contact and dietary routes of exposure for foliar, soil, and seed treatment applications. See **Appendix C** for a sample output from BeeREX. Additional information on bee-related exposure estimates, and the calculation of risk estimates in BeeRex can be found in the *Guidance for Assessing Risk to Bees* (USEPA *et al.*, 2014).

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

Effects Summary
For adult bees, based on the acute oral and contact toxicity data, dimethenamid-p is classified as "practically non-toxic" to bees (acute oral LD_{50}=>100 µg a.i./bee; contact LC_{50}=94 µg a.i./bee). On a chronic exposure basis, the 10-day adult bee toxicity test did not provide a NOAEL/NOAEC due to reductions in food consumption and mortality at all dose levels. For example, the NOAEL endpoint (<2.5 µg ai/bee/day) was based on a statistically significant reduction in food consumption (15%) and it is noted that there was also 8% mortality observed at this dose (compared to 0% in the control).

For acute exposure to larval stage bees, the 72-hour LD_{50} is 53 µg a.i./bee. On a chronic exposure basis, the NOAEL is 6.3 µg a.i./bee based on a 50% reduction in survival/emergence (day 22) at the 13 µg a.i./bee treatment level.

10.2 Tier I Risk Estimation (Contact Exposure)

On-Field Risk

Since an exposure potential of bees is identified for a variety of uses both on and off the treated field, the next step in the risk assessment process is to conduct a Tier 1 risk assessment. By design, the Tier 1 assessment begins with (high-end) model-generated (foliar and soil treatments) or default (seed treatments) estimates of exposure via contact and oral routes. For contact exposure, only the adult (forager and drones) life stage is considered since this is the relevant life stage for honeybees (*i.e.*, since other bees are in-hive, the presumption is that they would not be subject to contact exposure). Furthermore, toxicity testing protocols have only been developed for acute exposures. Effects are defined by laboratory exposures to groups of individual bees (which serve as surrogates for solitary non-*Apis* bees and individual social non-*Apis* bees).

On the basis of acute contact exposure to adult honey bees, RQs range from 0.028- 0.043 for rates of 1 (rounded up from 0.98) and 1.5 lb a.i./A, respectively. Based on this analysis, there are no LOC exceedances for the highest use rates, thus, contact risk to adult bees is low. A summary of the acute contact RQs for adult honey bees is provided in **Table 10-2**.

Table 10-2. Default Tier 1 Adult, Acute Contact Risk Quotients for Honey Bees Foraging on Various Use Sites

Use Pattern	Bee Attractiveness	Max. Single Application Rate	Dose (µg a.i./bee per 1 lb a.i./A)	Contact Dose (µg a.i./bee)	Acute RQ[1]
Maximum single rate for most dimethenamid-p crops	All crops are generally attractive (see table 10-1 for specifics)	1 lb a.i./A	2.7	2.7	0.028
Maximum single rate for Dimethenamid (and Dimethenamid-p turf)		1.5 lb a.i./A	2.7	4.05	0.043

[1] Based on a 48-h acute contact LC_{50} of 94 µg a.i./bee for Dimethenamid-p (MRID 41662418).

10.3 Tier I Risk Estimation (Oral Exposure)

On-Field Risk

For oral exposure, the Tier 1 assessment considers just the caste of bees with the greatest oral exposure (foraging adults). If risks are identified, then other factors are considered for refining the Tier 1 risk estimates. These factors include other castes of bees and available information on residues in pollen and nectar which is deemed applicable to the crops of interest. These exposure data may have been collected on surrogate crops (*e.g.*, phacelia, buckwheat, alfalfa) which are known to be attractive sources of both pollen and nectar for bees). In this case, residue data are not available for refining the exposure to dimethenamid/dimethenamid-p. For adult honeybees, dimethenamid-p acute exposure resulted in a non-definitive (*e.g.*, > 100 µg a.i./bee) endpoints, thus RQs were not calculated. For larval worker honeybees, acute RQs range from 0.256-0.38, thus, at rates of 1-1.5 lb a.i./A, acute risk is low. On a chronic exposure basis, oral exposure to larval worker honeybees results in LOC exceedances (RQs=2.16 and 3.24). For adult nectar-foragers, chronic RQs were not calculated due to the non-definitive endpoint (<2.46 µg a.i./bee/d), however, if using the lowest test concentration as a proxy, the EECs range from approximately 13 -20 times higher than the toxicity endpoint (and LOC). Based on these analyses, both life stages (adult and larval) have a potential for effects. A summary of acute/chronic oral RQs for adult foragers and larval worker honey bees are provided in **Table 10-3**.

Table 10-3. 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	Bee Caste/Task	Unit Dose (*µg* a.i./bee per 1 lb a.i./A)	Oral Dose (*µg* a.i./bee)	Acute Oral RQ[1,2]	Chronic Oral RQ[3]
Maximum single rate for most dimethenamid-p crops	1 lb a.i./A	Adult nectar forager	32	32	Not calculated	Not calculated
		Larval worker	13.6	13.6	0.256	**2.16**
Maximum single rate for Dimethenamid (and Dimethenamid-p turf)	1.5 lb a.i./A	Adult nectar forager	32	48	Not calculated	Not calculated
		Larval worker	13.6	20.4	0.38	**3.24**

[1] Based on a 48-h acute oral LD_{50} of >100 µg a.i./bee for adults (MRID 41823901) and 7-d LD_{50} of 53 µg a.i./bee for larvae (MRID -50362705).
[2] **Bolded** RQ value exceeds (or potentially exceeds) the acute risk LOC of 0.4 or chronic LOC of 1.0.
[3] Based on a 22-d chronic NOAEL of 6.3 µg a.i./bee/d for larvae (MRID 50631302).

10.4 Off-Field Risk

In addition to bees foraging on the treated field, bees may also be foraging in fields adjacent to the treated fields. Using the Ag Drift model to estimate the number of feet that risk extends off the field, the aerial applications range from 125-180 feet off field and ground applications range from 13-50 feet **(Table 10-4**). For ground applied with low boom and fine to medium coarse droplets, the distance is <10 feet.

10-4. Off Field Spray Drift Distance to no Longer Exceed the LOC* for Chronic Adult Bee Risk

Use Pattern	Max. Single Appl. Rate	Bee Caste/Task	Spray Drift Distance in feet (Aerial; Fine to Medium)	Spray Drift Distance in feet (Ground-low boom; Very fine to Fine Droplet)	Spray Drift Distance in feet (Ground-high boom; Very fine-Fine Droplet)
Maximum single rate for most dimethenamid-p crops	1lb a.i./A	Adult nectar forager	125	13	36
Maximum single rate for Dimethenamid (and Dimethenamid-p turf)	1.5 lb a.i./A	Adult nectar forager	180	20	49

*The distance is based on use of a proxy endpoint of the lowest concentration (2.5 µg a.i./bee ; the NOAEL was non-definitive due to a 15% reduction in food consumption at the lowest test concentration).
Ag Drift Model input is fraction of applied which is the LOC/RQ from BeeRex [e.g., LOC of 1 divided by proxy RQ of 13)=0.076]

10.5 Bee Risk Characterization – Additional Lines of Evidence

Dimethenamid-p is a selective systemic herbicide (chloroacetamide class) and is registered for pre-emergent/post-emergent applications for control of annual grasses, annual broadleaf weeds, and sedges in various crops. The target action of dimethenamid-p is via inhibition of germinating weed shoot growth, thus, providing weed control soon after soil emergence. As labelled, the application timing is described for pre-emergent/ post-emergent, for control of weeds and the initial application tends to be in the early crop growth stages. By far, the leading use is for corn (with 1.7 million pounds applied annually), followed by sorghum (200,000 lbs), soybeans and sweet corn (9,000 lbs each; USEPA, 2015). Corn is noted to be pollinator attractive, but for pollen exposure only, while the other crops may be attractive for nectar and pollen. Dimethenamid-p is a systemic compound; thus, exposure may be from direct deposition during flowering stages or via translocation of residues. With a variety of pollinator attractive uses, and sensitivity to both adult and larval stage bees, submission of reliable residue data (*e.g.,* from foliar residue, magnitude of residue, or rotational crop studies) may provide useful estimates for refinement of risk. Additionally, this assessment is limited to Tier 1 data only.

11 Terrestrial Plant Risk Assessment

11.1 Terrestrial Plant Exposure Assessment

Terrestrial plant risk has been assessed multiple times and up to the highest application rate of 1.5 lb a.i./A. The EECs were estimated using TERRPLANT v.1.2.2 and this current assessment provides a summary of the highest EECS and RQs.

Using TERRPLANT v.1.2.2., exposure is estimated for a single application evaluating exposure via spray drift and runoff. In the Table 11-2, the runoff RQs for dryland and semi-aquatic areas are relying upon the summation of the exposure from drift and runoff. Additionally, the spray drift RQs rely only on the spray drift estimated exposure. It is important to note that for spray drift, the TERRPLANT exposure estimate corresponds to an equivalent AgDrift estimated deposition for fine-medium droplets at approximately 200 feet from the edge of the treated field. For runoff, there are a few assumptions regarding the ratio of treated area to receiving non-target area that have an impact on the exposure estimation. In a dry area adjacent to the treatment area, exposure is estimated as sheet runoff. Sheet runoff is the amount of pesticide in water that runs off of the soil surface of a target area of land that is equal in size to the non-target area (1:1 ratio of areas). This differs for semi-aquatic areas, where runoff exposure is estimated as channel runoff. Channel runoff is the amount of pesticide that runs off of a target area 10 times the size of the non-target area (10:1 ratio of areas).

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

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

Exposure Scenario →	**Terrestrial Plant EECs (lb a.i./A)**		
Plant Group → **Use(s) ↓**	**Runoff and Spray Drift (Dry Areas)**	**Runoff and Spray Drift (Semi-Aquatic Areas)**	**Spray Drift Only**
Most Uses-Corn, soybean, Cotton, Sorghum etc. (0.98 lb a.i./A; Aerial)	0.10	0.54	0.05
Most Uses-Corn, soybean, Cotton, Sorghum etc. (0.98 lb a.i./A; Ground)	0.06	0.50	0.01
Turf (1.5 lb a.i./A; Ground-Liquid)	0.09	0.77	0.02
Turf (1.5 lb a.i./A; Ground-Granular)	0.08	0.75	0

[1] Based on a runoff fraction of 1449 mg/L (solubility)
[2] Based on a drift fraction of 1% (*i.e.*, 0.01) for flowable; 0% granular
[3] Based on a drift fraction of 5% (*i.e.*, 0.05) for flowable; 0% granular

11.2 Terrestrial Plant Risk Characterization

Based on these endpoints and the EECs previously calculated using TerrPlant (see above), there are LOC exceedances with RQs ranging from 2.34-130 (RQs summarized in **Table 11-2**). Therefore, as expected for an herbicide, there is risk identified for non-target monocot and dicot plants for the labelled dimethenamid/dimethenamid-p uses. The risk is greatest for terrestrial plants in semi aquatic area that are vulnerable to runoff. There are also several plant incidents with possible causation (incidents discussed earlier in Section 6.3), thus, serving as a line of evidence for risk to plants.

Table 11-2. Terrestrial Plant Risk Quotients (RQs) – Non-listed Species

	Runoff + Spray Drift (Dry Areas)		Runoff + Spray Drift (Semi-Aquatic Areas)		Spray Drift Only	
Plant Group → **Use(s) ↓**	**Monocot**	**Dicot**	**Monocot**	**Dicot**	**Monocot**	**Dicot**
Most Uses-Corn, soybean, Cotton, Sorghum etc. (0.98 lb a.i./A; Aerial)	**16.61**	**15.31**	**91.36**	**84.22**	**8.31**	**7.66**
Most Uses-Corn, soybean, Cotton, Sorghum etc. (0.98 lb a.i./A; Ground)	**9.97**	**9.19**	**84.71**	**78.09**	**1.66**	**1.53**
Turf (1.5 lb a.i./A; Ground-liquid)	**15.24**	**14.06**	**129.66**	**119.53**	**2.54**	**2.34**
Turf (1.5 lb a.i./A; Ground-granular)	**12.71**	**11.72**	**127.12**	**117.19**	<0.1	<0.1

Bolded RQ values exceed the LOC of 1.0.

Spray Buffer Analysis

Using the Ag Drift Model (Ver 2.1.1) to estimate the downwind deposition values of the pesticide applied by spray applications (using the 0.98-1.5 lb a.i. rates) to calculate the distance from the edge of field where exposures from spray drift are below the LOC (using the ryegrass EC25 of 0.006 lb a.i./A). Based on the 90th percentile EEC assumptions for spray drift at the 0.98 lb a.i./A rate, the Ag Drift model predicts LOC exceedances for plants inhabiting dry areas and ponds/wetlands at distances from the edge of the field up 790-+1000 ft for aerial application with medium/coarse sprays and is reduced to about 500 ft (420-680 ft) with coarse/very coarse sprays. For low- boom ground application of medium coarse sprays the buffer is reduced to 68-118 ft and 120-200 ft. for high boom.

Table 11-3. Off Field Spray Drift Distance to no Longer Exceed the LOC for Terrestrial Plants

Use Rate	Aerial				Ground-High Boom		Ground-Low Boom	
	Very Fine-Fine	Fine-Med	Med-Coarse	Coarse-Very Coarse	Very Fine-Fine	Fine-Med/Coarse	Very Fine-Fine	Fine-Med/Coarse
0.98 lb a.i./A	**>1000**	**>1000**	**790**	**430**	**358**	**120**	**165**	**68**
1.5 lb a.i./A	**>1000**	**>1000**	**>1000**	**680**	**492**	**200**	**262**	**118**

Conclusions

Given the uses of dimethenamid/dimethenamid-p and the environmental fate properties, there is a likelihood of exposure of dimethenamid/dimethenamid-p to non-target terrestrial and/or aquatic organisms. Consistent with previous risk assessments (USEPA, 2015), there is a potential for direct adverse effects to aquatic and terrestrial plants, terrestrial invertebrates (newly assessed), and birds and mammals from exposure to dimethenamid/dimethenamid-p as a result of registered uses.

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Appendix A. Example Aquatic Modeling Output and Input Batch Files

Below is an example output summary file from a single PWC modeling simulation.

Aerial Split Application to Cotton – Example Output file

Summary of Water Modeling of dimethenamid and the USEPA Standard Pond

Estimated Environmental Concentrations for dimethenamid are presented in Table 1 for the USEPA standard pond with the NCcottonSTD field scenario. A graphical presentation of the year-to-year peaks is presented in Figure 1. These values were generated with the Pesticide Water Calculator (PWC), Version 1.52. Critical input values for the model are summarized in Tables 2 and 3.

This model estimates that about 2.5% of dimethenamid applied to the field eventually reaches the water body. The main mechanism of transport from the field to the water body is by spray drift (49.8% of the total transport), followed by run off (45.9%) and erosion (4.3%).

In the water body, pesticide dissipates with an effective water column half-life of 92.3 days. (This value does not include dissipation by transport to the benthic region; it includes only processes that result in removal of pesticide from the complete system.) The main source of dissipation in the water column is metabolism (effective average half-life = 94.0 days) followed by photolysis (4893.0 days).

In the benthic region, pesticide dissipates slowly (186.3 days). The main source of dissipation in the benthic region is metabolism (effective average half-life = 186.3 days). The vast majority of the pesticide in the benthic region is sorbed to sediment rather than in the pore water. While most of the pesticide in the benthic region is sorbed, the pore-water concentration is estimated as the concentrations dissolved in water in the benthic region.

Table 1. Estimated Environmental Concentrations (ppb) for dimethenamid.

Peak (1-in-10 yr)	32.1
4-day Avg (1-in-10 yr)	31.2
21-day Avg (1-in-10 yr)	28.9
60-day Avg (1-in-10 yr)	23.6
365-day Avg (1-in-10 yr)	9.31
Entire Simulation Mean	5.59

Table 2. Summary of Model Inputs for Dimethenamid.

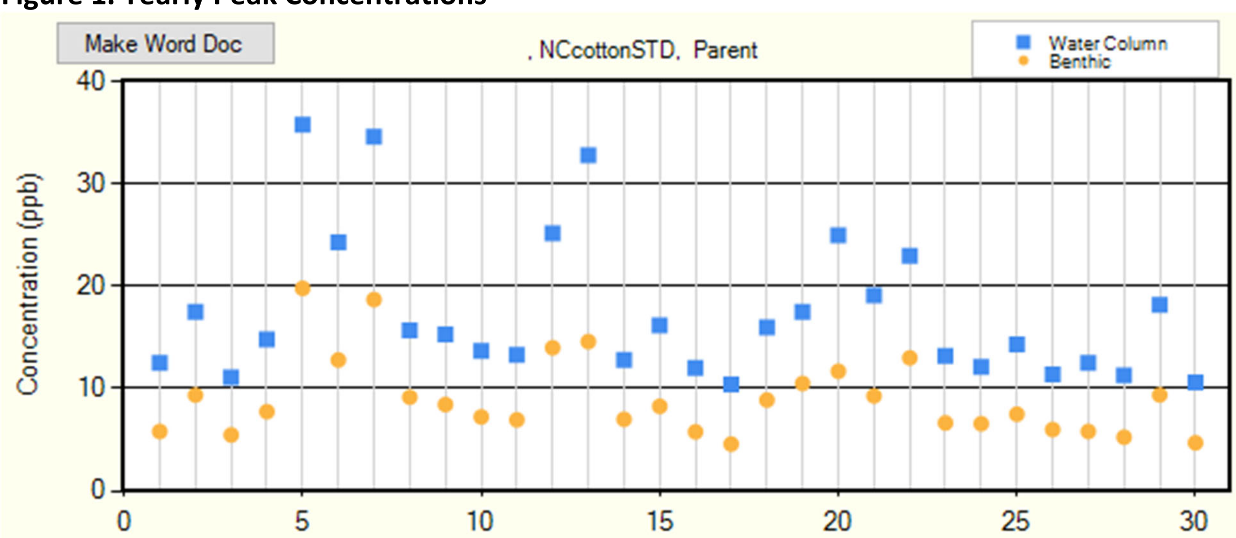
Scenario	NCcottonSTD
Cropped Area Fraction	1
Kd (ml/g)	3.59
Water Half-Life (days) @ 25 °C	53

Scenario	NCcottonSTD
Benthic Half-Life (days) @ 25 °C	105
Photolysis Half-Life (days) @ 40 °Lat	51.4
Hydrolysis Half-Life (days)	0
Soil Half-Life (days) @ 25 °C	26.5
Foliar Half-Life (days)	0
Molecular Weight	275.6
Vapor Pressure (torr)	1.88E-5
Solubility (mg/l)	1449
Henry's Constant	8.52E-08

Table 3. Application Schedule for Dimethenamid.

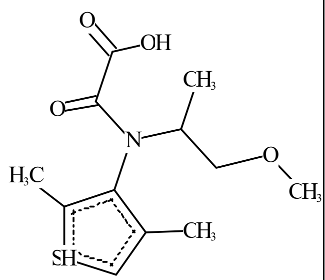
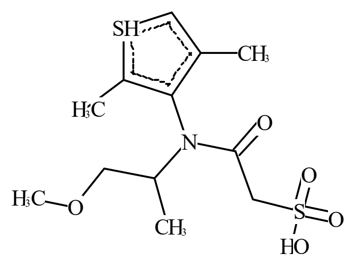
Days Since Emergence	Type	Amount (kg/ha)	Eff.	Drift
0	Above Crop (Foliar)	0.81	0.95	0.125
14	Above Crop (Foliar)	0.81	0.95	0.125

Figure 1. Yearly Peak Concentrations



Appendix B. Dimethenamid/Dimethenamid-P Degradate Information

Table B.1 Physical, Chemical, and Environmental Fate Properties of Oxalamide and Sulfonate Residues

Property	Dimethenamid Oxalamide	Dimethenamid Sulfonate	Source/ Comments
Chemical Name Registrant ID Formula Smiles Code Structure	(1RSaRS)-N-(2,4-dimethyl-3-thienyl)-N-(2methoxy-1-methylethyl)-oxamic acid M23 C12 H17 N1 O4 S1 c1(csc(c1N(C(=O)(C(=O)(O)))C(C) COC)C)C 	(1RSaRS)-N-(2,4-dimethyl-3-thienyl)-N-(2methoxy-1-methylethyl)-2sulfonyl-acetamide M27 C12 H19 N1 O5 S2 c1(C)c(N(C(=O)CS(=O)(=O)O)C(C) COC)c(C)sc1 	
Molecular Weight	271.33 g/mole	321.41 g/mole	EpiSuite v. 4.1
Solubility in water (25°C)	4126 mg/L	1.098 mg/L	EpiSuite v. 4.1 EpiSuite v. 4.1
Vapor pressure (25°C)	9.41E-008 mm Hg	9.89E-012 mm Hg	EpiSuite v. 4.1
Henry's Law Constant	8.142 x 10^{-12} atm-m3/mole	3.809 x 10^{-12} atm-m3/mole	EpiSuite v. 4.1
Octanol-Water Partition Coefficient (K_{ow} at 25°C)	0.75	1.02	EpiSuite v. 4.1
Hydrolysis (pH 5, 7, and 9 at 25°C)	No data	No data	
Aqueous Photolysis Half-life (pH 7)	No data	No data	
Soil Photolysis Half-life	No data	No data	

Property	Dimethenamid Oxalamide	Dimethenamid Sulfonate	Source/ Comments
Aerobic Soil Metabolism Half-life	24 - 41 days at 20 °C[2] mean 30 days median 26 days n = 3 Maximum formed: 14.8 % applied radioactivity[3]	40 - 140 days at 20 °C[2] mean 80 days median 60 days n = 3 Maximum formed: 9 % applied radioactivity[3]	[2]*EFSA Scientific Report* (2005) 53, 1-73, Conclusion on the peer review of dimethenamid [3]MRIDs 44332261, 41596532, and 44083202
Anaerobic Soil Metabolism Half-life	Stable	Stable	Conservative Assumption supported by EpiSuite v. 4.1
Anaerobic Aquatic Metabolism Half-life	Stable	Stable	Conservative Assumption supported by EpiSuite v. 4.1
Soil Partition Coefficient K_d	0.05 - 0.35 mL/g	0.0 - 0.43 mL/g	*EFSA Scientific Report* (2005) 53, 1-73, Conclusion on the peer review of dimethenamid
Soil Partition Coefficient K_{oc}	1.612 mL/g_{oc}[1] 3.5 - 17 mL/g_{oc}[2] mean 7.7 median 6.0 n = 6	22.47 mL/g_{oc}[1] 0.0 - 14 mL/g_{oc}[2] mean 6.7 median 6.9 n = 6	[1]EpiSuite v. 4.1 [2]*EFSA Scientific Report* (2005) 53, 1-73, Conclusion on the peer review of dimethenamid
Terrestrial Field Dissipation DT_{50}'s (Bare Soil)	Germany: 45 and 18 days France: 42 days Italy: 98, 53 and 159 days	Germany: 76 and 22 days France: 25 and 42 days Italy: 24, 74 and 137 days	*EFSA Scientific Report* (2005) 53, 1-73, Conclusion on the peer review of dimethenamid; 1st order multi-compartment model used to calculate half-lives.

Degradate Toxicity Summary

Table B.2. Summary of Toxicity Data for M23 metabolite (Oxalamide)

Studytype/species/dose levels	Results
Rat acute oral LD50	Oral LD50 > 5,000 mg/kg bw

Table B.3. Summary of results of Dimethenamid-p and Oxalamide metabolite on aquatic organisms

Test species	Test system	Result [mg a.i./L measured]	
		LC/EC50	NOEC
	Dimethenamid-p		
O. mykiss	flow-through - 96 h	6.3	3.7
L. macrochirus	flow-through - 96 h	10.0	4.1
O. mykiss	flow-through - 21d *	not determined	0.63
O. mykiss	flow-through - 90d *	not determined	0.12
Daphnia magna	flow-through - 48 h	12	3.4
Daphnia magna	semi-static –21 d *	not determined	1.36
P. subcapitata	static - 0-120 h	0.017	0.011
A. flos aquae	static - 0-120 h	0.38	0.11
Lemna gibba	semi-static - 14d	0.016	0.0082
	M23		
O. mykiss	static - 96 h	> 87	87
Daphnia magna	static - 48 h	> 95	< 95
P. subcapitata	static - 0-72 h	> 94	94

* studies performed with r/s-Dimethenamid

Table B.4. Summary of Toxicity Testing for M27 (Sulfonate)

Study type/species/dose levels	Results
Rat acute oral LD50	Oral LD50 > 5,000 mg/kg bw

Table B.5. Summary of results of Dimethenamid-p and Metabolite 27 on Aquatic Organisms

Test species	Test system	Result [mg ai/L measured]	
		LC/EC50	NOEC
	Dimethenamid-p		
0.mykiss	flow-through - 96 h	6.3	3.7
L. macrochirus	flow-through - 96 h	10.0	4.1
0.mykiss	flow-through - 21d *	not determined	0.63
0. mykiss	flow-through - 90d *	not determined	0.12
Daphnia magna	flow-through - 48 h	12	3.4
Daphnia magna	semi-static–21d*	not determined	1.36
P. subcapitata	static - 0-120 h	0.017	0.011
A. flos aquae	static - 0-120 h	0.38	0.11
Lemna gibba	semi-static - 14 d	0.016	0.0082
	M27		
0.mykiss	static - 96 h	> 100	100
Daphnia magna	static - 48 h	> 100	< 100
P. subcapitata	static - 0-72 h	> 208	208

* studies performed with r/s-Dimethenamid

Appendix C. Example Input/Output for Terrestrial Invertebrate Modeling (BEEREX)

Table 1. User inputs (related to exposure)

Description	Value
Application rate	1.5
Units of app rate	lb a.i./A
Application method	foliar spray
Are empirical residue data available?	no

Table 2. Toxicity data

Description	Value (µg a.i./bee)
Adult contact LD50	94
Adult oral LD50	NA
Adult oral NOAEL	NA
Larval LD50	53
Larval NOAEL	6.3

Table 3. Estimated concentrations in pollen and nectar

Application method	EECs (mg a.i./kg)
foliar spray	165
soil application	NA
seed treatment	NA
tree trunk	NA

Table 3. Estimated concentrations in pollen and nectar

Application method	EECs (mg a.i./kg)	EECs (µg a.i./mg)
foliar spray	165	0.165
soil application	NA	NA
seed treatment	NA	NA
tree trunk	NA	NA

Table 4. Daily Consumption of food, pesticide dose and resulting RQs

Life stage	Caste or task in hive	Average age (in days)	Jelly (mg/day)	Nectar (mg/day)	Pollen (mg/day)	Total dose (µg a.i./bee)	Acute RQ	Chronic RQ
Larval	Worker	1	1.9	0	0	0.003135	5.9151E-05	0.000498
		2	9.4	0	0	0.01551	0.00029264	0.002462
		3	19	0	0	0.03135	0.00059151	0.004976
		4	0	60	1.8	10.197	0.19239623	1.618571
		5	0	120	3.6	20.394	0.38479245	3.237143
	Drone	6+	0	130	3.6	22.044	0.41592453	3.499048
	Queen	1	1.9	0	0	0.003135	5.9151E-05	0.000498
		2	9.4	0	0	0.01551	0.00029264	0.002462
		3	23	0	0	0.03795	0.00071604	0.006024

		4+	141	0	0	0.23265	0.00438962	0.036929
Adult	Worker (cell cleaning and capping)	0-10	0	60	6.65	10.99725		4.470427
	Worker (brood and queen tending, nurse bees)	6 to 17	0	140	9.6	24.684		10.03415
	Worker (comb building, cleaning and food handling)	11 to 18	0	60	1.7	10.1805		4.138415
	Worker (foraging for pollen)	>18	0	43.5	0.041	7.184265		2.920433
	Worker (foraging for nectar)	>18	0	292	0.041	48.186765		19.58812
	Worker (maintenance of hive in winter)	0-90	0	29	2	5.115		2.079268
	Drone	>10	0	235	0.0002	38.775033		15.76221
	Queen (laying 1500 eggs/day)	Entire lifestage	525	0	0	0.86625		0.352134

Table 5. Results (highest RQ)

Exposure	Adults	Larvae
Acute contact	0.043085	NA
Acute dietary		0.38
Chronic dietary		3.24

Appendix D. Bibliography of MRID Studies

63-0 Reports of Multiple phys/chem Characteristics

MRID	Citation Reference
42542507	Cosgrove, T. (1992) Physical and Chemical Characteristics of End Use Product PM082-3: Lab Project Number: FPC-92-27-63. Unpublished study prepared by E.I. du Pont de Nemours and Co. Inc. 9 p.
43219203	Ong, J. (1994) SCEPTER/Dimethenamid 4.1 EC Herbicide: Physical and Chemical Characteristics: Lab Project Number: F/1264. Unpublished study prepared by American Cyanamid Co. 31 p.
43220803	O'Sullivan, E. (1994) PURSUIT/Dimethenamid Herbicide: Physical and Chemical Characteristics: Lab Project Number: F-1261. Unpublished study prepared by American Cyanamid Co. and Cytech. 37 p.
43281303	Washburn, R. (1988) Appearance, Color and Density of San 582H 6EC: Lab Project Number: 414103: 13: 414103/13. Unpublished study prepared by Sandoz Crop Protection Corp. 6 p.
44093803	Chang, J. (1996) Product Chemistry of SAN 1280 H 600 SE 403 DP: (Physical and Chemical Characteristics): Final Report: Lab Project Number: N002209A: DP 304065. Unpublished study prepared by Battelle. 45 p.

63-2-63-8 Solubility

MRID	Citation Reference
41596507	Guirguis, A.; Yu, C. (1988) Determination of Water Solubility for SAN 582 H: Lab Project Number: 414105; 1. Unpublished study prepared by Sandoz Crop Protection Corp. 11 p.
41596508	Laster, W. (1988) Solubility at 25(degree C) of Technical SAN 582H in Organic Solvent: Lab Project Number: 414103; 3. Unpublished study prepared by Sandoz Crop Protection Corp. 11 p.
41662405	Naris, M. (1990) Solubility of SAN 582H in Acetone, n-Octanol, Methylene Chloride and Carbon Disulfide: Lab Project Number: 414103: 34. Unpublished study prepared by Sandoz Crop Protection Corp. 14 p.

63-9 Vapor Pressure

MRID	Citation Reference
41596509	Roman, M. (1988) Vapor Pressure of SAN 582 H using the Thermal Evolution Analyzer: Lab Project Number: 414103; 1. Unpublished study prepared by Sandoz Crop Protection Corp. 9 p.

63-10 Dissociation Constant

MRID	Citation Reference

41596510	Rozek, A. (1988) Determination of the Dissociation Constant of SAN 582H: Lab Project Number: 414100: 3. Unpublished study prepared by Sandoz Crop Protection Corp. 16 p.

63-11 Oct/Water partition Coef.

MRID	Citation Reference
41596511	Guirguis, A.; Yu, C. (1988) Determination of n-Octanol/Water Parti- tion Coefficient for SAN 582H: Lab Project Number: 414105. Un- published study prepared by Sandoz Crop Protection Corp. 17 p.

63-12 pH

MRID	Citation Reference
41596512	Washburn, R. (1988) pH of Tech. SAN 582H in Aqueous Suspension: Lab Project Number: 414103; 6. Unpublished study prepared by Sandoz Crop Protection Corp. 11 p.
41596525	Pal, A. (1989) pH of SAN 582H 7.5L in Aqueous Emulsion: Lab Project Number: 414103; 28. Unpublished study prepared by Sandoz Crop Protection Corp. 14 p.
42404308	Pal, A. (1991) pH of SAN 854 H 480 SE: Lab Project Number: 414103: 40: DP 300359. Unpublished study prepared by Sandoz Crop Protection Corp. 20 p.
42512908	Pal, A.; Srnak, Z.; Belkind, B. (1991) pH of SAN 582 H, Technical: Lab Project Number: 414103-42: DP 300479. Unpublished study prepared by Sandoz Agro Inc. 17 p.
42666606	Pal, A. (1992) pH of SAN 1280 H 600 SE 401 DP: Final Report: Lab Project Number: 414103: 56: DP 300993. Unpublished study prepared by Sandoz Agro, Inc. 17 p.
43281304	Washburn, R. (1988) pH of San 582H 6EC in Aqueous Emulsion: Lab Project Number: 414103: 11: 414103/11. Unpublished study prepared by Sandoz Crop Protection Corp. 11 p.
44057406	Chen, H. (1996) pH of SAN 1412 H 720EC 400 DP: Final Report: Lab Project Number: 414413: DP-302033: AC-303. Unpublished study prepared by Sandoz Agro, Inc. 21 p.

63-13 Stability

MRID	Citation Reference
41596513	Arruda, J. (1989) Thermal Stability of Technical SAN 582H: Lab Pro- ject Number: 414103; 20. Unpublished study prepared by Sandoz Crop Protection Corp. 20 p.
41596514	Srnak, Z. (1989) Technical SAN 582H-Stability in Presence of Metal and Metal Ions, and Sensitivity to Sunlight: Lab Project Number: 414103: 21. Unpublished study prepared by Sandoz Crop Protection Corp. 19 p.
42512909	Wojtowicz, L.; Arruda J.; Belkind, B. (1992) Stability of Technical SAN 582 H: Lab Project Number: 414103-63: DP 301003. Unpublished study prepared by Sandoz Agro Inc. 51 p.

63-14 63-17 Storage stability

MRID Citation Reference

MRID	Citation Reference
41596528	Simons, R. (1990) Storage Stability of SAN 582H 7. 5L: Lab Project Number: 414106; 3. Unpublished study prepared by Sandoz Crop Protection Corp. 8 p.
42238802	Jones, R.; Simons. R.; Atallah, Y. (1991) Storage Stability of Technical SAN 582H: Lab Project Number: 414106: 9: DP300720. Unpublished study prepared by Sandoz, Env. Sci. and Form. 20 p.
42238803	Jones, R.; Simons. R.; Atallah, Y. (1991) Storage Stability of SAN 582 H 7. 5L: Lab Project Number: 414106: 8: DP300400. Unpublished study prepared by Sandoz, Env. Sci. and Form. 24 p.
42404310	Cannan, T. (1992) Series 63-17 Storage Stability of SAN 854 H 480 SE: Final Report: Lab Project Number: 414106: 11: DP 300927. Unpublished study prepared by Sandoz Agro, Inc. 40 p.
42542507	Cosgrove, T. (1992) Physical and Chemical Characteristics of End Use Product PM082-3: Lab Project Number: FPC-92-27-63. Unpublished study prepared by E.I. du Pont de Nemours and Co. Inc. 9 p.

63-18 71-1 Avian Single Dose Oral Toxicity

MRID	Citation Reference
41596546	Grimes, J. (1988) SAN 582 H: An Acute Oral Toxicity Study with the Bobwhite: Final Report: Lab Project Number: 131-124A. Unpub- lished study prepared by Wildlife International Ltd. 31 p.

71-2 Avian Dietary Toxicity

MRID	Citation Reference
41596547	Hinken, C.; Grimes, J.; Jaber, M. (1986) SAN 582 H: A Dietary LC50 Study with the Bobwhite: Lab Project Number: 131-122. Unpublished study prepared by Wildlife International Ltd. 32 p.
41596548	Grimes, J.; Jaber, M. (1986) SAN 582 H: A Dietary LC50 Study with the Mallard: Lab Project Number: 131-123. Unpublished study prepared by Wildlife International Ltd. 32 p.

71-4 Avian Reproduction

MRID	Citation Reference
43925801	Beavers, J.; Foster, J.; Mitchell, L. et al. (1994) SAN 582H Technical: A Reproduction Study with the Northern Bobwhite: Lab Project Number: 131-177: DP301545: 131/062992/QR/CHP30. Unpublished study prepared by Wildlife International Ltd. 217 p.
43925802	Beavers, J.; Foster, J.; Mitchell, L. et al. (1994) SAN 582H Technical: A Reproduction Study with the Mallard: Lab Project Number: 131-178: DP301548: 131/062992/MR/CHP30. Unpublished study prepared by Wildlife International Ltd. 219 p.

72-1 Acute Toxicity to Freshwater Fish

MRID	Citation Reference
41596549	Bowman, J. (1988) Acute Toxicity of SAN-582-H to Bluegill Sunfish (Lepomis macrochirus): Final Report: Lab Project Number: 36655. Unpublished study prepared by Analytical Bio-Chemistry Laboratories. 155 p.
41596550	Bowman, J. (1988) Acute Toxicity of SAN-582-H to Rainbow Trout (Salmo gairdneri): Lab Project Number: 36656. Unpublished study prepared by Analytical Bio-Chemistry Laboratories, Inc. 237 p.
42336601	Sword, M. (1991) Supplemental Submission: Acute Toxicity of SAN 582H to Bluegill (Lepomis macrochirus): Lab Project Number: 36655. Unpublished study prepared by ABC Labs. 8 p.

72-2 Acute Toxicity to Freshwater Invertebrates

MRID	Citation Reference
41596551	Frazier, S. (1988) Acute Toxicity of SAN-582-H to Daphnia magna: Final Report: Lab Project Number: 36657. Unpublished study pre- pared by Analytical Bio-Chemistry Laboratories, Inc. 147 p.
43914301	Holmes, C.; Swigert, J. (1992) SAN 582H: A Flow-Through Life-Cycle Toxicity Test with the Cladoceran (Daphnia magna): Amended Final Report: Lab Project Number: 131A-147A: DP 301146. Unpublished study prepared by Wildlife International Ltd. 62 p.

72-3 Acute Toxicity to Estuarine/Marine Organisms

MRID	Citation Reference
42336602	Wheat, J. (1992) SAN 582H Technical: Acute Toxicity to the Eastern Oyster, Crassostrea virginica, under Flow-through Conditions: Lab Project Number: J9106004E. Unpublished study prepared by Toxikon Environmental Sciences. 58 p.
42336603	Wheat, J. (1992) SAN 582H Technical: Acute Toxicity to the Sheepshead Minnow, Cyprinodon variegatus, under Flow-through Conditions: Lab Project Number: J9106004D. Unpublished study prepared by Toxikon Environmental Sciences. 57 p.
42336604	Wheat, J. (1992) SAN 582H Technical: Acute Toxicity to the Mysid, Mysidopsis bahia, under Static Test Conditions: Lab Project Number: J9106004C. Unpublished study prepared by Toxikon Environmental Sciences. 58 p.

72-4 Fish Early Life Stage/Aquatic Invertebrate Life Cycle Study

MRID	Citation Reference
42034801	Jenkins, C. (1991) DOZ 300 H (SAN 582 H): Daphnia magna 21 Day Juvenile Production Test Under Static Conditions: Final Report: Lab Project Number: SAS/048: 91/SAS048/0410. Unpublished study pre- pared by Life Science Research Limited. 38 p.

42056601	Jenkins, C. (1991) DOZ 300 H (SAN 582 H): 21-Day Rainbow Trout Toxicity Study Under Flow-Through Exposure Conditions: Final Report : Lab Project Number: ASA/047: 91/SAS047/0409. Unpublished study prepared by Life Science Research Limited. 33 p.
42336605	Graves, W.; Smith, G. (1992) SAN 582H Technical (K/E): An Early Life-Stage Toxicity Test with the Rainbow Trout (Oncorhynchus mykiss): Final Report: Lab Project Number: 131A-130A. Unpublished study prepared by Wildlife Intl. Ltd. 109 p.

81-1 Acute oral toxicity in rats

MRID	Citation Reference
41596536	Glaza, S. (1990) Acute Oral Toxicity Study of SAN582H 7.5L in Rats: Final Report: Lab Project Number: HLA 91003847. Unpublished study prepared by Hazleton Laboratories America, Inc. 35 p.
41662409	Lemen, J. (1989) Acute Oral Toxicity Study in Rats with SAN 582H Technical: Final Report: Lab Project Number: HLA 686-171. Un- published study prepared by Hazleton Laboratories America, Inc. 21 p.
42404313	Reagan, E. (1990) Acute Oral LD50 Study of SAN 854 H 480 SE in Sprague-Dawley Rats: Lab Project Number: 90.2385.036: DP 300239. Unpublished study prepared by Food and Drug Research Labs. 82 p.
42516006	Blasczak, D. (1992) Acute Oral Toxicity Study in Rats: San 582H Sulfonate Metabolite (M-27): Final Report: Lab Project Number: 92-6291. Unpublished study prepared by Bio/Dynamics, Inc. 16 p.
42542501	Sarver, J. (1991) Acute Oral Toxicity Study with DPX-PM083-0 (Granules) in Male and Female Rats: Lab Project Number: 4581-907: 593-91. Unpublished study prepared by E.I. du Pont de Nemours and Co. Inc. 40 p.
42666612	Blaszcak, D. (1992) Acute Oral Toxicity Study in Rats with SAN 1280 H 600 SE: Final Report: Lab Project Number: 0660. Unpublished study prepared by Bio/dynamics, Inc. 25 p.
43219204	Bradley, D.; Lowe, C. (1994) Oral LD50 Study in Albino Rats with AC252,214/AC187,993 4.1 EC Formulation: Lab Project Number: T/0687: A94/55/01. Unpublished study prepared by American Cyanamid Co. 16 p.
43220804	Bradley, D. (1994) Oral LD50 Study in Albino Rats with AC 263,499/AC 187,993 Formulation: Lab Project Number: T-0676. Unpublished study prepared by American Cyanamid Co. 16 p.
43281309	Reagan, E. (1989) Acute Oral Toxicity Study of SAN 582H 720 g/l EC in Sprague-Dawley Rats: Lab Project Number: 89/2385/023. Unpublished study prepared by Food and Drug Research Lab. 62 p.
43522101	Blaszcak, D. (1994) Acute Oral Toxicity Study of San 582 H 720 EC 420 DP in Rats: Final Report: Lab Project Number: 94/1063. Unpublished study prepared by Pharmaco LSR Inc. 52 p.
44057412	Blaszcak, D. (1996) Acute Oral Toxicity Study with SAN 1412 H 720EC 400 DP in Rats: Final Report: Lab Project Number: 95-1361. Unpublished study prepared by Huntingdon Life Sciences. 47 p.

44083201	Cummins, H. (1995) Dimethenamid Oxalamide: Acute Oral Toxicity Study in the Rat: (Final Report): Lab Project Number: 95/SAS066/0264: BS 5306: ISTT180/1. Unpublished study prepared by Pharmaco LSR Ltd. 46 p.
44093804	Shults, S.; Brock, A.; Serrone, D. (1996) Acute Oral Toxicity (LD50) Study in Rats with SAN 1280 H 600 SE 403DP: Lab Project Number: 6831-96-0082-TX-001: RI 96-0082. Unpublished study prepared by Ricerca, Inc. 40 p.
44097601	Blaszcak, D. (1991) Acute Oral Toxicity Study of SAN 582H Technical (K/E) in Rats: Final Report: Lab Project Number: 6014-91: DP 300316. Unpublished study prepared by Bio/dynamics, Inc. 17 p.
44097602	Warren, S.; Mueller, F.; Carpy, S. (1992) SAN 582 H: Comparative LD50 Acute Oral Toxicity Study in Rats (Amended) Final Report: Lab Project Number: Q 467 R: BS 2688: 91/143. Unpublished study prepared by Sandoz Agro Ltd. 127 p.
44097603	Blaszcak, D. (1996) Acute Oral Toxicity Study with SAN 1289 H Technical in Rats: Final Report: Lab Project Number: 96-1404. Unpublished study prepared by Huntingdon Life Sciences. 42 p.

81-2 81-3 Acute inhalation toxicity in rats

MRID	Citation Reference
41596538	Jackson, G.; Hardy, C. (1990) SAN 582H 7.5L: Acute Inhalation Toxicity Study in Rats 4-Hour Exposure: Lab Project Number: SNC 84/90352. Unpublished study prepared by Huntingdon Research Centre Ltd. 36 p.
41662411	Ullmann, L. (1986) 4-Hour Acute Inhalation Toxicity Study with SAN 582 H in Rats: Lab Project Number: RCC 075510. Unpublished study prepared by Researching & Consulting Co., Ag. 39 p.
42404315	Biesemeier, J. (1990) Acute Inhalation Toxicity Study of SAN 854 H 480 SE in Sprague-Dawley Rats: Lab Project Number: 90. 2385.038: DP 300241. Unpublished study prepared by Food and Drug Research Labs. 62 p.
42542503	Valentine, R. (1992) Acute Inhalation Toxicity Study with DPX-PM083-1 in Rats: Lab Project Number: 4581-913: 651-91. Unpublished study prepared by E.I. du Pont de Nemours and Co. Inc. 60 p.
42666614	Hoffman, G. (1992) An Acute (4-Hour) Inhalation Toxicity Study of SAN 1280 H 600 SE in the Rat Via Whole-Body Exposure: Final Report: Lab Project Number: 5102. Unpublished study prepared by Sandoz Agro, Inc. 142 p.
43219206	Hoffman, G. (1994) Acute Inhalation Toxicity Study with AC252,214/AC187,993 in Rats: Lab Project Number: 93/5158: 971/93/119. Unpublished study prepared by Pharmaco LSR Inc. 182 p.
43220806	Hoffman, G. (1994) Acute Inhalation Toxicity Study with AC 263,499/AC 187,993 in Rats: Lab Project Number: 93-5155. Unpublished study prepared by Pharmaco LSR Inc. 177 p.
43281311	Wedig, J. (1989) Acute Inhalation Safety Evaluation of SAN 582H 720 G/L EC in Rats: Lab Project Number: 377B/101/710/89. Unpublished study prepared by T.P.S., Inc. 44 p.

43531601	Hoffman, G. (1994) An Acute (4-Hour) Inhalation Toxicity Study of SAN 582 H 720 420 DP in the Rat via Nose-only Exposure: Final Report: Lab Project Number: 94/5200. Unpublished study prepared by Pharmaco LSR, Inc. 56 p.
44057414	Hoffman, G. (1996) An Acute (4-Hour) Inhalation Toxicity Study of SAN 1412 H 720EC 400 DP in the Rat via Nose-Only Exposure: Final Report: Lab Project Number: 95-5278. Unpublished study prepared by Huntingdon Life Sciences. 67 p.

81-4 P83-4 2-generation repro.-rat

MRID	Citation Reference
41615905	Suter, P.; Biedermann, K.; Wilson, J. et al. (1989) SAN 582 H: Two Generation Reproduction Study in the Rat: Lab Project Number: 201205. Unpublished study prepared by RCC Research and Consul- ting Company. 662 p.
41706810	Suter, P.; Mladenovic, P.; Terrier, C. (1990) SAN 582 H: One Generation Reproduction Pilot Study in the Rat: Report: Lab Project Number: 201194. Unpublished study prepared by Research and Consulting Co., Ag., and RCC Umweltchemie Ag. 198 p.

84-2 122-2 Aquatic plant growth

MRID	Citation Reference
41662417	VanDijk, A. (1989) Acute Toxicity of SAN 582 H to Scenedesmus sub- spicatus (OECD: Algae Growth Inhibition Test): Lab Project Number: 204603. Unpublished study prepared by RCC Umweltchemie Ag. 28 p.
42380601	Hoberg, J. (1992) SAN 582H Technical--Toxicity to the Freshwater Diatom, Navicula pelliculosa: Final Report: Lab Project Number: 92-4-4206: 10828. 1091.6107.440. Unpublished study prepared by Springborn Laboratories, Inc. 57 p.

123-1 Seed germination/seedling emergence and vegetative vigor

MRID	Citation Reference
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MRID	Citation Reference

166-2 Ground water-small retrospective

MRID	Citation Reference

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MRID	Citation Reference
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42056601	Jenkins, C. (1991) DOZ 300 H (SAN 582 H): 21-Day Rainbow Trout Toxicity Study Under Flow-Through Exposure Conditions: Final Report : Lab Project Number: ASA/047: 91/SAS047/0409. Unpublished study prepared by Life Science Research Limited. 33 p.
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81-1 Acute oral toxicity in rats

MRID	Citation Reference
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42516006 Blasczak, D. (1992) Acute Oral Toxicity Study in Rats: San 582H Sulfonate Metabolite (M-27): Final Report: Lab Project Number: 92-6291. Unpublished study prepared by Bio/Dynamics, Inc. 16 p.

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43219204 Bradley, D.; Lowe, C. (1994) Oral LD50 Study in Albino Rats with AC252,214/AC187,993 4.1 EC Formulation: Lab Project Number: T/0687: A94/55/01. Unpublished study prepared by American Cyanamid Co. 16 p.

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43522101 Blaszcak, D. (1994) Acute Oral Toxicity Study of San 582 H 720 EC 420 DP in Rats: Final Report: Lab Project Number: 94/1063. Unpublished study prepared by Pharmaco LSR Inc. 52 p.

44057412 Blaszcak, D. (1996) Acute Oral Toxicity Study with SAN 1412 H 720EC 400 DP in Rats: Final Report: Lab Project Number: 95-1361. Unpublished study prepared by Huntingdon Life Sciences. 47 p.

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44097601 Blaszcak, D. (1991) Acute Oral Toxicity Study of SAN 582H Technical (K/E) in Rats: Final Report: Lab Project Number: 6014-91: DP 300316. Unpublished study prepared by Bio/dynamics, Inc. 17 p.

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81-3 Acute inhalation toxicity in rats

MRID	Citation Reference
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41662411	Ullmann, L. (1986) 4-Hour Acute Inhalation Toxicity Study with SAN 582 H in Rats: Lab Project Number: RCC 075510. Unpublished study prepared by Researching & Consulting Co., Ag. 39 p.
42404315	Biesemeier, J. (1990) Acute Inhalation Toxicity Study of SAN 854 H 480 SE in Sprague-Dawley Rats: Lab Project Number: 90. 2385.038: DP 300241. Unpublished study prepared by Food and Drug Research Labs. 62 p.
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43219206	Hoffman, G. (1994) Acute Inhalation Toxicity Study with AC252,214/AC187,993 in Rats: Lab Project Number: 93/5158: 971/93/119. Unpublished study prepared by Pharmaco LSR Inc. 182 p.
43220806	Hoffman, G. (1994) Acute Inhalation Toxicity Study with AC 263,499/AC 187,993 in Rats: Lab Project Number: 93-5155. Unpublished study prepared by Pharmaco LSR Inc. 177 p.
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42666615	Blaszcak, D. (1992) Primary Eye Irritation Study in Rabbits with SAN 1280 H 600 SE: Final Report: Lab Project Number: 0663. Unpublished study prepared by Bio/dynamics, Inc. 19 p.

MRID	Citation Reference
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43220807	Boczon, L. (1994) Eye Irritation Study in Albino Rabbits with AC 263,499/AC 187,993 Formulation: Lab Project Number: T-0664. Unpublished study prepared by American Cyanamid Co. 18 p.
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44093806	Shults, S.; Brock, A.; Serrone, D. (1996) Primary Eye Irritation Study in Albino Rabbits with SAN 1280 H 600 SE 403DP: Lab Project Number: 6831-96-0084-TX-001: RI 96-0084. Unpublished study prepared by Ricerca, Inc. 39 p.

81-5 83-4 2-generation repro.-rat

MRID	Citation Reference
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84-2 122-2 Aquatic plant growth

MRID	Citation Reference
41662417	VanDijk, A. (1989) Acute Toxicity of SAN 582 H to Scenedesmus sub- spicatus (OECD: Algae Growth Inhibition Test): Lab Project Number: 204603. Unpublished study prepared by RCC Umweltchemie Ag. 28 p.
42380601	Hoberg, J. (1992) SAN 582H Technical--Toxicity to the Freshwater Diatom, Navicula pelliculosa: Final Report: Lab Project Number: 92-4-4206: 10828. 1091.6107.440. Unpublished study prepared by Springborn Laboratories, Inc. 57 p.

123-1 Seed germination/seedling emergence and vegetative vigor

MRID	Citation Reference

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123-2 Aquatic plant growth

MRID	Citation Reference
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42380603	Hoberg, J. (1992) SAN 582H Technical--Toxicity to the Freshwater Alga, Anabaena flos-aquae: Final Report: Lab Project Number: 92-5-4249: 10828.1091.6107.420. Unpublished study prepared by Springborn Laboratories, Inc. 65 p.

141-1 Honey bee acute contact

MRID	Citation Reference
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161-1 Hydrolysis

MRID	Citation Reference

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161-2 Photodegradation-water

MRID	Citation Reference
41662406	Fostiak, W.; Yu, C. (1988) Photodegradation Study of SAN 582 H in Aqueous Solution: Lab Project Number: 414105: 3. Unpublished study prepared by Sandoz Crop Protection Corp. 69 p.
42266207	Sabat, M.; Yu, C. (1992) SAN 582H: Photodegradation Study in Aqueous Solution: Final Report: Lab Project Number: 414105: 23: DP-300754. Unpublished study prepared by Sandoz Agro, Inc. 48 p.

161-3 Photodegradation-soil

MRID	Citation Reference
41662407	Yu, C.; Ekdawi, M.; Fostiak, W. (1989) Photodegradation Study of SAN 582 H on Soil: Lab Project Number: 414105: 8. Unpublished study prepared by Sandoz Crop Protection Corp. 41 p.
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162-1 Aerobic soil metabolism

MRID	Citation Reference
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44083205	Conway, W. (1996) SAN 582H: Further Assessment of Environmental Fate: Final Report: Lab Project Number: DP 304011: 414105-35. Unpublished study prepared by Sandoz Agro, Inc. 60 p.
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162-2 Anaerobic soil metabolism

MRID	Citation Reference
41706801	Bade, T. (1990) Anaerobic Soil Metabolism of SAN-582H: Lab Project Number: 414105: 13. Unpublished study prepared by Sandoz Crop Protection Corp. 87 p.

162-3 Anaerobic aquatic metab.

MRID	Citation Reference
42367201	Das, Y. (1992) Metabolism of ?Thienyl-3-carbon 14| SAN 582H under Anaerobic Soil Conditions: Lab Project Number: ISSI 90011: TDS DP300833: CTM T-1-255. Unpublished study prepared by Innovative Scientific Services, Inc. 325 p.

163-1 Leach/adsorp/desorption

MRID	Citation Reference
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42034806	Tong, T. (1991) Soil Adsorption and Desorption of SAN-582H, Unaged, by the Batch Equilibrium Method: Lab Project Number: 414105: 21 : 300446. Unpublished study prepared by Sandoz Crop Protection Corp. 90 p.
44083205	Conway, W. (1996) SAN 582H: Further Assessment of Environmental Fate: Final Report: Lab Project Number: DP 304011: 414105-35. Unpublished study prepared by Sandoz Agro, Inc. 60 p.

164-1 Terrestrial field dissipation

MRID	Citation Reference
41706802	Smith, K. (1990) Dissipation and Mobility of SAN-582H in Soil after One Pre-emergence Application to Corn in North Carolina: Lab Project Number: 414108: 1. Unpublished study prepared by Sandoz Crop Protection Corp. 379 p.
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41706804 Smith, K. (1990) Dissipation and Mobility of SAN-582H in Soil after One Pre-Plant Incorporated Application to Corn in Illinois: Lab Project Number: 414108: 3. Unpublished study prepared by Sandoz Crop Protection Corp. 376 p.

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47258003 White, M. (2005) Laboratory Validation of BASF Method D0408 Entitled: "Method for the Determination of Residues of BAS 656 H (Dimethenamid) and its Metabolites, M-23 and M-27, Residues in Bare and Turf Plot Soil Utilizing LC/MS/MS.". Project Number: D0408, 134006, 2005/5000088. Unpublished study prepared by BASF Corporation. 70 p.

165-1 Confined rotational crop

MRID	Citation Reference

42380501 Pierotti, M.; Moore, P. (1992) Confined Accumulation Study of SAN-582H on Rotational Crops: Laboratory Final Report: Lab Project Number: 414105: 17: DP300940. Unpublished study prepared by Sandoz Agro, Inc. 563 p.

165-4 Bioaccumulation in fish

MRID Citation Reference

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166-1 Ground water-small prospective

MRID	Citation Reference
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166-2 Ground water-small retrospective

MRID	Citation Reference
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171-4B Residue Analytical Methods

MRID	Citation Reference
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41662420	Smith, K. (1990) Determination of the Stability of Residues of SAN- 582H and Its Oxalamide Metabolite in Stored Corn Samples: Lab Project Number: 414108: 9. Unpublished study prepared by Sandoz Crop Protection Corp. 129 p.
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41823902	Bade, T.; Guirgus, M. (1991) Confirmatory Method Trial of the Residue Method "A Method for the Determination of Residues of SAN-58 2H in Corn and Soil Samples": Lab Project Number: 414108: 14. Unpublished study prepared by Sandoz Crop Protection Corp. 83 p.
41843803	Jimenez, N. (1991) Analysis of Soybean Samples for SAN-582H and its Oxalamide and Sulfonate Metabolites (1989 Season): Lab Project Number: 414108; Report No. 12; DP-300229. Unpublished study pre- pared by Sandoz Crop Protection Corp. 633 p.
41843804	Jimenez, N. (1991) Analysis of Soybean Samples for SAN-582H and its Oxalamide and Sulfonate Metabolites (1990 Season): Lab Project Number: DP-300228; 414108; Report No. 11. Unpublished study prepared by Sandoz Crop Protection Corp. 436 p.
42289505	Jimenez, N. (1992) Reanalysis of Corn Samples from the 1989 Season for SAN-582H Residue: Lab Project Number: 414108. Unpublished study prepared by Sandoz Agro, Inc. 488 p.
42289506	Jimenez, N. (1992) Analysis of Corn Samples from the 1990 Season for SAN-582H Residue: Lab Project Number: 414108. Unpublished study prepared by Sandoz Agro, Inc. 436 p.
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835.6100 Terrestrial field dissipation

MRID	Citation Reference
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850.3040 Field testing for pollinators

MRID	Citation Reference
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850.6100 Environmental Chemistry Methods and Associated Independent Laboratory Validation

MRID	Citation Reference
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860.1340 Residue analytical method

MRID	Citation Reference
50362706	Wooler, G. (2017) Independent Laboratory Validation of BASF Analytical Method L0109/02, ¿Determination of Dimethenamid-p and Its Metabolites Reg. No. 360715 (M23), Reg. No. 360714 (M27) and Reg. No. 360712 (M31) in Soil and Sediment by HPLC-MS/MS¿. Project Number: 822650, 107344, 2017/7015778. Unpublished study prepared by Critical Path Services, LLC (CPS). 261p.

860.1500 Crop field trials

MRID	Citation Reference
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885.4150 Wild mammal testing, Tier I

MRID	Citation Reference
47260101	McGaughey, B.; Rives, A.; Dressel, S.; et al. (2007) NatureServe Data Evaluation and Review. Project Number: 06763. Unpublished study prepared by Compliance Services International. 78 p.

885.4750 Aquatic ecosystem test

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