No. 19-70115

UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

NATIONAL FAMILY FARM COALITION, *et al*.,

Petitioners,

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, *et al*.,

Respondents,

and

MONSANTO COMPANY,

Intervenor-Respondent.

ON PETITION FOR REVIEW FROM THE UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

PETITIONERS' EXCERPTS OF RECORD VOLUME VII of IX

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[1] Unless otherwise specified, the document identifier numbers refer to their document numbers as listed in the Certified Indices, ECF Nos. 26-3 (Sections A through P), 34-3 (Section Q).

[2] Respondent United States Environmental Protection Agency (EPA) did not produce, but only provided hyperlinks to, publicly available documents. *See* ECF No. 26-3. For the Court's convenience, Petitioners have produced those hyperlinked documents in their entirety in the Excerpts of Record.

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[3] This e-mail contains a hyperlink to an online article that Petitioners have produced in its entirety. For the Court's convenience, Petitioners have produced relevant hyperlinked articles in their entirely in the Excerpts of Record. Throughout the index these documents containing hyperlinks are noted with a double asterisk (*e.g.* __.__**).

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3/8/2011	A.91	Ecological Risk Assessment for Dicamba and its Degradate, 3,6-dichlorosalicylic acid (DCSA), for the Proposed New Use on Dicamba-Tolerant Soybean (MON 87708).	ER 1712
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6/4/2010	B.0024	Scott Kilman, *Superweed Outbreak Triggers Arms Race*, Wall St. J. (submitted as an attachment to the comment submitted by Ryan Crumley, The Center for Food Safety)	ER 1754
8/31/2005	C.7	EFED Reregistration Chapter For Dicamba/Dicamba Salts	ER 1760
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3/24/2016	F.6	Addendum to Dicamba Diglycolamine (DGA) Salt and its Degradate, 3,6-dichlorosalicylic acid (DCSA) Section 3 Risk Assessment: Refined Endangered Species Assessment for Proposed New Uses on Herbicide-Tolerant Cotton and Soybean in 7 U.S. States	ER 1794

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

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

PC Code: 128931
DP Barcode: 426789
Date: March 24, 2016

MEMORANDUM

SUBJECT: Dicamba DGA: Second Addendum to the Environmental Fate and Ecological Risk Assessment for Dicamba DGA salt and its Degradate, 3,6-dichlorosalicylic acid (DCSA) for the Section 3 New Use on Dicamba-Tolerant Soybean

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This is an addendum to the Environmental Fate and Effects Division's (EFED) ecological risk assessment for dicamba DGA salt (Clarity® formulation or M1691, EPA Reg No. 524-582) and its degradate, 3,6-dichlorosalicyclic acid (DCSA), for the proposed new use on dicamba-tolerant soybean. It includes analysis of information that was not previously included in the original soybean new use risk assessment (USEPA, 2011, DP 378444). Since the original risk assessment was conducted, the registrant, Monsanto, has submitted:

1) field trial data that impacts EFED's previous analysis of spray drift,
2) data for incidents and inquiries from the use of dicamba DGA salt,

3) laboratory volatility data for dicamba DGA and DMA salt formulations, and
4) terrestrial plant reproductive effects data.

Additionally, this addendum includes analysis conducted by EFED regarding:

5) the implication of new mammalian chronic effects endpoints for parent dicamba and the metabolite DCSA from the Health Effects Division (HED; USEPA 2016, D378366+),
6) a revised T-REX run using refined estimates of foliar dissipation half-lives and variable application rates,
7) the potential for effects to beneficial terrestrial invertebrates,
8) effects posed by runoff, and
9) potential synergistic interactions with glyphosate.

1. Spray Drift and Buffers (Field Trial Data)

In the first addendum to the EFED Section 3 risk assessment for dicamba DGA salt for use on dicamba-tolerant soybeans (D404138, 5/20/14), EFED estimated that the distance from the application site to where no effects are observed to sensitive plants (based on the NOAEC for the most sensitive apical endpoint of plant height for the most sensitive tested species, non-dicamba tolerant soybeans) ranged from 100 to 175 feet (for the 0.5 lb a.e./A tolerant-soybean post-emergent application rate). However, based on a weight of evidence approach and refined AgDrift modeling for coarser droplet spectra (coarse to ultra-course droplet distribution), EFED refined this distance to 124 feet (rounded up to 125 feet) or to 107 feet if label language were to restrict the droplet size to solely extra-coarse and ultra-coarse droplet sizes).

EFED further refined this analysis after receiving more information including a spray drift deposition study submitted by BASF (MRID 49067704). In light of this information, Monsanto proposed that the spray drift buffer distance be reduced to 70 feet for M1691 Herbicide using the TTI 11004 nozzle at application spray pressures ≤ 63 psi. EFED's subsequent analysis for submitted field trial data (presented below), however, indicates that a larger buffer may be necessary in order to limit potential effects to sensitive plants to the sprayed field. **Linking this data to our previous modeling efforts and employing a weight of evidence approach, EFED proposes that the label should be modified to include language to maintain a 100 to 110 foot downwind buffer when applying at the 0.5 lbs a.e./A application rate. The July 2015 amended labels subsequently submitted by Monsanto included a 110 foot buffer and 220 foot buffer for 0.5 and 1.0 lbs a.e./A application rates, respectively.**

Field Trial Data Discussion

Subsequent to EPA's 5/20/2014 addendum, Monsanto presented information from academic field research that had not previously been submitted to the Agency for review. EPA requested data from these field trials and Monsanto submitted the raw data (MRID 49612701 pg. 51) on 4/13/2015 along with a response document (MRID 49570501 pg. 1). Monsanto's response document included an analysis that the 70 foot buffer would be protective of the no-effect distance for sensitive plants (the "no-effect" distance is based on the most sensitive NOAEC for the apical endpoint of plant height for the most sensitive tested species, non-dicamba tolerant soybeans) for 7 of the 9 submitted trials and a proposed rationale for why it may not have been protective in the remaining 2 trials. The response document also included Monsanto's statement that the field trial data are not suitable for use in EPA's regulatory decision-making process, but overall support the then-proposed 70 foot buffer.

While EFED agrees that the field trial data are generally not suitable for regulatory decision-making, we believe that they demonstrate additional uncertainty that the previously proposed 70 foot buffer would be sufficient to prevent potential effects to non-target plants that are off the field. In an attempt to conduct a quantitative evaluation of the field trial data, EFED considered that the data could reasonably represent a dose-response effect, with higher treatment doses expected to be closer to the application site. In this context, the distances farthest from the application site were considered to be likely to have little to no dicamba residues and loosely were considered controls. EFED then considered that plant heights and yield (similar to our apical endpoints of plant height and biomass from the standard vegetative vigor plant ecotoxicity tests) at the closer distances (*i.e.* treatment groups) could be compared to those of plants at the "control" distances using statistical hypothesis tests, similar to our standard statistical methodologies for data evaluation of ecotoxicity tests. In an effort to streamline the data analysis process, EFED used standard t-tests in Excel to conduct the analysis.

This statistical analysis indicated that a majority (5/9) of the field trials provided evidence that the proposed 70 foot buffer would not be sufficient to keep any effects to sensitive plants' apical endpoints contained to the field. Three of the nine trial sites had significant inhibitions compared to the "control groups" at distances greater than EFED's refined buffer of 125 feet, though EFED notes Monsanto's rationale for the greater distances in two of those sites (Monmouth, IL and Haubstadt, IN) might be due to applications not conforming to the currently proposed label restrictions for M-1691 Herbicide. The maximum "no effect" spray drift distance that EFED determined for the remaining site (Rower, AR) was 147.5 feet.

Since these field trials involved no true controls and residue analysis was not conducted to confirm the lack of residues in the farthest plants, the magnitude of an effect seen between "treatment" groups and true control plants might be higher than what this analysis indicates. These field trials were all conducted at the 0.5 lbs a.e./A (maximum single post-emergent application rate) and all were conducted using the TTI11004 nozzle in accordance with the label directions. The operating pressures varied across the sites from 30 psi to 50 psi (other than for the Haubstadt trial site, for which nozzle pressures were not recorded), which is less than the labeled maximum operating pressure of 63 psi. Higher operating pressures than used in these field trials (but within the proposed labeled directions for use), may result in an increased proportion of finer spray droplets and consequently result in effects at distances greater than observed in these field trials. The specific process, results and conclusions that EFED used in evaluating Monsanto's submitted field trial data and relating it as an additional line of evidence in determining an appropriate buffer that would result in no adverse effects to EPA's apical endpoints for terrestrial plants (the most sensitive taxa to the herbicide dicamba), is discussed immediately below.

Details of EFED's Process to Determine a "No Effect" Spray Drift Buffer from the Available Field Trial (MRID 49612701 pg. 51) Data:

Transects (at each site or for each swath, where multiple swaths were tested) were combined to determine mean soybean (non dicamba-tolerant) plant heights (14 & 28 DAT) or yields at set distances. The farthest two distances for which plant height or yield data were recorded were considered "controls," though there are considerable uncertainties to this approach. Specifically, no true controls were used, no residue analysis was conducted to confirm that these plants were not exposed to dicamba (or other chemical) residues, data were only recorded when there was at least 5% visual response (which could have been due to a number of factors including potential dicamba residues) and for many of these "controls" the height/yield endpoint may not have been recorded in all transects, resulting in a lower sample size (n) for controls and therefore a decreased power in the statistical t-test.

All analyses were conducted in MS Excel. Means for each distance towards the sprayer were compared to the "control" means to determine the percent inhibition at each distance. T-tests (1-tailed, assumed equal variances unless an F-test {$p<0.05$} showed unequal variances) were conducted to compare the endpoints of the treatment distances to the controls. Since these were field tests and had considerable uncertainties surrounding the controls, EFED considered significance at the (α=) 0.1 level which increases the conservatism of the analysis. The buffer for a "no effect" distance at each site was considered the first distance greater than the maximum distance which had a significant decrease compared to the control group. For example, at the Brooksville, MS site, the furthest distance which exhibited a significant decrease ($p<0.10$) in height at 28 DAT compared to the control group was 86.25 feet. The next highest distance at which soybean heights were measured was 96.25 feet (not significant, $p=0.19$), which therefore was considered the "no effect" distance buffer for that site.

Results of the Analysis of the Field Trial (MRID 49612701) Data

After reviewing this field trial data, EFED made the following findings. Of the nine field trials discussed above, a majority (five) provide evidence that a 70 foot buffer may not be sufficient, and four provide evidence that a 100 foot buffer may not be sufficient (**Table 1**). With a buffer distance of 125 feet for a 0.5 lb a.e./A application rate, 3 sites (33%) would provide evidence that a larger buffer might be necessary, with Monsanto stating (and subsequently providing information) that two of these (Monmouth and Haubstadt) may not have followed the currently proposed label by either using a different formulation or applying when wind speed was lower than required by the current proposed draft label.

Table 1. Distance (in feet) from Site of Application to a "No Effect" *

Site	Height (ft.) 14 DAT	Height (ft.) 28 DAT	Yield (ft.)	Comments
Brooksville, MS	46.25	96.25	66.25	
Rower, AR	7.9	20.6	**248.7****	14 DAT "controls" had only n=2. 28 DAT controls had n=3. ****Note**, for yield, after the 12% inhibition at 223.4', no treatment group was significantly (p<0.1) inhibited compared to controls (inhibitions ranged from 1.03—23.75% after this). The higher inhibitions were not significant due to the use of the nonequal variance t-test, but would have been had we assumed equal variances). Therefore, using best professional judgment informed by the data and t-test results , EFED has reduced the no effect distance for this endpoint to **147.5'**, after which all inhibitions at shorter distances were > 10% (other than only 1.1% inhibition at 7.9 feet).
W. Lafeyette, IN	66.25	26.25	No Data	14 DAT "controls" had n=3, 28 DAT "controls" had n=2
Scott, MS	26.25	26.25	66.25	
Jackson, TN	16.25	16.25	16.25	Yield "controls" had n=4.
Kirkwood, IL	116.25	116.25	16.25	
Monmouth, IL Swath 1	74.2	137.8	0	14 DAT controls had n=4, 28 DAT controls had n=3, Yield controls had n=3
Monmouth, IL Swath 2	53	95.4	254.4	14 DAT controls had n=3, 28 DAT controls had n=2, Yield controls had n=2
Haubstadt, IN Swath 1	30	80	10	Swath 1 only took measurements to a maximum of 100 feet. 14 DAT controls had n=5, 28 DAT controls had n=3
Haubstadt, IN Swath 2	40	80	150	14 DAT controls had n=3, 28 DAT controls had n=3, Yield controls had n=2
Gilbert, IA Swath 1	N/A	N/A	N/A	This swath was not evaluated as no field measurements were taken past 30 feet.
Gilbert, IA Swath 2	35	15	5	14 & 28 DAT and Yield controls had n=4. For yield, no distance had lower mean yield compared to controls.

*** Distance based on Plant Height after 14 and 28 days after treatment (DAT) and Yield ($\alpha = 0.10$). No effect" indicates no reduction in plant height or biomass relative to controls. In controls, the sample size (n) is considered 6 (or 10 for Brooksville, MS and Scott, MS trial sites) unless otherwise noted in the comments section where fewer controls may affect the power of the test.**

Weight of Evidence Conclusions

After reviewing the field trial data submitted to EPA, EFED finds that there is considerable uncertainty around the use of a 70 foot in-field buffer with the intent to keep any adverse effects (related to our apical endpoints of plant height and biomass) on the field, as the majority of the sites appeared to have effects on plant height at distances past this. Though the quality of this field trial data is not suitable for the purpose of establishing an appropriate buffer distance (especially as the lack of true controls may mean that the magnitude of effects to true control plants could be greater than indicated here), EFED believes this data provides a line of evidence that an in-field buffer greater than 70 feet is warranted to ensure protection of listed species, such as that determined in our previous risk assessment addendum (D404138, 5/20/14) which used a refined modeling approach extracting out the coarse, extra-coarse and ultra-coarse droplet spectra to determine an average 124 foot buffer (rounded up to 125 feet) or **solely the extra-coarse and ultra-coarse droplet spectra for an estimated average distance of 107 feet (rounded up to 110 feet) for a 0.5 lbs a.e./A application.** The draft label only supports the use of one nozzle (Tee Jet® TTI11004) with a maximum operating pressure of 63 psi which restricts droplet spectra to ultra-coarse and extremely coarse.

Using a weight of evidence approach (covering the refined modeling analysis conducted in the previous risk assessment addendum, the spray drift deposition study submitted by BASF (MRID 49067704) and the submitted field trial data discussed here), EFED concluded that **the label should be modified to include language to maintain a 100 to 110 foot downwind buffer when applying at the 0.5 lbs a.e./A application rate and with the described nozzles restricting the droplet spectra extra-coarse and ultra-coarse. The July 2015 amended labels subsequently submitted by Monsanto included a 110 foot buffer and 220 foot buffer for 0.5 and 1.0 lbs a.e./A application rates, respectively.**

Further data that may help refine this estimate would be field trial data with actual controls (and/or residue analysis to indicate a lack of dicamba or other herbicide treatments), larger control sample sizes and transect replication, field measurements provided regardless of whether plant visual response (damage) was observed or not, a greater number of swaths at each trial site (reflective of typical practices in soybean agriculture) and using the maximum labeled nozzle operating pressure.

2. *Incidents*

Incident Reports Submitted by Monsanto (2012-2014)

Monsanto provided information for 73 incidents involving the M1691 formulation from 2012 to 2014. In their response document (MRID 49612701 pg. 68), Monsanto notes that observations were solely qualitative visual estimates and that no measurements of apical endpoints such as plant height or yield were taken. Monsanto further noted that the incidents related either to seed production activities or to activities performed as part of the product development process relating to product stewardship. They stated that current proposed label requirements were not in place in 2012, that all of these incidents either did not follow all of the current draft label requirements (including tank mixtures with additional pesticide active ingredients such as glyphosate, nozzle type, wind-speed, wind direction, spray volume, etc.) or they were a result of other factors (*e.g.* burndown application, heavy rainfall, equipment contamination, spillage, etc.) and that the percentage of incidents as a function of the number of applications made has decreased in each subsequent year since 2012.

EFED has conducted an initial review of these incidents and generally agrees with Monsanto that the incidents resulted from applications not in accordance with currently proposed draft label language or were attributed to other (non-dicamba) factors. However, four incidents (Inquiries 19, 20, 24, and 30) from 2014 lacked sufficient information in the report (such as on tank mixture, application rates, nozzles, wind direction & speed, equipment speed, buffer distance, spray volume & pressure or boom height) to determine whether their occurrence followed applications that were in accordance with the current proposed draft label requirements. Although, as Monsanto notes, much of this data arises from seed production activities or activities related to the product development process and were not generated for purposes of risk assessment, EFED does not discount that they could be suggestive of potential incidents in the field and they could provide useful information to that end.

EFED also acknowledges that the incident observations are qualitative measures of visual injury (*e.g.* leaf spotting or curling). Nonetheless, the information presented in these incidents may be useful if future labels incorporate changes such as potential tank mixes with additional active ingredients or additional nozzle types, since some of these incidents include information on tank mixes and nozzle types which would be relevant in the case where those changes are made to the label.

Missouri and Arkansas Case files

The Missouri Department of Agriculture (MDA) has submitted information for incidents occurring from 2013 to 2015 and the Arkansas Plant Board (APB) has submitted information for incidents occurring in 2015, regarding observations of dicamba-type damage to non-tolerant plants following either preemergence or postemergence applications to dicamba-tolerant (DT) soybeans or cotton. Similar to the incidents reported by Monsanto for 2012-2014, all of the incidents were qualitative visual estimates and no observations or measurements of apical endpoints such as plant height or yield were taken.

2013-2014 Incidents

MDA has notified EPA of two incidents following potential dicamba applications that occurred in 2013 and 2014. In 2013, dicamba-type damage was observed in a non-DT soybean field (MO Case File #81513M00701, EIIS Incident report number I026579-001). The only dicamba application in the area was reported to be a Clarity herbicide application on DT-soybeans 2,800 feet from the damaged field. The air temperature and humidity at the time of dicamba application were reported to be 82^0F and 55%, respectively. Dicamba residues were found in one foliage sample taken from the affected field at 42 µg/kg. In the other two samples, dicamba residues were not detected (limit of detection not reported, but a limit of quantification of 3.8

µg/kg). The case file submitted to the agency did not originally determine the cause of the dicamba damage. In subsequent communication with the Agency (2015 letter from D. Slade, MDA to Grant Rowland, EPA), MDA concluded that the application of Clarity herbicide was not transported to the affected site by spray drift, but by later volatilization.

In their response document (MRID 49612701 pg. 1, submitted prior to MDA's December, 2015 letter), Monsanto noted that it has reviewed the complete incident report from the Missouri Department of Agriculture (MRID 49612701 pg. 75). Monsanto stated that the report indicated that 1) there was potential the crop visual injury response was observed prior to the dicamba application, 2) MO Department of Agriculture did not come to a definitive conclusion on the primary cause of the incident and 3) other plausible explanations were not investigated, such as temperature inversion, alternative sources of dicamba, such as leaking equipment or damage from other herbicides. Therefore, Monsanto concluded that the incident did not provide evidence that the observed plant response was a result of exposure to vapor drift of dicamba residues. Monsanto also included this incident in their description of the 73 incidents from 2012-2014 discussed previously in this section and noted that this incident would not comply with the current proposed label requirements, as M1691 was tank mixed with glyphosate and other adjuvants.

EPA notes that MDA has now completed their investigation of this incident, measured residues indicating the presence of dicamba residues on the affected site, concluded that dicamba volatilization rather than drift was the likely cause of the damage and initiated enforcement action against the applicator for allowing the product to move from the target field. The climatic conditions at the time of application were slightly outside of the range of conditions from the available laboratory studies on dicamba DGA salt's volatility. Given that effects to EPA's apical endpoints of plant height and biomass were not measured, there is uncertainty whether this incident indicates that volatilization following dicamba applications may result in impacts to apical endpoints beyond the proposed spray drift buffer of 110 feet for a 0.5 lb/A application. However, based on the available data, a volatilization buffer equal to the spray drift buffers, and extending in all directions from the treated field, is justified. The current proposed labels only apply a unidirectional spray drift buffer in the direction wind is blowing. Further discussion of volatility is provided in **Section 3** below.

MDA also notified EPA of an incident in 2014 (MO Case File #072214MO0701) where "dicamba type" damage was observed on a non-DT cotton field where the only nearby dicamba application would have been a Clarity herbicide application on DT-soybeans, 2.2 miles from the affected site. As with the other incidents, the provided information only indicated observations of visual injury and not effects to apical endpoints such as plant height and yield. Residue samples taken from the affected site failed to detect dicamba residues. It is unclear whether this incident was also included in Monsanto's submitted information on the 73 incidents from 2012-2014 (discussed previously in this section). With the current information available, and due to the lack of identified dicamba residues, it is uncertain whether the damage observed in the incident was a result of dicamba applications or due to some other unidentified cause. If the observed damage was caused by dicamba, then given the large distance between the affected site and the nearest known dicamba application, it would likely have been a result of volatilization, rather than spray drift.

2015 Incidents

Missouri and Arkansas recently submitted to EPA a total of 15 incidents in 2015 that might be attributed to dicamba use (12 in Arkansas and 3 in Missouri). The information indicates that these incidents resulted from 6 separate instances of applications of dicamba, with 8 of the incidents (7 from Arkansas and 1 from Missouri) being a result of a single instance of a post-emergent dicamba application to DT-cotton of Strut herbicide (active ingredient Dicamba DGA), tank-mixed with glyphosate and applied at two times the labeled rate for the proposed Clarity/M1691 post-emergent use. Visual observations of plant damage extended to 1320 feet (1/4 mile) from the application site. The remaining incidents were pre-emergent applications of dicamba or at this time remain uncertain as to whether any application of dicamba was made.

Conclusions Regarding Incident Information 2012—2015

For the purposes of the registration of dicamba on dicamba-tolerant soybean, the incident information available at this time indicates that the vast majority of incidents occurred following applications that were not made according to the current draft label requirements. Label requirements that were not followed included tank mixes with other active ingredients and adjuvants, higher application rates, and applications with different nozzle types and climatic conditions than permitted according to the draft label. Quantitative measurements of yield loss or decreased plant height were not made in any of the incident descriptions. Currently, EPA has no methodology for relating qualitative estimates of visual damage to quantitative effects to apical endpoints.

Most of these incidents were likely caused by spray drift off the field following the application. The only incident where volatility of dicamba residues has been concluded to be the cause of the incident by a regulatory agency (MDA for MO Case File #81513M00701, EIIS Incident report number I026579-001) was an incident where the application was also made as a tank mix of glyphosate, additional adjuvants, and dicamba. However, EFED believes that this difference from the draft label is unlikely to have impacted the ability of dicamba residues to volatilize since the different active ingredients and adjuvants are generally presumed to have disassociated from each other by the time any volatilization would occur. Rather, the volatilization may have been more likely impacted by the climatic conditions (temperature and humidity) in the days following the application which fall outside of the range of submitted laboratory data conditions. Additional discussion and characterization of volatility is provided in the next section.

3. Volatility

After reviewing data submitted to EPA relating to the volatility of dicamba, EFED had concerns regarding the volatility of dicamba, and possible post-application, vapor-phase off-site transport that might damage non-target plants. Monsanto responded to these concerns with a submission (MRID 49612701 pg. 143) that acknowledged the long-recognized volatility of dicamba and described measurements of the volatilization in the different formulations.

The information submitted to address EFED's concerns was helpful, but the submission did not include enough detail to verify the measurements in the studies. EFED determined that it would be useful also to perform volatility experiments under varied conditions of temperature and relative humidity, because these factors seem to be important in field conditions.

The registrant has agreed to place directional, in-field spray drift buffers of 110 feet for the 0.5 lb a.e./A application rate and 220 feet for the 1.0 lb a.e./A application rate. One open literature study (Egan and Mortensen 2012), directly addresses the potential for volatilization and transport of dicamba, and the potential for damage to the most sensitive tested species, soybean (non dicamba-tolerant). Based on damage assessments of non dicamba-tolerant soybean plants placed near treated fields after spray drift from a 0.5 lb/A DGA salt application had dissipated, the authors estimated the exposure at distance by correlation to known dose-damage correlations. They estimated that the 95% upper bound vapor exposure would drop below the soybean NOAEC at approximately a distance of 25 meters (82 feet). This is well within the 110-foot spray drift buffer proposed for the 0.5-lb/A rate. Thus, based on at least one study, this buffer distance should be adequate to protect against volatilization exposure for EPA's apical endpoints of plant height and yield. However, consideration should be made as to whether this buffer distance should be applied on all sides of the field, rather than the currently labeled uni-directional buffer according to wind direction.

The incident described by MDA in the previous section (MO Case File #81513M00701, EIIS Incident report number I026579-001) provides limited information that the proposed 110 to 220-foot spray drift buffers would not be adequate to limit off-site plant damage due to post-application volatilization. However, since the incident only qualitatively describes visual damage, while the buffer is intended to be protective of apical endpoints of height and yield, this remains an uncertainty, and would benefit from additional field trial data under varied conditions of temperature and relative humidity. Based on the best available data for dicamba residues from vapor drift compared to effects on apical endpoints, EFED believes that a 110 foot buffer for the 0.5 lb ae/A application rate should be adequate to protect against effects on non-target plants from volatilization of dicamba residues. This analysis similarly suggests that a 220-foot buffer is protective for the 1.0 lb ae/A application rate, though this may be overly conservative since the 1.0 lb ae/A rate is for pre-emergent applications that may be applied under conditions less conducive to vapor drift (*e.g.* cooler temperatures)

4. Potential Effects on Terrestrial Plant Reproduction

EFED is aware of published literature associating dicamba applications with effects to soybean progeny. These studies indicate potential effects to the quantity and reproductive quality of future soybean generations following dicamba applications that would not be observed in the guideline vegetative vigor and seedling emergence studies EFED typically uses to assess risk to terrestrial plants. Therefore, these data raise a potential concern that has not been directly addressed in OPP assessments, should these effects occur at lower exposures than the effects observed in the guideline terrestrial plant studies. In meetings and email correspondence in January/February, 2015, OPP asked whether Monsanto was aware of this issue. Monsanto requested the references that OPP was aware of, so that they could independently review them.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, DC 20460

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

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MEMORANDUM

Subject: Addendum to Dicamba Diglycolamine Salt (DGA) and its Degradate, 3,6-dichlorosalicylic acid (DCSA) Section 3 Risk Assessment: Refined Endangered Species Assessment for Proposed New Uses on Herbicide-Tolerant Soybean and Cotton in in 11 U.S. States: (Arizona, Colorado, Delaware, Florida, Maryland, New Mexico, New Jersey, New York, Pennsylvania, Virginia and West Virginia).

To: Grant Rowland, Risk Manager Reviewer
Kathryn Montague, Product Manager Team 23
Dan Kenny, Branch Chief
Herbicide Branch
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From: Elizabeth Donovan, Biologist 3/24/16
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Monica Wait, Risk Assessment Process Leader Monica Wait 3/24/16
Environmental Risk Branch 6
Environmental Fate and Effects Division (7507P)
Office of Pesticide Programs

Through: Mark Corbin, Branch Chief 3-24-16
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Prior to conducting this refined Endangered Species Assessment, the Environmental Fate and Effects Division (EFED) performed a screening level ecological risk assessment for a Federal action involving proposed new uses of the diglycolamine salt of dicamba (dicamba DGA) on dicamba herbicide-tolerant soybean on March 8, 2011 (DP 378444); an amendment to the assessment was issued on May 20, 2014 (DP 404138, 404806, 405887, 410802, and 411382). Concurrent with this refined Endangered Species Assessment, a Section 3 New Use dicamba DGA salt on dicamba-tolerant cotton screening-level assessment (DP 404823) and a subsequent addendum (DP 426789) that addresses multiple issues (spray drift buffers, runoff, risk to terrestrial invertebrates and updated mammalian toxicological endpoints for parent dicamba and its degradate, DCSA) have been finalized. In the screening level risk assessment, potential direct risk concerns could not be excluded for:

- mammals (chronic, from the soybean use only, due to residues from dicamba's metabolite, DCSA, rather than from parent dicamba);
- birds (acute from parent dicamba for both soybean and cotton uses; chronic from DCSA residues only in soybean but not in cotton), considered surrogates for reptiles, and terrestrial-phase amphibians; and
- terrestrial plants (soybean and cotton uses)

In the screening level risk assessments, indirect effect risk concerns for all taxa were possible for any species that have dependencies (e.g., food, shelter, and habitat) on mammals, birds, reptiles, terrestrial-phase amphibians, or terrestrial plants. Additionally, the screening level assessment showed that direct risk concerns were unlikely (*i.e.* levels of concern were not exceeded) for:

- mammals (acute) and (chronic—for the cotton use only);
- birds, reptiles, and terrestrial-phase amphibians (chronic from parent dicamba or DCSA degradate from use on cotton);
- terrestrial insects (acute and chronic);
- freshwater fish (acute and chronic);
- aquatic-phase amphibians (acute and chronic);
- estuarine/marine fish (acute and chronic);
- freshwater invertebrates (acute and chronic); estuarine/marine invertebrates (acute and chronic); and
- aquatic plants[1]

EPA has a specific process based on sound science that it follows when assessing risks to listed species for pesticides like dicamba that will be used on seeds that have been genetically modified to be tolerant to the pesticide. The Agency begins with a screening level assessment that

[1] The listed species LOC was exceeded for non-vascular aquatic plants, however there are no listed species of this taxa.

includesa basic ecological risk assessment based on its 2004 Overview of the Ecological Risk Assessment Process document. [USEPA, 2004, available at http://www.epa.gov/oppfead1/endanger/litstatus/riskasses.htm]. That assessment uses broad default assumptions to establish estimated environmental concentrations of particular pesticides. If the screening level assessment results in a determination that no levels of concern are exceeded, EPA concludes its analysis. On the other hand, where the screening level assessment does not rule out potential effects (exceedances of the level of concern) based on the broad default assumptions, EPA then uses increasingly specific methods and exposure models to refine its estimated environmental concentrations. At each screening step, EPA compares the more refined exposures to the toxicity of the pesticide active ingredient to determine whether the pesticide exceeds levels of concern established for listed aquatic and terrestrial species. EPA determines that there is "no effect" on listed species if, at any step in the screening level assessment, no levels of concern are exceeded. If, after performing all of the steps in the screening level assessment, a pesticide still exceeds the Agency's levels of concern for listed species, EPA then conducts a species-specific refined assessment to make effects determinations for individual listed species. The refined assessment, unlike the screening level assessment, takes account of species' habitats and behaviors to determine whether any listed species may be affected by use of the pesticide.

The screening level ecological risk assessment generates a series of taxonomic (e.g., mammals, birds, fish, etc.) risk quotients (RQs) that are the ratio of estimated exposures to acute and chronic effects endpoints. These RQs are then compared to EPA established levels of concern (LOCs) to determine if risks to any taxonomic group are of concern. The LOCs address risks for both acute and chronic effects. Acute effects LOCs range from 0.05 for aquatic animals that are Federally-listed threatened or endangered species (listed species) to 0.5 for aquatic non-listed animal species and 0.1 to 0.5 for terrestrial animals for listed and non-listed species. The LOC for chronic effects for all animal taxa (listed and non-listed) is 1. Plant risks are handled in a similar manner, but with different toxicity thresholds (NOAEC/EC_{05} and EC_{25}, respectively) used in RQ calculation for listed and non-listed species and an LOC of 1 used to interpret the RQ. When a given taxonomic RQ exceeds either the acute or chronic LOC a concern for direct toxic effects is identified for that particular taxon. If RQs fall below the LOC, a no effect determination is identified for the corresponding taxon.

The purpose of this document is to explain the refined risk assessment conducted for Federally-listed threatened or endangered (listed) species that could potentially be impacted by this pesticide registration. The refined assessment was conducted based on the 2004 Overview document, as discussed above. The assessment of risks to listed species posed by the use of Dicamba DGA has been conducted in phases covering a specific set of states, assessing risk to all the listed species covered in those states. This assessment covers the endangered species analysis for 11 states: Arizona, Colorado, Delaware, Florida, Maryland, New Mexico, New Jersey, New York, Pennsylvania, Virginia and West Virginia (AZ, CO, DE, FL, MD, NM, NJ, NY, PA, VA and WV). Based on EFED's LOCATES v.2.4.0 database and information from the U.S. Fish and Wildlife Service (USFWS), 322 species in the 11 states proposed for registration were identified as within the action area (at a preliminary county-wide level of resolution) associated with the new herbicide-tolerant soybean and cotton uses. **Table 1** below presents a summary of this assessment. Separate concurrent assessment phases cover the endangered species analysis for 16 states (Arkansas, Kansas, Louisiana, Illinois, Indiana, Iowa, Minnesota, Mississippi, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, and Wisconsin (DP 416416, 420160, 420159, 420352, 421434, 421723)) and 7 states (Alabama, Georgia, Kentucky, Michigan, North Carolina, South Carolina, and Texas (DP 422305).

EPA consulted U.S. Fish and Wildlife Service Recovery Plans to determine whether listed species in these states would be expected to occur in an action area encompassing the treated soybean and corn fields. The refined assessment was then conducted on those species that could not be excluded from the action area. EPA also consulted the recovery plans in the refined assessment for additional habitat information and incorporated species biological information regarding dietary items (used to model dicamba DGA residues in prey tissue) and body weight (used to determine food consumption rates and scale ecotoxicity data from the tested surrogate species, the bobwhite quail and rat, to the body weight of the listed species).

The Environmental Fate and Effects Division (EFED) has completed an endangered species risk assessment for Arizona, Colorado, Delaware, Florida, Maryland, New Mexico, New Jersey, New York, Pennsylvania, Virginia and West Virginia in support of registering dicamba diglycolamine (DGA) salt on herbicide-tolerant cotton and soybean in these states. **Table 1** presents a summary of the assessment.

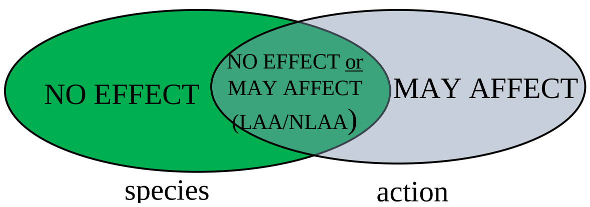
Table 1. Summary of species effects determinations and critical habitat modification determinations for Federally listed threatened or endangered species in Arizona, Colorado, Delaware, Florida, Maryland, New Mexico, New Jersey, New York, Pennsylvania, Virginia and West Virginia for dicamba DGA use on genetically modified cotton and soybeans.

Species	**Effects Determination**	**Comments**
Audubon Crested Caracara	**May Affect, Not Likely to Adversely Affect for Palm Beach County** (Cotton only; concurrence by USFWS pending) No effect (soybean; and for cotton in all other counties except Palm Beach)	The species is found in 22 counties in Florida. However, no county has soybean production and only one county has any cotton: Palm Beach County
All other species (terrestrial and aquatic)	No effect	
Critical Habitat	**Modification Determination**	**Comments**
All Critical Habitats (322 species)	No Modification	None

Making an Effects Determination

The bullets below outline EFED's process for making an effects determination for the Federal action:

- For listed individuals inside the action area but **NOT** part of an affected taxa **NOR** relying on the affected taxa for services (involving food, shelter, biological mediated resources necessary for survival/reproduction), use of a pesticide would be determined to have NO EFFECT.
- For listed individuals outside the action area, use of a pesticide would be determined to have NO EFFECT.
- Listed individuals inside the action area may either fall into the NO EFFECT or MAY AFFECT (LIKELY or NOT LIKELY TO ADVERSELY AFFECT) categories depending upon their specific biological needs, circumstances of exposure, etc.



- LIKELY or NOT LIKELY TO ADVERSELY AFFECT determinations are made using the following criteria:
  - Insignificant - The level of the effect cannot be meaningfully related to a "take."
  - Highly Uncertain - The effect is highly unlikely to occur.
  - Wholly beneficial - The effects are only good things.

Spray Drift Mitigation

EFED's refined endangered species risk assessment took into account the spray drift mitigation language that was added to the most recent proposed label submitted by the registrant. An accounting of federally-listed threatened or endangered species within the 11 states (covered in this assessment) proposed for dicamba DGA use on genetically modified cotton and soybeans is included in **Appendix 1** (322 species). Specifically, the spray drift mitigation language on the M1691 Herbicide Supplemental labels for the use dicamba DGA salt on ROUNDUP READY 2 XTEND™ soybean and BOLLGARD II® XTENDFLEX cotton includes the following limitations:

Specifically, the spray drift mitigation language includes the following limitations:

- Specifying the use of a nozzle (Tee Jet® TTI11004) with ASABE S-572 ultra-coarse and extremely coarse droplet spectra and a maximum operating pressure of 63 psi.

- A maximum equipment ground speed of 15 miles per hour and ground boom height of 24 inches above the target pest or crop canopy.
- Restricting all applications when wind speeds are < 3 mph or > 15 mph and restricting applications when wind is blowing towards sensitive areas at > 10 mph. Maintaining use of a 110 foot in-field buffer for a 0.5 lb a.i./A application (220 foot in-field buffer for a 1 lb a.i./A application) when the wind is blowing towards any areas that are not fields in crop cultivation, paved areas, or areas covered by buildings and other structures.
- Applications done in low relative humidity conditions are to use equipment set to produce larger droplet spectra to compensate for evaporation.
- Applications are not be conducted during temperature inversions.
- In order to prevent effects to non-target susceptible plants, the label also includes the following language: "do not apply under circumstances where spray drift may occur to food, forage or other plantings that might be damaged or the crops thereof rendered unfit for sale, use or consumption. Avoid contact of herbicide with foliage, green stems, exposed non-woody roots of crops, and desirable plants, including beans, cotton, flowers, fruit trees, grapes, ornamentals, peas, potato, soybean, sunflower, tobacco, tomato, and other broadleaf plants because severe injury or destruction may result, including plants in a greenhouse. Applicators are required to ensure that they are aware of the proximity to sensitive areas, and to avoid potential adverse effects from the off-target movement of M1691 Herbicide. The Applicator must survey the application site for neighboring sensitive areas prior to application. The applicator also should consult sensitive crop registries for locating sensitive areas where available."
- Finally, in order to prevent unintended damage from the drift of M1691 Herbicide, the label says not to apply this product when the wind is blowing towards adjacent commercially grown sensitive crops.

The incorporation of the spray drift mitigation measures into the product labeling as outlined above would result in exposure to dicamba DGA from spray drift at a level where effects are expected only within the confines of the treated field and so the action area is limited to the dicamba DGA treated field. Further, the incorporation of the "susceptible plants" spray drift mitigation language on the label is to avoid damage to these plants (including adjacent crops). Because the risk assessment interprets the threshold for plant damage concern to be based on the most sensitive plant species tested and the screening level ecological risk assessment has demonstrated that these plant effects endpoints constitute the most conservative terrestrial organism levels of effect, it is concluded that the "susceptible plants" requirement requires a level of drift mitigation that would also prevent less sensitive organisms from being exposed at levels of concern. Terrestrial species that are not expected to occur on treated fields under the provisions of the proposed label are not expected to be directly exposed to dicamba DGA, nor are their critical biologically mediated resources expected to be exposed to levels of the herbicide above any effects thresholds of concern. Additionally, as indicated in the screening level ecological risk assessments for cotton and soybean, no aquatic receptor taxa are of concern for drift or runoff exposure (LOCs were not exceeded for aquatic taxa). **Consequently, all but 14 of the 322 listed species originally identified as potentially at-risk are determined to be**

given a "no effect" (NE) without further refinement because they are not expected to occur in an action area encompassing the treated soybean and cotton fields (Appendix 2). The remaining 14 species are assessed using the refinements set forth in the 2004 Overview document referred to earlier in this assessment and considering the restictions contained in the proposed labeling, species specific biology, dicamba-specific foliar residue data and dicamba application timing information in this refined endangered species assessment.

Exposure through Runoff

The cotton screening-level risk assessment and the concurrently issued soybean addendum characterized risk following exposure to dicamba residues in runoff and found that the predicted concentrations from modeling were lower than the most sensitive taxa's endpoint (soybean plant height). Combining the predictions of this modeling, the toxicological endpoints and that most of the off-site plant community would not experience foliar contact with dicamba DGA in runoff sheet flow, EFED concluded that all available lines of evidence supported a "no effects" determination for runoff exposure for off-field listed plants for the proposed labeled use of dicamba DGA. Additionally, rainfast mitigation on the label would also protect against the risk of exposure to listed species off the treated field.

In addition to the spray drift and runoff mitigation measures contained in the proposed labeling, EFED analyzed species-specific biology, dicamba-specific foliar residue data and dicamba application timing information in this refined endangered species assessment. An accounting of the federally-listed threatened or endangered species within the 11 states proposed for this registration showed 322 listed species as potentially at risk (direct or indirect effects) as a result of the screening-level assessment (**Appendix 1**). The spray drift mitigation label language cannot preclude listed species being exposed to dicamba DGA salt or DCSA residues on treated fields, should a listed species utilize such areas as part of its range and corresponding habitat. Of the 322 listed species within the 11 states (AZ, CO, DE, FL, MD, NM, NJ, NY, PA, VA and WV) considered part of the proposed Federal decision, the following 14 species were reasonably expected to occur on soybean and cotton fields, which could potentially be treated with dicamba and therefore could not be assumed to be "no effect" solely on the basis of occurrence outside the action area:

Of these 14 species, a "no effect" determination was reached in the concurrent assessment actions for 16 states(DP 416416, 420160, 420159, 420352, 421434, 421723 covering AR, IL, IA, IN, KS, LA, MN, MS, MO, NE, ND, OH, OK, SD, TN, and WI) and 7 states (DP 422305 covering AL, GA, KY, MI, NC, SC, and TX) for the following species and is applicable to these 11 states as well:

- Eastern indigo snake (*Drymarchon corais couperi*)
- Indiana bat (*Myotis sodalis*)
- Lesser prairie-chicken (*Tympanuchus pallidicinctus*)
- Virginia big-eared bat (*Corynorhinus (=Plecotus) townsendii virginianus*)

- Ocelot (*Leopardus (Felis) pardalis*)
- Whooping crane (*Grus americana*)
- Red wolf (*Canis rufus*)
- Gray wolf (*Canis lupus*)

This leaves the following species for which the remainder of this document uses species specific biological information and dicamba DGA use patterns in more depth to further refine the assessment and effects determinations:

- California condor *(Gymnogyps californianus)*
- Audubon's crested caracara (*Polyborus plancus audubonii*)
- Delmarva Peninsula fox squirrel *(Sciurus niger cinereus)*
- Jaguar *(Panthera onca)*
- Florida panther (*Puma (=felis) concolor coryi*)
- Sonoran pronghorn *(Antilocapra americana sonoriensis)*

Therefore, species specific biological information (e.g., body size, dietary requirements, and seasonality) and dicamba DGA use patterns were considered in more depth to further refine the assessment and effects determinations.

This assessment also uses the refined exposure values determined in the cotton screening level assessment and the concurrently issued addendum to the soybean screening level risk assessment documents compared to the initial exposure estimates from the soybean screening level assessment. This ESA assessment also evaluates chronic exposures from DCSA separately from the chronic exposure to parent dicamba. Dicamba exposure values were determined from the upper bound of the modeled T-REX run for exposures following spray applications based on the Kenaga nomogram modified by Fletcher *et al* (1984), which is based on a large set of actual field residue data. Modeled dicamba exposure values were identical between the soybean addendum and the cotton screening level risk assessment (since the maximum application rates and minimum application intervals are the same).

Similar modeling of DCSA residues, which are formed inside the tolerant-soybean and tolerant-cotton plants through plant metabolism, is not feasible at this time due to a lack of sufficient data tracking DCSA residues in plant tissues over time to ascertain degradation rates. Therefore, in the soybean addendum and the cotton screening-level risk assessment, EFED used the maximum empirical measured DCSA residue concentrations in dicamba-tolerant soybean (61.1 mg/kg (ppm) DCSA in broadleaf plants and 0.440 ppm in soybean seeds) and cotton plant tissues (6.29 ppm DCSA in cotton gin byproducts and 0.27 ppm in undelinted cotton seed) to evaluate chronic exposures to DCSA for animals foraging on soybean and cotton plants. Residues in arthropods (as a dietary item for birds and mammals consuming insects that have consumed soybean/cotton tissues with DCSA residues) were assumed to follow the Kenaga nomogram relationship between broadleaf plants and arthropods for spray applications (*i.e.* arthropod concentrations estimated to be approximately 70% of the concentrations in broadleaf plant tissues or 42.5 ppm

DCSA in arthropods feeding on soybean plants and 4.4 ppm in arthropods feeding on cotton plants). The empirical residue data for cotton indicated that chronic exposures of birds and mammals to dicamba or DCSA in cotton tissues ***would not*** be above any levels of concern. Although the concurrently issued soybean addendum indicates that chronic risk to mammals and birds was only a concern from DCSA residues in plant/prey tissues *and not from residues of parent dicamba*, since the original soybean screening-level assessment (USEPA, 2011) indicated chronic risk to mammals, this assessment presents the estimated exposures and comparisons to threshold toxicity values for both dicamba and DCSA for mammals, but evaluates them separately since their chronic toxicity and exposure profiles differ greatly. For birds, following the conclusions of the screening level assessments and the soybean addendum, only acute risk from dicamba exposures and chronic risk from DCSA exposures is evaluated.

The following text discusses the lines of evidence and processes that were used to make effects determinations for listed species identified as potentially at-risk in the screening level assessment.

Refined ecological risk assessment for the remaining species potentially exposed to dicamba residues

For the effects determinations for California condor, Audobon's crested caracara, Delmarva Peninsula fox squirrel, jaguar, Florida panther and Sonoran pronghorn, a refined risk assessment approach was used to evaluate additional lines of evidence to determine whether the conservative generic assumptions in the screening risk assessment apply to a particular species of interest (*e.g.* the California condor). In the case of the California condor, the refined risk assessment investigated the impacts of more condor-specific data related to:

1. Bird size (as the condor is larger than the 1000g large bird category used in the initial screen)

2.. Bird food consumption tailored to:
 a. The true weight of the bird
 b. Energy requirements of the condor
 c. Improvement on the generic food intake model of the screen to assess energy content of the diet and the actual free living energy requirements of a bird the size of a California condor

3. Toxicity endpoints scaled from the weight of the tested surrogate species (bobwhite quail) to reflect the comparatively larger actual size of the condor.

Using the California condor as the example to show how EPA made its effects determinations, EPA determined that the California condor could be primarily feeding on carcasses of large mammals that may have been present in treated cotton and soybean fields. EPA therefore assumed that the predicted concentrations of dicamba DGA salt found in large (1000g) mammals that were exclusively feeding on short grass exposed to dicamba residues from the spray application would be a conservative prey analysis for the condor consistent with the preliminary risk concerns identified in the screening assessments. For chronic exposures to DCSA residues, EPA assumed the prey mammal was feeding exclusively on soybean forage containing the maximum measured DCSA concentrations. This analysis is conservative as it assumes 1) that 100% of the condor's food consumption comes from 1kg mammals that have fed exclusively on dicamba exposed short grass (the dietary item with the highest modeled residue levels) or DCSA residues in exposed dicamba-tolerant soybean plants (the only plants that would have significant DCSA residues) and 2) the level of dicamba DGA residues assumed to be on the consumed short grass is based on the upper bound Kenaga residues expected for short grass directly exposed to spray applications of dicamba DGA while the level of DCSA residues is assumed to be the maximum measured concentration (61.1 ppm). Additionally, using the residues in a 1 kg mammal carcass is also likely conservative, given that condor primarily feeds on larger prey species such as deer, elk, feral pigs, livestock, horses, and pinnipeds. EPA determined the field metabolic rate of the California condor through the use of a published peer reviewed allometric equation that relates bodyweight to energy requirements. Values were obtained from a published peer reviewed EPA document produced by the Office of Research and Development for Agency-wide use in conducting ecological risk assessment (USEPA, 1993) and the work of Dunning, 1984. The mass of dicamba DGA in the mammalian prey diet is determined from the T-REX run found in the addendum to the screening-level risk assessment (USEPA, 2016a), issued concurrently with this refined risk assessment The mass of prey consumed per day is then multiplied by mass of dicamba in the mammal's diet to determine the mass of dicamba or DCSA in the condor's daily diet in mg/day. Then the daily dose that the condor (considering its bodyweight) receives is determined by multiplying the mass of dicamba or DCSA in the exposed mammalian prey (which had consumed exclusively exposed plants) divided by the bodyweight of the condor. Then EPA scaled the acute toxicity endpoint (based on the tested surrogate bird species, bobwhite quail's default weight of 178 grams) to the bodyweight of the California condor to determine the acute oral toxicity for the condor. For exposures to DCSA residues, the chronic toxicity endpoint for the mallard (the most sensitive tested species) was modified by the relationship between the chronic dicamba and DCSA endpoints for rats (a 17x difference). The acute RQ for dicamba exposures is then calculated by dividing the daily dose of dicamba from consuming the exposed mammal carcasses by the acute oral toxicity endpoint while the chronic RQ is calculated by dividing the daily dose of DCSA by the chronic toxicity endpoint. In this case, the acute RQ was 0.01, which is below the endangered species level of concern of 0.1 while the chronic RQ was 0.02 which is below the listed and non-listed species chronic LO of 1.0. At this point, EPA was able to conclude that dicamba DGA would not have an effect on the California condor.

Birds

The screening-level assessments showed that birds could be at risk of mortality from acute exposures to dicamba DGA on treated fields, but chronic risk was not expected as no chronic RQs exceeded the Agency's LOC (1.0) for chronic risk (USEPA 2011. D378444, p. 15). The concurrently issued soybean addendum did indicate that chronic exposures to DCSA residues in soybean could be a concern, while the screening level cotton assessment indicated that chronic exposures to DCSA residues in cotton would not exceed the Agency's LOC for chronic risk. Therefore, for listed species that could reasonably be expected to occur on treated soybean and cotton fields, EPA conducted a refined assessment for acute (dicamba only) and chronic (DCSA only, and only for soybean) exposures. Of the remaining bird species identified as potentially at acute risk in the seven states, two are reasonably expected to occur on treated soybean and cotton fields. Therefore, species specific biological information and dicamba DGA use patterns were considered in more depth to further refine the assessment and effects determinations for those species.

California condor

Dicamba Acute Effects Assessment

Initial screening level risk assessment results for birds showed concerns for acute effects. The species' 5-Year review (USFWS, 2013) describes the condor as an obligate scavenger feeding primarily on large mammalian carcasses including deer, elk, feral pigs, livestock, horses, and pinnipeds, though smaller carrion may also be consumed. The assumptions in the initial screen were adjusted to account for the condor's biology:

The first step in the refinement process is to calculate dicamba DGA residues in the prey species. Using the conservative assumptions that the prey species is represented by a 1000 g mammal that feeds exclusively on exposed short grass receiving the upper bound Kenaga residues from the spray application of dicamba, EFED calculated the residues in this prey as 40.17 mg dicamba DGA salt/kg-bw (T-REX modeling from concurrently issued dicamba soybean addendum).

The next step is to calculate the expected daily dose for a typical 10 kg (10000 g, Dunning 1984) condor, the adjusted LD_{50} value, and the acute dose-based RQ for the condor based on the following allometric equations:

Food Intake (wet) = $(0.301(10000)^{0.75})/(1-0.69)/1000$ = 0.97 kg wet/day

Dose-based EEC in condor eating large mammal= 40.17 mg/kg wet x 0.97/(10000/1000) = **3.90 mg/kg-bw/day**

Adjusted LD_{50} = 188 mg/kg-bw $(10000/178)^{(1.15-1)}$ = **344 mg/kw-bw**

Acute Dose-Based RQ = 3.90/344 = **0.01**

An RQ of 0.01 does not exceed the LOC of 0.1; **consequently a "no effect" determination is concluded for the California condor.**

DCSA Assessment for California condor consuming prey that had previously consumed soybean forage

The first step in the refinement process is to calculate DCSA residues in the prey species. Using the assumption that the prey species is represented by a 1000 g mammal and the conservative assumptions that the prey animal feeds exclusively on exposed soybean forage containing the maximum measured residues of 61.1 ppm, EFED calculated the residues based on the following allometric equations (USEPA, 1993):

1000 g mammal prey ingestion rate (dry) = $0.621(1000)^{0.564}$ =30.56 g /day

1000 g mammal prey ingestion rate (wet) = 30.56/0.2 = 152.8 g/day

DCSA residue in prey eating soybean forage/hay 61.1 mg DCSA/kg-food (ww) x 0.1528 kg food/kg-bw = **9.34 mg/kg-bw/day**

The next step is to calculate the expected daily dose for a typical 10 kg (10000 g, Dunning 1984) condor, the adjusted LD_{50} value, and the acute dose-based RQ for the condor based on the following allometric equations:

Food Intake (wet) = $(0.301(10000)^{0.75})/(1-0.69)/1000 = 0.97$ kg wet/day

Dose-based EEC in condor eating large mammal= 9.34 mg/kg wet x 0.97/(10000/1000) = **0.91 mg/kg-bw/day**

Avian Chronic Endpoint of 695 mg/kg-diet (from mallard duck study for parent dicamba) modified by ratio of parent dicamba to metabolite DCSA from chronic rat studies (17x) results in Avian chronic NOAEC of **40.88 mg/kg-diet.**

Chronic Dose-Based RQ = 0.91/40.88 = **0.02**

<u>Audubon's Crested Caracara</u>

Dicamba Acute Effects Assessment

The five year review (USFWS 2009) of the caracara indicated that current habitat use includes (ranked highest to lowest proportion): improved pasture, dry prairie, freshwater marsh, mixed upland hardwoods, shrub swamp, shrub and brushland, grassland, pinelands, bare soil, urban, other agriculture, citrus, and scrub. It is therefore considered likely that individual birds may make use of cultivated soybean and cotton fields as potential foraging habitat.

Initial screening level risk assessment results for birds indicated concerns for acute effects. The assumptions in the initial screen were adjusted to account for the caracara's biology:

The first step in the refinement process is to calculate dicamba DGA residues in the prey species. The caracara is an opportunistic predator of a variety of terrestrial vertebrates and invertebrates (USFWS 1999). In evaluating dicamba residues from the screening risk assessment, the residues for a small bird consuming short grass exceed those of other dietary items (such as arthropods) and so conservatively serve as a dietary exposure pathway for this species-specific risk assessment, and EFED calculates the residues as 299.47 mg DGA/kg-bw (T-REX modeling from concurrently issued dicamba soybean addendum). This is a conservative approach as it assumes that the caracara if feeding exclusively on a prey species represented by a small (20g) bird feeding exclusively on exposed short grass receiving the upper bound Kenaga residues from the spray application of dicamba.

The next step is to calculate the expected daily dose for a typical 900g (Dunning 1984) bird, the adjusted LD_{50} value, and the acute dose-based RQ for the caracara based on the following allometric equations:

> Field metabolic rate kcal/day = $1.146(900)^{0.749}$ = 187 kcal/day (USEPA 1993, body weight Dunning 1984).
>
> Mass of prey consumed per day = 187 kcal/day/(1.7 kcal/g ww X 0.78 AE) = 141 g/day (1.7 is energy content of prey item from USEPA (1993); 0.78 is assimilation efficiency from USEPA 1993, assumption of small mammal prey from Biological Information on Listed Species of Amphibians and Model Parameterization for Pesticide Effects Determinations, United States Environmental Protection Agency, Office of Pesticide Programs July 15, 2013)
>
> Mass of dicamba DGA in 20 g small bird diet item= 299.47 mg/kg-ww from T-REX run
>
> Mass of dicamba in daily diet = 141 g/day X 299.47 mg dicamba/kg-ww small bird prey X 0.001 = 42.23 mg/day
>
> Daily dose in cararcara = 42.23 dicamba/day/0.9 = **46.92 mg/kg-bw/day**
>
> Adjusted LD_{50} = 188 mg/kg-bw $(900/178)^{(1.15-1)}$ **= 239.74 mg/kw-bw**
>
> Acute Dose-Based RQ = 46.92/239.74 = **0.20**

An RQ of 0.20 exceeds the LOC of 0.1, suggesting that even at a more refined level of assessment for this species an effect is possible should the species be found in treated fields. Similar though lower RQs would follow for consumption of small mammals (screening assessment dicamba residue 250.70 mg/kg, but not for the more likely insect diet during preplant with screening assessment residues of 102.99 mg/kg).

The analysis suggests that if a caracara is feeding in a cotton or soybean field, then there is a potential for a lethal event. Establishing a potential for overlap between species range and the cropped areas proposed for treatment is an important consideration in how likely an exposure event might be for individual caracara. To evaluate overlap between cotton or soybean and a specific species range, a GIS co-occurrence analysis was conducted. The caracara's range was compared to the aggregated National Agricultural Statistics Service (NASS) reported acres from the 2012 Census of Agriculture Full Report, and the 5 year aggregated USDA Cropland Data Layer (CDL) crop group layers. The most recent species range file provided by U.S Fish and Wildlife Service headquarters office, as of May 26, 2015, was used for these analyses.

To calculate the NASS overlap, first all the reported crops from the 2012 Census of Agriculture Full Report were cross walked into the 11 EFED crop groups for each county. All counties within the species range were selected from the aggregated crop group table, each crop was summed to generate the total NASS acres, and then percent overlap was calculated.

The CDL is the best available land cover data to spatially characterize agricultural crops nationally. As with any land cover data, there will be errors present. The accuracy of the CDL is well documented on a state by state basis. Essentially, major commodity crops have a more robust training and validation dataset than minor crops, and their accuracy values correspond accordingly. Several methods have been employed to minimize data errors within the CDL.

The CDL has over 100 cultivated classes hierarchically grouped into 11 general classes. Combining classes reduces errors of omission and commission between similar crop categories. The CDL is also annually produced. Five years of CDL from 2010-2014 were temporally aggregated. The concept is that anywhere a class occurs within those 5 years is represented as a temporally aggregated individual class. Temporal aggregation also accounts for crop rotations.

The CDL's agricultural classes were further refined by comparing county level NASS 2012 Census of Agriculture (CoA) acreage reports to county level CDL acreages. If a county's CDL acreage for a given class was lower than the CoA, EPA expanded the CDL class's extent within cultivated areas until the CDL acreage matched the CoA acreage. Using the temporally and thematically aggregated CDL as an input, EPA developed a script that compares each CDL crop group in each county to the corresponding CoA acreage report. If the CDL acreage was less than NASS, EPA expanded the raster in 1 pixel iterations until the CoA value was reached, or the area within the county's cultivated mask was built out. Region growing was restricted using the most recent CDL Cultivated Layer as a mask, so as to avoid buffering into any non-agricultural land cover types. This method reduces land cover mapping errors by adjusting the extent of each category to the best available census values.

To calculate the overlap of the 5-year CDL-aggregated layers, the zonal statistics tool in ArcGIS was used to count the pixels for each layer within the species range. These counts were converted to an area measurement, and the percent overlap calculated. The intersection of the maps represents the geographical extent of overlap of caracara habitat with cotton and soybeans. None of the Audubon's crested caracara's range overlaps with soybean using either the NASS or CDL datasets. Using the NASS dataset, none of the caracara's range overlaps with cotton production while using the CDL dataset <0.00001% of the established range overlaps with cotton (1 acre cotton coverage overlap within the caracara's habitat in Palm Beach County). As the crop overlap analysis suggests no soybean cropland co-occurrence with caracara range, EPA **concludes a No Effect (NE) determination for the soybean use.**

On the basis of the extremely low identified proportion of the distribution of the species, the co-occurrence of the species with treated cotton is determined to not occur in the majority of the caracara range (<0.00001%), and to be highly unlikely to occur in the one county with any cotton acreage (Palm Beach County with 1 acre of cotton according to the CDL dataset). **Consequently, if the dicamba cotton label does not restrict Palm Beach County, EPA would conclude a May Affect/Not Likely to Adversely Affect (NLAA) determination for the Audubon's Crested Caracara with Palm Beach County (concurrence pending) while a No Effect (NE) determination would be concluded for the other counties in the caracara's**

range. If use in Palm Beach County was excluded on the cotton label, than EPA would also conclude a No Effect determination for the cotton use.

DCSA Assessment for Audubon caracara

Given the acute analysis for parent dicamba DGA and the conclusion of a No effect or May Affect/Not Likely to Adversely Affect determination based on a lack of co-occurrence of the caracara with soybean and cotton production outside of Palm Beach County and extremely low co-occurrence in Palm Beach County, further analysis was deemed unnecessary for the DCSA degradate effects to the caracara.

Mammals

The screening-level assessments indicated that acute risk to mammals was not expected as no acute RQs exceeded the Agency's LOC (0.1) for acute risk (USEPA 2011. D378444, p. 15). However, the soybean screening-level assessment (USEPA, 2011) indicated that mammals could be at reproductive risk from chronic exposures to dicamba DGA on treated fields, though the cotton screening level and concurrently issued soybean addendum (USEPA, 2016a and USEPA, 2016b) indicated that chronic exposures to dicamba DGA would be below the chronic LOC (1.0). This difference is due to soybean screening level risk assessment's use of a chronic endpoint from the rat 2-generation study (MRID 43137101), of 45 mg/kg-bw for the NOAEL, based on decreased pup weight at 136 mg/kg-bw compared to the concurrent controls. HED recently reanalyzed the data from this study (USEPA, 2016c; D431873) in comparison to the historical control database range and determined that the NOAEL and LOAEL should be raised to 136 and 450 mg/kg-bw, respectively, as pup weights in each generation in the 136 mg/kg-bw treatment group were within the historical control range and above the historical control mean for the F1, F2A and F2B generations. Therefore, the cotton screening level risk assessment, the concurrently issued soybean addendum and this refined endangered species risk assessment use this revised NOAEL for dicamba DGA salt.

The concurrently issued soybean addendum did indicate that chronic exposures to dicamba's metabolite, DCSA, residues in soybean could be a concern, while the screening level cotton assessment indicated that chronic exposures to DCSA residues in cotton would not exceed the Agency's LOC for chronic risk. Therefore, EPA only conducted a refined assessment for chronic exposures to DCSA in soybeans for listed species that could reasonably be expected to occur on treated soybean fields.

Of the mammalian species identified as potentially at risk in the eleven states, four are reasonably expected to occur on treated soybean fields. Species specific biological information and dicamba DGA use patterns were considered in more depth to further refine the assessment and effects determinations for the four species potentially expected to occur on treated soybean fields.

Delmarva Peninsula fox squirrel

Dicamba Chronic Effects Assessment

The recovery plan for the squirrel (USFWS 1993; http://ecos.fws.gov/docs/recovery_plan/930608.pdf)) discusses a number of food items for the organism, however much of the discussion centers on forest habitat and its resources. The document does mention the squirrel's association with woodlands proximal to corn and soybean fields. Corn, soybean, and other grains provide reliable supplemental food according to Sheperd and Swihart (1995). However, it is unlikely, given the toxic gossypol content of cotton seed, that the plant provides similar resources as soybean for the squirrel. The following represents a refined risk assessment considering the body mass associated energy requirements of the squirrel and the use of soybeans as a food source.

Initial screening level risk assessment results for mammals identified concerns for chronic effects. Using the conservative assumption that 100% of the fox squirrel's diet is made up of exposed soybean seed/grain having received the upper bound Kenaga residues from the spray application of dicamba, exposure assumptions from the screening assessment were adjusted to account for fox squirrel's biology:

Field metabolic rate kcal/day = $2.514(800)^{0.507}$= 74.51 kcal/day
(USEPA 1993, body weight reflects screening assumption for the fox squirrel from Recovery Plan (USFWS 1993; http://ecos.fws.gov/docs/recovery_plan/930608.pdf))

Mass of soybean seed consumed per day = 74.51 kcal/day /(5 kcal/g ww X 0.85 AE)= 17.5 g/day
(5 is energy content of seed item from USEPA (1993); 0.85 is assimilation efficiency for seeds consumed by rodents from USEPA 1993)

Mass of dicamba DGA in seed/grain diet 17.74 mg/kg-ww from T-REX run (conservative estimate of exposure for the fox squirrel's diet of tree mast, buds, flowers, insects, fruit, seeds etc. and available dietary items in agricultural fields).

Mass of dicamba DGA in daily diet = 17.5 g/day X 16.43 mg dicamba DGA/kg-ww seed X 0.001 = 0.29 mg/day

Daily dose in fox squirrel = 0.29 mg dicamba DGA/day/0.8 kg **= 0.36 mg/kg-bw/day**

Fox squirrel NOAEL mg/kg-bw/day = 136 mg/kg-bw $(350/800)^{(0.25)}$ = **110.61 mg/kg-bw**

The RQ for chronic effects = 0.36/110.61 = **0.003**

A chronic RQ of 0.003 does not exceed the chronic LOC of 1.0. **Consequently, it is reasonable to make a "no effect" determination for the Delmarva Peninsula fox squirrel.**

DCSA Analysis for Delmarva Fox Squirrel consuming DCSA residues present in soybean grain

Initial screening level risk assessment results for mammals identified concerns for chronic effects. Using the conservative assumption that 100% of the fox squirrel's diet is made up of exposed soybean seed/grain having containing the maximum measured DCSA residues, exposure assumptions from the screening assessment were adjusted to account for fox squirrel's biology:

> Field metabolic rate kcal/day = $2.514(800)^{0.507}$= 74.51 kcal/day
> (USEPA 1993, body weight reflects screening assumption for the fox squirrel from Recovery Plan (USFWS 1993; http://ecos.fws.gov/docs/recovery_plan/930608.pdf))
>
> Mass of soybean seed/grain consumed per day = 74.51 kcal/day /(5 kcal/g ww X 0.85 AE)= 17.5 g/day
> (5 is energy content of seed item from USEPA (1993); 0.85 is assimilation efficiency for seeds consumed by rodents from USEPA 1993)
>
> Mass of DCSA in seed/grain diet 0.44 mg/kg-ww (maximum empirical residues for the most likely available dietary items (soybean grain) in agricultural fields).
>
> Mass of DCSA in daily diet = 17.5 g/day X 0.44 mg DCSA/kg-ww seed X 0.001 = 0.008 mg/day
>
> Daily dose in fox squirrel = 0.008 mg DCSA /day/0.8 kg **= 0.01 mg/kg-bw/day**
>
> Fox squirrel NOAEL mg/kg-bw/day = 8 mg/kg-bw $(350/800)^{(0.25)}$ = **6.51 mg/kg-bw**
>
> The RQ for chronic effects = 0.01/6.51 = **0.001**

An chronic RQ of 0.001 does not exceed the chronic LOC of 1.0. **Consequently, it is reasonable to make a "no effect" determination for the Delmarva Peninsula fox squirrel.**

<u>Jaguar</u>

Dicamba Chronic Effects Assessment

Initial screening level risk assessment results for mammals identified concerns for chronic effects. Jaguars are ambush hunters with large home ranges, capable of feeding on a wide variety of prey, though medium-sized (1-10 kg) and larger prey appear to be much more commonly used than smaller prey species (USFWS, 2012, Rosas-Rosas, 2006 and López-González and Miller, 2002). Using the conservative assumptions that the prey species is represented by a 1000 g mammal that feeds exclusively on exposed short grass receiving the upper bound Kenaga residues from the spray application of dicamba, exposure assumptions from the screening assessment were adjusted to account for the jaguar's biology:

> Field metabolic rate kcal/day = $0.6167(45000)^{0.862}$= 6326 kcal/day
> (USEPA 1993, body weight reflects screening assumption for the jaguar from Recovery Plan, USFWS 2012; http://ecos.fws.gov/docs/recovery_plan/049777%20-%20Jaguar%20Recovery%20Outline%20-%20April%202012_2.pdf)
>
> Mass of prey consumed per day = 6326 kcal/day/(1.7 kcal/g ww X 0.84 AE)= 4430 g/day (1.7 is energy content of prey item from USEPA (1993); 0.84 is assimilation efficiency from USEPA 1993, 1 kg mammal diet from Recovery Plan, USFWS 2012; http://ecos.fws.gov/docs/recovery_plan/049777%20-%20Jaguar%20Recovery%20Outline%20-%20April%202012_2.pdf)
>
> Mass of dicamba DGA in 1 kg mammal diet 40.17 mg/kg-ww (conservative estimate for a 1 kg mammal feeding on short grass) from T-REX run
>
> Mass of dicamba DGA in daily diet = 4430 g/day X 40.17 mg dicamba DGA/kg-ww mammal prey X 0.001 = 178 mg/day
>
> Daily dose in jaguar = 178 mg dicamba DGA/day/45 kg = **3.95 mg/kg-bw/day**
>
> Jaguar NOAEL mg/kg-bw/day = 136 mg/kg-bw X $(350/45000)^{(0.25)}$ = **40.39 mg/kg-bw**
>
> The RQ for chronic effects = 3.95/40.39 = 0.10.

A chronic RQ of 0.10 does not exceed the chronic LOC of 1.0. **Consequently, a "no effect" determination is made for the jaguar.**

DCSA Assessment for Jaguar consuming prey that had previous consumed exposed soybean forage

Using the conservative assumptions that the prey species is represented by a 1000 g mammal that feeds exclusively on exposed soybean forage containing the maximum measured DCSA residues (61.1 mg/kg), exposure assumptions from the screening assessment were adjusted to account for the jaguar's biology:

> The first step in the refinement process is to calculate DCSA residues in the prey species. Using the assumption that the prey species is represented by a 1000 g mammal and the conservative assumptions that the prey animal feeds exclusively on exposed soybean forage containing the maximum measured residues of 61.1 ppm, EFED calculated the residues based on the following allometric equations (USEPA, 1993):

1000 g mammal prey ingestion rate (dry) = $0.621(1000)^{0.564}$ =30.56 g /day

1000 g mammal prey ingestion rate (wet) = 30.56/0.2 = 152.8 g/day

DCSA residue in prey eating soybean forage/hay 61.1 mg DCSA/kg-food (ww) x 0.1528 kg food/kg-bw = **9.34 mg/kg-bw/day**

The next step is to determine the expected daily dose for a typical 45 kg jaguar, the adjusted NOAEL value and the chronic dose-based RQ for the jaguar based on the following allometric equations:

Field metabolic rate kcal/day = $0.6167(45000)^{0.862}$= 6326 kcal/day
(USEPA 1993, body weight reflects screening assumption for the jaguar from Recovery Plan, USFWS 2012; http://ecos.fws.gov/docs/recovery_plan/049777%20-%20Jaguar%20Recovery%20Outline%20-%20April%202012_2.pdf)

Mass of prey consumed per day = 6326 kcal/day/(1.7 kcal/g ww X 0.84 AE)= 4430 g/day (1.7 is energy content of prey item from USEPA (1993); 0.84 is assimilation efficiency from USEPA 1993, 1 kg mammal diet from Recovery Plan, USFWS 2012; http://ecos.fws.gov/docs/recovery_plan/049777%20-%20Jaguar%20Recovery%20Outline%20-%20April%202012_2.pdf)

Mass of DCSA in 1 kg mammal diet = 9.34 mg/kg-ww (conservative estimate for a 1 kg mammal feeding on soybean forage containing the maximum measured empirical residues of 61.1 mg/kg)

Mass of DCSA in daily diet = 4430 g/day X 9.34 mg DCSAA/kg-ww mammal prey X 0.001 = 41.38 mg/day

Daily dose in jaguar = 41.38 mg DCSA/day/45 kg = **0.92 mg/kg-bw/day**

Jaguar NOAEL mg/kg-bw/day = 8 mg/kg-bw X $(350/45000)^{(0.25)}$ = **2.38 mg/kg-bw**

The RQ for chronic effects = 0.92/2.38 = 0.39

A chronic RQ of 0.39 does not exceed the chronic LOC of 1.0. **Consequently, a "no effect" determination is made for the jaguar.**

Florida Panther

Dicamba Chronic Effects Assessment

Initial screening level risk assessment results for mammals identified concerns for chronic effects. The recovery plan (USFWS, 2008) describes the panther as a wide ranging animal primarily feeding on white-tailed deer and feral hogs with secondary prey including raccoon, armadillos, rabbits and alligators. Using the conservative assumptions that the prey species is represented by a 1000 g mammal that feeds exclusively on exposed short grass receiving the upper bound Kenaga residues from the spray application of dicamba, exposure assumptions from the screening assessment were adjusted to account for the panther's biology:

> Field metabolic rate kcal/day = $0.6167(34000)^{0.862}$= 4968 kcal/day
> (USEPA 1993, body weight reflects screening assumption for the typical panther female from Recovery Plan, USFWS 2008)
>
> Mass of prey consumed per day = 4968 kcal/day/(1.7 kcal/g ww X 0.84 AE)= 3479 g/day (1.7 is energy content of prey item from USEPA (1993); 0.84 is assimilation efficiency from USEPA 1993, 1 kg mammal diet from Recovery Plan, USFWS 2008)
>
> Mass of dicamba DGA in 1 kg mammal diet 40.17 (conservative estimate for a 1kg mammal feeding on short grass) mg/kg-ww from T-REX run
>
> Mass of dicamba DGA in daily diet = 3479 g/day X 40.17 mg dicamba DGA/kg-ww mammal prey X 0.001 = 139.75 mg/day
>
> Daily dose in panther = 139.75 mg dicamba DGA /day/34 kg = **4.11 mg/kg-bw/day**
>
> Panther NOAEL mg/kg-bw/day = 136 mg/kg-bw X $(350/34000)^{(0.25)}$ = **43.32 mg/kg-bw**
>
> The RQ for chronic effects = 4.11/43.32 = 0.09

A chronic RQ of 0.09 does not exceed the chronic LOC of 1.0. **Consequently, a "no effect" determination is made for the panther.**

DCSA Assessment for Florida panther consuming prey that had consumed exposed soybean forage

> The first step in the refinement process is to calculate DCSA residues in the prey species. Using the assumption that the prey species is represented by a 1000 g mammal and the conservative assumptions that the prey animal feeds exclusively on exposed soybean forage containing the maximum measured residues of 61.1 ppm, EFED calculated the residues based on the following allometric equations (USEPA, 1993):
>
> 1000 g mammal prey ingestion rate (dry) = $0.621(1000)^{0.564}$ =30.56 g /day

1000 g mammal prey ingestion rate (wet) = 30.56/0.2 = 152.8 g/day

DCSA residue in prey eating soybean forage/hay 61.1 mg DCSA/kg-food (ww) x 0.1528 kg food/kg-bw = **9.34 mg/kg-bw/day**

The next step is to determine the expected daily dose for a typical 34 kg panther, the adjusted NOAEL value and the chronic dose-based RQ for the panther based on the following allometric equations:

Field metabolic rate kcal/day = $0.6167(34000)^{0.862}$= 4968 kcal/day
(USEPA 1993, body weight reflects screening assumption for the typical panther female from Recovery Plan, USFWS 2008)

Mass of prey consumed per day = 4968 kcal/day/(1.7 kcal/g ww X 0.84 AE)= 3479 g/day (1.7 is energy content of prey item from USEPA (1993); 0.84 is assimilation efficiency from USEPA 1993, 1 kg mammal diet from Recovery Plan, USFWS 2008)

Mass of DCSA in 1 kg mammal diet 9.34 (conservative estimate for a 1kg mammal feeding on soybean forage containing the maximum measured empirical resiudes of 61.1 mg/kg-ww)

Mass of DCSA in daily diet = 3479 g/day X 9.34 mg DCSA/kg-ww mammal prey X 0.001 = 32.49 mg/day

Daily dose in panther = 32.49 mg DCSA /day/34 kg = **0.96 mg/kg-bw/day**

Panther NOAEL mg/kg-bw/day = 8 mg/kg-bw X $(350/34000)^{(0.25)}$ = **2.55 mg/kg-bw**

The RQ for chronic effects = 0.96/2.55 = 0.38

A chronic RQ of 0.38 does not exceed the chronic LOC of 1.0. **Consequently, a "no effect" determination is made for the panther.**

<u>Sonoran pronghorn</u>

Dicamba Chronic Effects Assessment

Initial screening level risk assessment results for mammals identified concerns for chronic effects. Pronghorn consume forbs such as buckwheat, ragweed, milkvetch and borage species as well as some woody species including ironwood and mesquite and succulent fruit such as chain-fruit cholla (USFWS, 2015). Though many agricultural crops do not provide adequate forage for the pronghorn, some, such as alfalfa do (USFWS, 2015). Therefore, it is possible that pronghorn may forage on agricultural crops such as soybean. Given the toxic gossypol content of cotton plant parts, it is unlikely that this plant provides similar resources as soybean for the pronghorn. Using the conservative assumptions that the pronghorn is exclusively consuming exposed broadleaf plants (the most likely dietary item with the highest modeled dicamba residues) receiving the upper bound Kenaga residues from the spray application of dicamba, exposure assumptions from the screening assessment were adjusted to account for the pronghorn's biology:

Field metabolic rate kcal/day = $1.419(47630)^{0.727}$= 3571 kcal/day
(USEPA 1993, body weight reflects screening assumption for the pronghorn from Recovery Plan, USFWS 2003; http://ecos.fws.gov/docs/recovery_plan/031126.pdf)

Mass of broadleaf plants consumed per day = 3571 kcal/day/(0.63 kcal/g ww X 0.76 AE)= 7458 g/day (0.63 is energy content of broadleaf dietary item from USEPA (1993); 0.76 is assimilation efficiency from USEPA 1993, broadleaf plant diet from Recovery Plan, USFWS 2003; http://ecos.fws.gov/docs/recovery_plan/031126.pdf)

Mass of dicamba DGA in broadleaf plant diet 147.91 mg/kg-ww from T-REX run

Mass of dicamba DGA in daily diet = 7458 g/day X 147.91 mg dicamba DGA/kg-ww mammal prey X 0.001 = 1103 mg/day

Daily dose in pronghorn = 1103 mg dicamba DGA/day/47.63= **23.16 mg/kg-bw/day**

Pronghorn NOAEL mg/kg-bw/day = 136 mg/kg-bw X $(350/47630)^{(0.25)}$ = **39.82mg/kg-bw**

The RQ for chronic effects = 23.16/39.82 = 0.58.

A chronic RQ of 0.58 does not exceed the chronic LOC of 1.0. **Consequently, a "no effect" determination is made for the pronghorn.**

DCSA Analysis for Pronghorn

Using the conservative assumptions that the pronghorn is exclusively consuming exposed soybean plants containing the maximum measured DCSA residues (61.1 mg/kg), exposure assumptions from the screening assessment were adjusted to account for the pronghorn's biology:

Field metabolic rate kcal/day = $1.419(47630)^{0.727}$= 3571 kcal/day
(USEPA 1993, body weight reflects screening assumption for the pronghorn from Recovery Plan, USFWS 2003; http://ecos.fws.gov/docs/recovery_plan/031126.pdf)

Mass of soybean forage consumed per day = 3571 kcal/day/(0.63 kcal/g ww X 0.76 AE)= 7458 g/day (0.63 is energy content of broadleaf dietary item from USEPA (1993); 0.76 is assimilation efficiency from USEPA 1993, broadleaf plant diet from Recovery Plan, USFWS 2003; http://ecos.fws.gov/docs/recovery_plan/031126.pdf)

Mass of DCSA in broadleaf plant diet 61.1 mg/kg-ww (maximum measured concentrations in soybean forage)

Mass of DCSA in daily diet = 7458 g/day X 61.1 mg DCSA/kg-ww soybean forage X 0.001 = 455.68 mg/day

Daily dose in pronghorn = 455.68 mg dicamba DGA/day/47.63= **9,57 mg/kg-bw/day**

Pronghorn NOAEL mg/kg-bw/day = 8 mg/kg-bw X $(350/47630)^{(0.25)}$ = **2.34 mg/kg-bw**

The RQ for chronic effects = 9.57/2.34 = **4.09**

A chronic RQ of 4.09 exceeds the chronic LOC of 1.0, suggesting that an effect is possible should the species be found in treated soybean fields (There were no exceedances for mammals feeding on DCSA contaminated cotton tissues based on the Section 3 screening level risk assessment. However, similar calculations conducted for pronghorn feeding in cotton fields would result in an RQ of 0.42, based on the maximum measured DCSA residues in cotton. As this would be below the LOC, a "**no effect" (NE)** determination could be made for pronghorn feeding on cotton fields)

This analysis suggests that if a pronghorn is feeding in a soybean field there is a potential for a lethal event. Establishing a potential for overlap between species range and the cropped areas proposed for treatment is an important consideration in how likely an exposure event might be for individual pronghorn.

To evaluate overlap between cotton and soybean and a specific species range a GIS co-occurrence analysis was conducted. Specific species range maps for the pronghorn are not currently available. However, the U.S. Fish and Wildlife Species Profile Page[2] identifies the pronghorn to be known or believed to occur in Yuma, Pinal, Maricopa, Pima, La Paz and Santa Cruz counties. The pronghorn recovery plan (USFWS, 1998) describes pronghorn habitat as broad alluvial valleys ranging in elevation from 122 meters in the west to 488 meters in the east. Using the county and elevation information, the species' range was compared to the aggregated NASS reported acres from the 2012 Census of Agriculture Full Report, and the 5 year aggregated CDL crop group layers.

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https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=A009. Accessed 6/16/2015.[3] Critical habitat designation status determined using U.S. Fish & Wildlife Service's Environmental Conservation Online System (ECOS) species profiles.

To calculate the NASS overlap, first all the reported crops from the 2012 Census of Agriculture Full Report were cross walked into the 11 EFED crop groups for each county. All counties within the species range were selected from the aggregated crop group table, each crop was summed to generate the total NASS acres, and then percent overlap was calculated.

The CDL is the best available land cover data to spatially characterize agricultural crops nationally. As with any land cover data, there will be errors present. The accuracy of the CDL is well documented on a state by state basis. Essentially, major commodity crops have a more robust training and validation dataset than minor crops, and their accuracy values correspond accordingly. Several methods have been employed to minimize data errors within the CDL.

The CDL has over 100 cultivated classes hierarchically grouped into 11 general classes. Combining classes reduces errors of omission and commission between similar crop categories. The CDL is also annually produced. Five years of CDL from 2010-2014 were temporally aggregated. The concept is that anywhere a class occurs within those 5 years is represented as a temporally aggregated individual class. Temporal aggregation also accounts for crop rotations.

The CDL's agricultural classes were further refined by comparing county level NASS 2012 Census of Agriculture (CoA) acreage reports to county level CDL acreages. If a county's CDL acreage for a given class was lower than the CoA, EPA expanded the CDL class's extent within cultivated areas until the CDL acreage matched the CoA acreage. Using the temporally and thematically aggregated CDL as an input, EPA developed a script that compares each CDL crop group in each county to the corresponding CoA acreage report. If the CDL acreage was less than NASS, EPA expanded the raster in 1 pixel iterations until the CoA value was reached, or the area within the county's cultivated mask was built out. Region growing was restricted using the most recent CDL Cultivated Layer as a mask, so as to avoid buffering into any non-agricultural land cover types. This method reduces land cover mapping errors by adjusting the extent of each category to the best available census values.

To calculate the overlap of the 5 year CDL-aggregated layers, the zonal statistics tool in ArcGIS was used to count the pixels for each layer within the species range. These counts were converted to an area measurement, and the percent overlap calculated. This process was repeated to calculate the overlap of each crop group layer with the species range between 122 and 488 m using the National Elevation Dataset. The National Elevation Dataset was downloaded on May 26, 2015 from: http://ned.usgs.gov/.

In Yuma, Pinal, Maricopa, Pima, La Paz and Santa Cruz counties between 122 and 488 meters, there was no identified soybean production according to either the NASS or CDL datasets. Cotton production was limited to 0.24% (CDL) to 0.74% (NASS) of the area in those counties at this elevation. Since the screeing level assessment identified that risks to mammals are not anticipated for dicamba use on dicamba-tolerant cotton (levels of concern were not exceeded for exposure to either dicamba or its degradate DCSA), **a No Effect (NE) determination is concluded for pronghorn feeding on cotton fields.** Since the crop overlap analysis suggests that there is no soybean cropland co-occurrence with pronghorn range, EPA also **concludes a No Effect (NE) determination for pronghorn from soybean uses**

<u>Critical Habitat Determinations</u>

In addition to the species-specific effects determinations, EFED also conducted a critical habitat modification analysis consistent with the Overview Document as discussed earlier in this refined assessment. The critical habitat modification analysis is based on an assessment of how dicamba DGA salt would affect the U.S. Fish and Wildlife Service or National Marine Fisheries Service (the Services) established principle constituent elements (PCE's) of the designated habitat as well as how direct species effects outcomes would impact critical habitat's present and future utility for promoting the conservation of a particular listed species. The Agency will conclude "modification" of designated critical habitat if the range of designated critical habitat co-occurs with the states subject to the Federal action and one or more of the following conditions exist:

1. The available Services' information indicates that cotton or soybean fields are habitat for the species and there is a "may affect" determination for the species associated with exposure to dicamba DGA salt or its degradate, DCSA, as labeled.

2. The available Services' information indicates that the species uses cotton or soybean fields and one or more effects on taxonomic groups predicted for dicamba DGA salt or its degradate DCSA, on cotton and soybean fields would modify one or more of the designated PCEs.

If neither of the above conditions are met, EPA concludes "no modification."

Results of Analysis

Of the 322 listed species within the states, there are 308 species identified in the effects determinations as not using cotton or soybean fields and 14 species using these fields (**Appendix 3**). Critical habitats have been designated for 122 of the 322 species. One-hundred sixteen (116) species with critical habitat were judged to not use cotton or soybean fields and so the critical habitat determination for these species was "no modification."

The remaining 6 species with critical habitat designations were assumed to use cotton or soybean fields and so the previous listed species effects determinations were consulted to ascertain if any were determined to be at risk for direct adverse effects. None of the species were determined to be at risk for direct adverse effects, so the PCE's listed in the Services' critical habitat designations were consulted to determine if, in light of the screening assessment risk findings, they would be impacted by on-field exposure to dicamba DGA salt. For all but one of these species, the PCE's are not relatable to agricultural fields and so a determination of no modification has been made for these 5 species.

The only remaining species using cotton or soybean fields and with critical habitat PCE's relatable to agricultural fields was the whooping crane, for which agricultural fields were discussed as providing waste grain as a potential food source for migratory cranes. The only way the proposed dicamba DGA salt could affect this PCE is by making grain potentially toxic to the birds. As there is unlikely to be any edible waste grain remaining following cotton harvesting, it is unlikely that the proposed dicamba DGA salt use on cotton could affect this PCE, however the proposed use on soybean could affect this PCE by making waste soybean grain potentially toxic.

The Health Effects Division summarized available soybean grain residues of dicamba in the Human Health Risk Assessment for the Registration Eligibility Decision for Dicamba and Associated Salts (DP317703). Based on the soybean trials results, maximum residues of dicamba were 0.04 ppm in hay, 0.097 ppm in forage, and 8.13 ppm in seed 6-8 days post treatment (MRIDs 43814101 and 44089307). These measured values were used to set the tolerance value of 10 ppm for soybean seeds. The measured residues are not reasonably expected to be at a level raising a concern for direct effects to the whooping crane because the direct effects assessment for this species (presented in the Section 3 Risk Assessment Refined Endangered Species Assessment that assessed risks to endangered species in 16 states (Arkansas, Kansas, Louisiana, Illinois, Indiana, Iowa, Minnesota, Mississippi, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, and Wisconsin {DP 416416, 420160, 420159, 420352, 421434, 421723})) did not establish a concern for residues in other dietary items at much **higher** (~ 1 order of magnitude) concentrations than would occur at the maximum measured residues in seed or if residues were present even at the tolerance level of 10.0 ppm. Because this analysis shows no direct effects of dicamba at levels that would be expected in the fields as waste grain, an indirect effect, there is no modification of critical habitat. Similarly, measured DCSA residues in waste soybean grain (0.44 ppm) would be well below the estimated DCSA concentrations in arthropods (42.5 ppm) used in the direct effects assessment for this species (D416516+, pp. 9-10). Therefore, whooping crane critical habitat within the 11 states in this refined assessment would not be modified.

Summary of Determinations for Critical Habitat

The Agency has determined that the proposed labeled use of dicamba DGA salt on cotton and soybeans will not modify designated critical habitat for all 122 species for which such habitats have been designated in AZ, CO, DE, FL, MD, NM, NJ, NY, PA, VA and WV.

A summary of listed species identified as not being on agricultural fields with and without critical habitat designations for the seven states assessed for dicamba DGA salt is provided in **Appendix 3**.

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Appendix 1

Threatened and Endangered Species in Arizona, Colorado, Delaware, Florida, Maryland, New Mexico, New Jersey, New York, Pennsylvania, Virginia, and West Virginia

Common Name	Scientific Name	Taxon
Indiana bat	*Myotis sodalis*	Mammal
Black-footed ferret	*Mustela nigripes*	Mammal
Gray wolf	*Canis lupus*	Mammal
Finback whale	*Balaenoptera physalus*	Mammal
Humpback whale	*Megaptera novaeangliae*	Mammal
North Atlantic Right Whale	*Eubalaena glacialis*	Mammal
Gray bat	*Myotis grisescens*	Mammal
Canada Lynx	*Lynx canadensis*	Mammal
Virginia big-eared bat	*Corynorhinus (=Plecotus) townsendii virginianus*	Mammal
Ocelot	*Leopardus (=Felis) pardalis*	Mammal
Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*	Mammal
Mexican long-nosed bat	*Leptonycteris nivalis*	Mammal
Red-cockaded woodpecker	*Picoides borealis*	Bird
Mexican spotted owl	*Strix occidentalis lucida*	Bird
Piping Plover	*Charadrius melodus* except Great Lakes watershed	Bird
Piping Plover	*Charadrius melodus* Great Lakes watershed	Bird
Least tern	*Sterna antillarum*	Bird
Roseate tern	*Sterna dougallii dougallii*	Bird
Southwestern willow flycatcher	*Empidonax traillii extimus*	Bird
Lesser Prairie-Chicken	*Tympanuchus pallidicinctus*	Bird
Whooping crane	*Grus americana*	Bird
Hawksbill sea turtle	*Eretmochelys imbricata*	Reptile
Leatherback sea turtle	*Dermochelys coriacea*	Reptile
Loggerhead sea turtle	*Caretta caretta*	Reptile
Kemp's ridley sea turtle	*Lepidochelys kempii*	Reptile
Green sea turtle	*Chelonia mydas*	Reptile
Shortnose sturgeon	*Acipenser brevirostrum*	Fish
Pecos gambusia	*Gambusia nobilis*	Fish
Spotfin Chub	*Erimonax monachus*	Fish
Slender chub	*Erimystax cahni*	Fish
Yellowfin madtom	*Noturus flavipinnis*	Fish
Blackside dace	*Phoxinus cumberlandensis*	Fish
Arkansas River shiner	*Notropis girardi*	Fish
Smalleye Shiner	*Notropis buccula*	Fish
Duskytail darter	*Etheostoma percnurum*	Fish
Cumberland bean (pearlymussel)	*Villosa trabalis*	Bivalve
Choctaw bean	*Villosa choctawensis*	Bivalve

Purple bean	*Villosa perpurpurea*	Bivalve
Appalachian monkeyface (pearlymussel)	*Quadrula sparsa*	Bivalve
Chipola slabshell	*Elliptio chipolaensis*	Bivalve
Cumberland monkeyface (pearlymussel)	*Quadrula intermedia*	Bivalve
Fat three-ridge (mussel)	*Amblema neislerii*	Bivalve
Fuzzy pigtoe	*Pleurobema strodeanum*	Bivalve
Pink mucket (pearlymussel)	*Lampsilis abrupta*	Bivalve
Dromedary pearlymussel	*Dromus dromas*	Bivalve
Round Ebonyshell	*Fusconaia rotulata*	Bivalve
Littlewing pearlymussel	*Pegias fabula*	Bivalve
Finerayed pigtoe	*Fusconaia cuneolus*	Bivalve
Gulf moccasinshell	*Medionidus penicillatus*	Bivalve
Narrow pigtoe	*Fusconaia escambia*	Bivalve
Ochlockonee moccasinshell	*Medionidus simpsonianus*	Bivalve
Oval pigtoe	*Pleurobema pyriforme*	Bivalve
Rough pigtoe	*Pleurobema plenum*	Bivalve
Shinyrayed pocketbook	*Lampsilis subangulata*	Bivalve
Shiny pigtoe	*Fusconaia cor*	Bivalve
Southern kidneyshell	*Ptychobranchus jonesi*	Bivalve
Southern sandshell	*Hamiota (=Lampsilis) australis*	Bivalve
Spectaclecase (mussel)	*Cumberlandia monodonta*	Bivalve
Tan riffleshell	*Epioblasma florentina walkeri (=E. walkeri)*	Bivalve
Tapered pigtoe	*Fusconaia burkei*	Bivalve
Rayed Bean	*Villosa fabalis*	Bivalve
Clubshell	*Pleurobema clava*	Bivalve
Cumberlandian combshell	*Epioblasma brevidens*	Bivalve
Oyster mussel	*Epioblasma capsaeformis*	Bivalve
Cracking pearlymussel	*Hemistena lata*	Bivalve
Slabside Pearlymussel	*Pleuronaia dolabelloides*	Bivalve
James spinymussel	*Pleurobema collina*	Bivalve
Dwarf wedgemussel	*Alasmidonta heterodon*	Bivalve
Fanshell	*Cyprogenia stegaria*	Bivalve
Northern riffleshell	*Epioblasma torulosa rangiana*	Bivalve
Purple bankclimber (mussel)	*Elliptoideus sloatianus*	Bivalve
Snuffbox mussel	*Epioblasma triquetra*	Bivalve
Rabbitsfoot	*Quadrula cylindrica cylindrica*	Bivalve
Fluted kidneyshell	*Ptychobranchus subtentum*	Bivalve
Sheepnose Mussel	*Plethobasus cyphyus*	Bivalve
Pecos assiminea snail	*Assiminea pecos*	Gastropod
Karner blue butterfly	*Lycaeides melissa samuelis*	Insect
Mitchell's satyr Butterfly	*Neonympha mitchellii mitchellii*	Insect

Spruce-fir moss spider	*Microhexura montivaga*	Arachnid
Colorado Butterfly plant	*Gaura neomexicana var. coloradensis*	Dicot
Pecos (=puzzle, =paradox) sunflower	*Helianthus paradoxus*	Dicot
Northern wild monkshood	*Aconitum noveboracense*	Dicot
Small-anthered bittercress	*Cardamine micranthera*	Dicot
Sneed pincushion cactus	*Coryphantha sneedii var. sneedii*	Dicot
Small whorled pogonia	*Isotria medeoloides*	Monocot
Sensitive joint-vetch	*Aeschynomene virginica*	Dicot
Smooth coneflower	*Echinacea laevigata*	Dicot
Swamp pink	*Helonias bullata*	Monocot
Canby's dropwort	*Oxypolis canbyi*	Dicot
Eastern prairie fringed orchid	*Platanthera leucophaea*	Monocot
Harperella	*Ptilimnium nodosum*	Dicot
Michaux's sumac	*Rhus michauxii*	Dicot
American chaffseed	*Schwalbea americana*	Dicot
Houghton's goldenrod	*Solidago houghtonii*	Dicot
Seabeach amaranth	*Amaranthus pumilus*	Dicot
Virginia sneezeweed	*Helenium virginicum*	Dicot
Virginia spiraea	*Spiraea virginiana*	Dicot
Running buffalo clover	*Trifolium stoloniferum*	Dicot
Ute ladies'-tresses	*Spiranthes diluvialis*	Monocot
Leedy's roseroot	*Rhodiola integrifolia ssp. leedyi*	Dicot
American hart's-tongue fern	*Asplenium scolopendrium var. americanum*	Ferns
Rock gnome lichen	*Gymnoderma lineare*	Lichen
Sonoran pronghorn	*Antilocapra americana sonoriensis*	Mammal
Delmarva Peninsula fox squirrel	*Sciurus niger cinereus*	Mammal
Florida panther	*Puma (=Felis) concolor coryi*	Mammal
Jaguar	*Panthera onca*	Mammal
Mount Graham red squirrel	*Tamiasciurus hudsonicus grahamensis*	Mammal
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	Mammal
Lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	Mammal
Preble's meadow jumping mouse	*Zapus hudsonius preblei*	Mammal
Hualapai Mexican vole	*Microtus mexicanus hualpaiensis*	Mammal
Red wolf	*Canis rufus*	Mammal
California condor	*Gymnogyps californianus*	Bird
Florida grasshopper sparrow	*Ammodramus savannarum floridanus*	Bird
Yuma clapper rail	*Rallus longirostris yumanensis*	Bird
Masked bobwhite (quail)	*Colinus virginianus ridgwayi*	Bird
California least tern	*Sterna antillarum browni*	Bird
American crocodile	*Crocodylus acutus*	Reptile
Atlantic salt marsh snake	*Nerodia clarkii taeniata*	Reptile

New Mexican ridge-nosed rattlesnake	*Crotalus willardi obscurus*	Reptile
Bluetail mole skink	*Eumeces egregius lividus*	Reptile
Bog (=Muhlenberg) turtle	*Clemmys muhlenbergii*	Reptile
Desert tortoise	*Gopherus agassizii*	Reptile
Eastern indigo snake	*Drymarchon corais couperi*	Reptile
Narrow-headed gartersnake	*Thamnophis rufipunctatus*	Reptile
Northern Mexican gartersnake	*Thamnophis eques megalops*	Reptile
Cheat Mountain salamander	*Plethodon nettingi*	Amphibian
Frosted Flatwoods salamander	*Ambystoma cingulatum*	Amphibian
Jemez Mountains Salamander	*Plethodon neomexicanus*	Amphibian
Reticulated flatwoods salamander	*Ambystoma bishopi*	Amphibian
Shenandoah salamander	*Plethodon shenandoah*	Amphibian
Sonora tiger Salamander	*Ambystoma tigrinum stebbinsi*	Amphibian
Chiricahua leopard frog	*Rana chiricahuensis*	Amphibian
Humpback chub	*Gila cypha*	Fish
Maryland darter	*Etheostoma sellare*	Fish
Colorado pikeminnow (=squawfish)	*Ptychocheilus lucius*	Fish
Gila topminnow (incl. Yaqui)	*Poeciliopsis occidentalis*	Fish
Apache trout	*Oncorhynchus apache*	Fish
Gila trout	*Oncorhynchus gilae*	Fish
Greenback Cutthroat trout	*Oncorhynchus clarki stomias*	Fish
Woundfin	*Plagopterus argentissimus*	Fish
Diamond Darter	*Crystallaria cincotta*	Fish
Roanoke logperch	*Percina rex*	Fish
Bonytail chub	*Gila elegans*	Fish
Chihuahua chub	*Gila nigrescens*	Fish
Sonora chub	*Gila ditaenia*	Fish
Virgin River Chub	*Gila seminuda (=robusta)*	Fish
Yaqui catfish	*Ictalurus pricei*	Fish
Gila chub	*Gila intermedia*	Fish
Yaqui chub	*Gila purpurea*	Fish
Loach minnow	*Tiaroga cobitis*	Fish
Desert pupfish	*Cyprinodon macularius*	Fish
Beautiful shiner	*Cyprinella formosa*	Fish
Okaloosa darter	*Etheostoma okaloosae*	Fish
Pecos bluntnose shiner	*Notropis simus pecosensis*	Fish
Little Colorado spinedace	*Lepidomeda vittata*	Fish
Razorback sucker	*Xyrauchen texanus*	Fish
Spikedace	*Meda fulgida*	Fish
Zuni Bluehead Sucker	*Catostomus discobolus yarrowi*	Fish
Rio Grande silvery minnow	*Hybognathus amarus*	Fish

Smalltooth sawfish	*Pristis pectinata*	Fish
Atlantic Sturgeon (gulf subspecies)	*Acipenser oxyrinchus desotoi*	Fish
Green blossom (pearlymussel)	*Epioblasma torulosa gubernaculum*	Bivalve
Tubercled blossom (pearlymussel)	*Epioblasma torulosa torulosa*	Bivalve
Birdwing pearlymussel	*Lemiox rimosus*	Bivalve
Rough rabbitsfoot	*Quadrula cylindrica strigillata*	Bivalve
Chittenango ovate amber snail	*Succinea chittenangoensis*	Gastropod
Flat-spired three-toothed Snail	*Triodopsis platysayoides*	Gastropod
Virginia fringed mountain snail	*Polygyriscus virginianus*	Gastropod
Kanab ambersnail	*Oxyloma haydeni kanabensis*	Gastropod
Alamosa springsnail	*Tryonia alamosae*	Gastropod
Chupadera springsnail	*Pyrgulopsis chupaderae*	Gastropod
Roswell springsnail	*Pyrgulopsis roswellensis*	Gastropod
Koster's springsnail	*Juturnia kosteri*	Gastropod
Three Forks Springsnail	*Pyrgulopsis trivialis*	Gastropod
San Bernardino springsnail	*Pyrgulopsis bernardina*	Gastropod
Socorro springsnail	*Pyrgulopsis neomexicana*	Gastropod
Pawnee montane skipper	*Hesperia leonardus montana*	Insect
Uncompahgre fritillary butterfly	*Boloria acrocnema*	Insect
Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*	Insect
Puritan tiger beetle	*Cicindela puritana*	Insect
Hay's Spring amphipod	*Stygobromus hayi*	Crustacean
Madison Cave isopod	*Antrolana lira*	Crustacean
Socorro isopod	*Thermosphaeroma thermophilus*	Crustacean
Noel's Amphipod	*Gammarus desperatus*	Crustacean
Lee County cave isopod	*Lirceus usdagalun*	Crustacean
Squirrel Chimney Cave shrimp	*Palaemonetes cumingii*	Crustacean
Acuna Cactus	*Echinomastus erectocentrus var. acunensis*	Dicot
Fickeisen Plains cactus	*Pediocactus peeblesianus fickeiseniae*	Dicot
DeBeque phacelia	*Phacelia submutica*	Dicot
Sacramento prickly poppy	*Argemone pleiacantha ssp. pinnatisecta*	Dicot
Sentry milk-vetch	*Astragalus cremnophylax var. cremnophylax*	Dicot
Mancos milk-vetch	*Astragalus humillimus*	Dicot
Osterhout milkvetch	*Astragalus osterhoutii*	Dicot
Virginia round-leaf birch	*Betula uber*	Dicot
Navajo sedge	*Carex specuicola*	Monocot
Lee pincushion cactus	*Coryphantha sneedii var. leei*	Dicot
Lewton's polygala	*Polygala lewtonii*	Dicot
Jones Cycladenia	*Cycladenia humilis var. jonesii*	Dicot
Nichol's Turk's head cactus	*Echinocactus horizonthalonius var. nicholii*	Dicot
Kuenzler hedgehog cactus	*Echinocereus fendleri var. kuenzleri*	Dicot

Arizona hedgehog cactus	*Echinocereus triglochidiatus var. arizonicus*	Dicot
Zuni fleabane	*Erigeron rhizomatus*	Dicot
Gypsum wild-buckwheat	*Eriogonum gypsophilum*	Dicot
Penland alpine fen mustard	*Eutrema penlandii*	Dicot
Brady pincushion cactus	*Pediocactus bradyi*	Dicot
Knowlton's cactus	*Pediocactus knowltonii*	Dicot
Peebles Navajo cactus	*Pediocactus peeblesianus var. peeblesianus*	Dicot
Siler pincushion cactus	*Pediocactus (=Echinocactus,=Utahia) sileri*	Dicot
North Park phacelia	*Phacelia formosula*	Dicot
Arizona Cliff-rose	*Purshia (=Cowania) subintegra*	Dicot
Northeastern bulrush	*Scirpus ancistrochaetus*	Monocot
Colorado hookless Cactus	*Sclerocactus glaucus*	Dicot
Mesa Verde cactus	*Sclerocactus mesae-verdae*	Dicot
San Francisco Peaks ragwort	*Packera franciscana*	Dicot
Todsen's pennyroyal	*Hedeoma todsenii*	Dicot
Sandplain gerardia	*Agalinis acuta*	Dicot
Kearney's blue-star	*Amsonia kearneyana*	Dicot
Welsh's milkweed	*Asclepias welshii*	Dicot
Sacramento Mountains thistle	*Cirsium vinaceum*	Dicot
Cochise pincushion cactus	*Coryphantha robbinsorum*	Dicot
Pima pineapple cactus	*Coryphantha scheeri var. robustispina*	Dicot
clay-loving wild buckwheat	*Eriogonum pelinophilum*	Dicot
Peter's Mountain mallow	*Iliamna corei*	Dicot
Holmgren milk-vetch	*Astragalus holmgreniorum*	Dicot
Huachuca water-umbel	*Lilaeopsis schaffneriana var. recurva*	Dicot
Pagosa skyrocket	*Ipomopsis polyantha*	Dicot
Dudley Bluffs twinpod	*Physaria obcordata*	Dicot
Shale barren rock cress	*Arabis serotina*	Dicot
Penland beardtongue	*Penstemon penlandii*	Dicot
Holy Ghost ipomopsis	*Ipomopsis sancti-spiritus*	Dicot
Dudley Bluffs bladderpod	*Lesquerella congesta*	Dicot
Parachute beardtongue	*Penstemon debilis*	Dicot
Canelo Hills ladies'-tresses	*Spiranthes delitescens*	Monocot
Gierisch mallow	*Sphaeralcea gierischii*	Dicot
Aboriginal Prickly-apple	*Harrisia aboriginum*	Dicot
Apalachicola rosemary	*Conradina glabra*	Dicot
Avon Park harebells	*Crotalaria avonensis*	Dicot
Beach jacquemontii	*Jacquemontia reclinata*	Dicot
Beautiful pawpaw	*Deeringothamnus pulchellus*	Dicot
Brooksville bellflower	*Campanula robinsiae*	Dicot
Cape Sable Thoroughwort	*Chromolaena frustrata*	Dicot
Carter's mustard	*Warea carteri*	Dicot
Carter's small-flowered flax	*Linum carteri carteri*	Dicot

Chapman rhododendron	*Rhododendron chapmanii*	Dicot
Cooley's meadowrue	*Thalictrum cooleyi*	Dicot
Cooley's water-willow	*Justicia cooleyi*	Dicot
Crenulate lead-plant	*Amorpha crenulata*	Dicot
Deltoid spurge	*Chamaesyce deltoidea* ssp. *deltoidea*	Dicot
Etonia rosemary	*Conradina etonia*	Dicot
Florida bonamia	*Bonamia grandiflora*	Dicot
Florida brickell-bush	*Brickellia mosieri*	Dicot
Florida golden aster	*Chrysopsis floridana*	Dicot
Florida semaphore cactus	*Consolea corallicola*	Dicot
Florida skullcap	*Scutellaria floridana*	Dicot
Florida ziziphus	*Ziziphus celata*	Dicot
Four-petal pawpaw	*Asimina tetramera*	Dicot
Fragrant prickly-apple	*Cereus eriophorus* var. *fragrans*	Dicot
Fringed campion	*Silene polypetala*	Dicot
Garber's spurge	*Chamaesyce garberi*	Dicot
Garrett's mint	*Dicerandra christmanii*	Dicot
Gentian pinkroot	*Spigelia gentianoides*	Dicot
Godfrey's butterwort	*Pinguicula ionantha*	Dicot
Highlands scrub hypericum	*Hypericum cumulicola*	Dicot
Key tree cactus	*Pilosocereus robinii*	Dicot
Lakela's mint	*Dicerandra immaculata*	Dicot
Longspurred mint	*Dicerandra cornutissima*	Dicot
Miccosukee gooseberry	*Ribes echinellum*	Dicot
Okeechobee gourd	*Cucurbita okeechobeensis* ssp. *okeechobeensis*	Dicot
Papery whitlow-wort	*Paronychia chartacea*	Dicot
Pigeon wings	*Clitoria fragrans*	Dicot
Pygmy fringe-tree	*Chionanthus pygmaeus*	Dicot
Roan Mountain Bluet	*Hedyotis purpurea var. montana*	Dicot
Rugel's pawpaw	*Deeringothamnus rugelii*	Dicot
Sandlace	*Polygonella myriophylla*	Dicot
Scrub blazingstar	*Liatris ohlingerae*	Dicot
Scrub buckwheat	*Eriogonum longifolium* var. *gnaphalifolium*	Dicot
Scrub lupine	*Lupinus aridorum*	Dicot
Scrub mint	*Dicerandra frutescens*	Dicot
Scrub plum	*Prunus geniculata*	Dicot
Short-leaved rosemary	*Conradina brevifolia*	Dicot
Small's milkpea	*Galactia smallii*	Dicot
Snakeroot	*Eryngium cuneifolium*	Dicot
Telephus spurge	*Euphorbia telephioides*	Dicot
Tiny polygala	*Polygala smallii*	Dicot
White birds-in-a-nest	*Macbridea alba*	Dicot
Wide-leaf warea	*Warea amplexifolia*	Dicot

Wireweed	*Polygonella basiramia*	Dicot
Bartram's Hairstreak Butterfly	*Strymon acis bartrami*	Insect
Florida Leafwing Butterfly	*Anaea troglodyta floridalis*	Insect
Miami Blue Butterfly	*Cyclargus (=Hemiargus) thomasi bethunebakeri*	Insect
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	Insect
Florida perforate cladonia	*Cladonia perforata*	Lichen
Anastasia Island beach mouse	*Peromyscus polionotus phasma*	Mammal
Choctawhatchee beach mouse	*Peromyscus polionotus allophrys*	Mammal
Florida Bonneted bat	*Eumops floridanus*	Mammal
Florida salt marsh vole	*Microtus pennsylvanicus dukecampbelli*	Mammal
Key deer	*Odocoileus virginianus clavium*	Mammal
Key Largo cotton mouse	*Peromyscus gossypinus allapaticola*	Mammal
Key Largo woodrat	*Neotoma floridana smalli*	Mammal
Lower Keys marsh rabbit	*Sylvilagus palustris hefneri*	Mammal
Perdido Key beach mouse	*Peromyscus polionotus trissyllepsis*	Mammal
Rice rat	*Oryzomys palustris natator*	Mammal
Southeastern beach mouse	*Peromyscus polionotus niveiventris*	Mammal
St. Andrew beach mouse	*Peromyscus polionotus peninsularis*	Mammal
West Indian Manatee	*Trichechus manatus latirostris*	Mammal
Audubon crested caracara	*Polyborus plancus audubonii*	Bird
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	Bird
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	Bird
Florida scrub-jay	*Aphelocoma coerulescens*	Bird
Kirtland's Warbler	*Setophaga kirtlandii*	Bird
Wood stork	*Mycteria americana*	Bird
Bachman's warbler (=wood)	*Vermivora bachmanii*	Bird
Sand skink	*Neoseps reynoldsi*	Reptile
Stock Island tree snail	*Orthalicus reses (not incl. nesodryas)*	Gastropod
Britton's beargrass	*Nolina brittoniana*	Monocot
Harper's beauty	*Harperocallis flava*	Monocot
Johnson's seagrass	*Halophila johnsonii*	Monocot
Knieskern's Beaked-rush	*Rhynchospora knieskernii*	Monocot
Florida torreya	*Torreya taxifolia*	Conf/cycds
Elkhorn coral	*Acropora palmate*	Coral
Staghorn coral	*Acropora cervicornis*	Coral

Appendix 2

Listed Species Rationale for NO Effects When Action Area is Limited to Treated Agricultural Filed by Assumed Mitigation for Spray Drift

The spray drift (in-field buffer) and rainfast mitigations discussed in the cotton section 3 ecological risk assessment (D404823), the concurrently issued soybean addendum (D426789) and at the beginning of this assessment are anticipated to restrict dicamba and DCSA residues above any threshold toxicity values to the agricultural field. Therefore, the following table describes the habitat and rationale for all listed species that were determined to not use cotton and soybean fields or resources that may overlap with dicamba DGA uses.

Species	Habitat	Rationale	Source
Terrestrial Animals			
Anastasia Island beach mouse *(Peromyscus polionotus phasma)*	Primarily located on coastal sand dunes, coastal scrub, sandy areas, and inland wood vegetation. The species occupy both frontal (primary and secondary) and scrub dunes. Habitat size is 3-14 linear miles of beach. Young beach mice move an average of 432 m (1,415 ft) before establishing a home range. Elevated coastal scrub provides refugia from storms.	The proposed uses of dicamba DGA are not expected to overlap with scrub, beach, dune or woody habitat.	US FWS. 1993. Recovery Plan for the Anastasia Island and Southeastern Beach Mouse. Atlanta Georgia. 30 pp. http://ecos.fws.gov/docs/recovery_plan/930923b.pdf. US FWS. 2007. Anastasia Island beach mouse (*Peromyscus polionotus phasma*), 5-Year Review: Summary and Evaluation. Jacksonville, Florida. 25 pp. http://ecos.fws.gov/docs/five_year_review/doc1086.pdf.
Bachman's warbler (*Vermivora bachmanii*)	Breeds in palustrine forested wetlands; seen near longleaf pine forest near brackish marsh. (USFWS 2007)	The proposed dicamba DGA uses are not expected to overlap with wetlands.	USFWS 2007. Five Year Review: http://ecos.fws.gov/docs/five_year_review/doc1037.pdf
Bartram's Hairstreak Butterfly, *(Strymon acis bartrami)*	Mostly occur within pine rocklands, specifically those that retain their mutual and sole host plant, pineland croton. Adult butterflies will also make use of rockland hammock and hydric pine flatwood vegetation when interspersed within the pine rockland habitat.	The proposed uses of dicamba DGA are not expected to overlap with pine rockland habitat.	US FWS. 2014. Endangered Status for the Florida Leafwing and Bartam's Scrub-Hairstreak Butterflies. http://www.gpo.gov/fdsys/pkg/FR-2014-08-12/pdf/2014-18614.pdf
Black-footed ferret (*Mustela nigripes*)	The black-footed ferret relies on prairie dog colonies for both food and shelter.	The proposed dicamba DGA uses are not expected to overlap with prairie dog colonies.	USFWS. 2008. 5-Year Review. http://ecos.fws.gov/docs/five_year_review/doc2364.pdf

Butterfly, Karner blue (*Lycaeides melissa samuelis*)	Habitat is successional areas with wild lupines, such as open areas in and near forest stands, along with old fields, highway and powerline rights-of-way, and remnant barrens and savannas, having a broken or scattered tree or tall shrub canopy (US FWS, 2003. pp.28-30)	The proposed dicamba DGA uses are not expected to overlap with successional areas with lupines or other wildflowers.	USFWS. 2003. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/030919.pdf
Butterfly, Mitchell's satyr (*Neonympha mitchellii mitchellii*)	Mitchell's satyr habitat is best characterized as a sedge-dominated fen community; Known habitats are all peatlands but range along a continuum from prairie/bog fen to sedge meadow/swamp. However, certain attributes at each site remain fairly constant. All historical and active habitats have a herbaceous community which is dominated by sedges, usually Carex stricta, with scattered deciduous and/or coniferous trees, most often L. laricina or Juniperus virginiana (red cedar) (US FWS 1998, pp. 11-12).	The proposed dicamba DGA uses are not expected to overlap with wetlands or areas with sedge communities.	USFWS 1998. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/980402.pdf
Cape Sable seaside sparrow *(Ammodramus maritimus mirabilis)*	Species habitat consists of short hydroperiod prairie, freshwater to brackish marshes, mixed marl prairie community that often includes muhly grass (*Muhlenbergia filipes*). These short-hydroperiod prairies contain moderately dense, clumped grasses, with open space permitting ground movements by the sparrows. Sparrows tend to avoid tall, dense, saw- grass-dominated communities, spike-rush (*Eleocharis sp.*) marshes, extensive cattail (*Typha sp.*) monocultures, long-	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats and open areas. Agricultural field monocultures are not expected to provide adequate habitat for the sparrow.	US FWS. 1999. South Florida multiple-species recovery plan. Available on FWS website. http://ecos.fws.gov/docs/recovery_plan/140903.pdf http://www.fws.gov/southeast/vbpdfs/species/birds/csss.pdf

	hydroperiod wetlands with tall, dense vegetative cover, and sites supporting woody vegetation. Cape Sable seaside sparrows avoid sites with permanent water cover.		
Carolina northern flying squirrel (Glaucomys sabrinus coloratus)	Species composition of the occupied forest may vary in different locations, some combination of hardwoods and conifers (particularly spruce and fir) appears essential to support these animals...Food sources for the Carolina northern flying squirrel include fungi, lichens, staminate cones, insects, and other animal matter (US FWS 1990, p. 6-7)	The proposed dicamba DGA uses are not expected to overlap with hardwood and conifer forests.	USFWS. 1990. Recovery Plan for Appalachian Northern Flying Squirrels. United States Fish and Wildlife Service.
Chittenango ovate amber snail *(Succinea chittenangoensis)*	Habitat is in a ravine at the base of the 167-foot-tall waterfall formed by Chittenango Creek. The snail requires cool to mild-temperature, moist conditions provided by the waterfalls and mist in its environment. The base of the waterfall, and the ledges where it is found comprise an early successional sere that is periodically rejuvenated to a bare substrate by floodwaters. Seems to prefer green vegetation such as the various mosses, liverworts, and other low herbaceous vegetation found within the spray zone adjacent to the Falls (US FWS 2006.	The proposed uses of dicamba DGA are not expected to overlap with waterfall habitat.	US FWS. 2006. Recovery Plan for the Chittenango Ovate Amber Snail http://ecos.fws.gov/docs/recovery_plan/060823.pdf
Choctawhatchee beach mouse *(Peromyscus polionotus allophrys)*	The beach mouse is inhabits coastal sand dunes and coastal scrub; primary, secondary, and interior or scrub dunes (vegetation includes sea oats, grasses, woody goldenrod, false rosemary, scrub oats, and yaupon holly). Approximately 2,500 acres of	The proposed uses of dicamba DGA are not expected to overlap with sand dune and coastal scrub habitat.	US FWS. 1987. Recovery plan for the Choctawhatchee, Perdido Key and Alabama Beach Mouse. U.S. Fish and Wildlife Service, Atlanta, Georgia. 45 pp. http://ecos.fws.gov/docs/recovery_plan/870812.pdf.

	habitat separated into four populations.		US FWS. 2007. Choctawhatchee Beach Mouse (*Peromyscus polionotus allophrys*), 5-Year Review: Summary and Evaluation. Panama City, Florida. 25 pp. http://ecos.fws.gov/docs/five_year_review/doc1081.pdf.
Everglade snail kite *(Rostrhamus sociabilis plumbeus)*	Located on wetlands, lowland freshwater marshes, and shallow vegetated edges of lakes (natural and manmade). Range restricted to the watersheds of the Everglades, Lake Okeechobee and Kissimmee, and Upper St. John River.	The proposed uses of dicamba DGA are not expected to overlap with wetland habitat	US FWS. 1999. South Florida multiple-species recovery plan. http://ecos.fws.gov/docs/recovery_plan/140903.pdf http://www.fws.gov/verobeach/MSRPPDFs/EvergladeSnailKite.pdf
Flat-spired three-toothed Snail *(Triodopsis platysayoides)*	Found in cool, moist, deep fissures in shale, sandstone, and limestone outcrops and in talus. Outcrops of rock more than one meter high are considered potential habitat if they contain cracks and crevices at least one meter deep. Rock structure is more important than the age and type of trees growing on rock. At night, the species has seen observed foraging and resting under wet leaves, next to rock structures.	The proposed uses of dicamba DGA are not expected to overlap with rock outcrops.	US FWS. 2007. Flat-spired Three-Toothed Snail (Triodopsis platysayoides) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1172.pdf
Florida Bonneted bat *(Eumops floridanus)*	Habitat mainly consists of foraging areas and roosting sites, including artificial structures. Open, fresh water and wetlands provide prime foraging areas for bats.	The proposed uses of dicamba DGA are not expected to overlap with wetland and other aquatic habitats.	US FWS. 2013. Endangered Species Status for the Florida Bonneted Bat. http://www.gpo.gov/fdsys/pkg/FR-2013-10-02/pdf/2013-23401.pdf
Florida Leafwing Butterfly *(Anaea troglodyta floridalis)*	Mostly occur within pine rocklands, specifically those that retain their mutual and sole host plant, pineland croton. Adult butterflies will also make use of rockland hammock and hydric pine flatwood vegetation when interspersed within the pine rockland habitat.	The proposed uses of dicamba DGA are not expected to overlap with pine rockland and other rocky or woody habitats.	US FWS. 2014. Endangered Status for the Florida Leafwing and Bartam's Scrub-Hairstreak Butterflies. http://www.gpo.gov/fdsys/pkg/FR-2014-08-12/pdf/2014-18614.pdf
Florida salt marsh vole	Located on salt marsh habitats dominated by salt grass (*Distichlis spicata*), but may also contain smooth cordgrass (*Spartina*	The proposed uses of dicamba DGA are not expected to overlap with salt marsh habitats.	US FWS. 1997. Recovery plan for the Florida salt marsh vole. U.S. Fish and Wildlife Service, Atlanta Georgia. 9pp.

(Microtus pennsylvanicus dukecampbelli)	*alterniflora*) and glasswort (*Salicornia* spp.) vegetation. Dense ground-level vegetation is common. Estimated home range is 804 square meters.		http://ecos.fws.gov/docs/recovery_plan/970930d.pdf.
Florida scrub-jay *(Aphelocoma coerulescens)*	Habitat is mostly scrub communities (primarily oak scrub) with find, white, drained sand. Currently only occurs in scattered and often small patches in peninsular Florida.	The proposed uses of dicamba DGA are not expected to overlap with scrubland habitats.	US FWS. 1990. Recovery Plan for the Florida Scrub Jay. http://ecos.fws.gov/docs/recovery_plan/900509.pdf
Frosted Flatwoods salamander (*Ambystoma cingulatum*)	Fire-maintained, open-canopied, flatwoods and savannas dominated by longleaf pine (*Pinus palustris*), with naturally occurring slash pine (*P. elliotti*) in wetter areas. Adults spend most of their lives underground. Breed in small, isolated ephemeral ponds (USFWS 2009)	The proposed dicamba DGA uses are not expected to overlap with flatwoods or savannas.	USFWS 2009. Federal Register, vol. 74, No. 62. 50 CFR 17. Endangered and threatened wildlife and plants; determination of endangered status of reticulated flatwoods salamander; designation of critical habitat for frosted flatwoods salamander and reticulated flatwoods salamander. United States Fish and Wildlife Service. Available on line at: http://www.gpo.gov/fdsys/pkg/FR-2009-02-10/pdf/E9-2403.pdf#page=1
Bat, gray (Myotis grisescens)	Gray bats are year round cave dwellers, although they may also use mines. They hibernate from as late as November 10 to late March or early April. At other times, they forage from late afternoon through early morning within 12-20 miles of their caves, most often within 4 miles of their caves. Foraging habitat is strongly correlated with open waters (rivers, lakes, reservoirs) (US FWS, 2009, pp. 6-7). Historically, rivers near caves provided both foraging habitat and riparian tree vegetation that provided cover. Small	The proposed dicamba DGA uses are not expected to encompass caves or the forest/open water areas where bats forage.	USFWS. 1982. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/820701.pdf USFWS. 2009. 5-Year Review. http://ecos.fws.gov/docs/five_year_review/doc2625.pdf

	lakes and reservoirs where cover is not too distant also provide foraging habitat. Bats will opportunistically forage in riparian and upland areas, particularly when migrating (US FWS, 1982. pp. 6-7).		
Key deer *(Odocoileus virginianus clavium)*	Habitat consists of pine flatwoods, pine rocklands, hardwood hammocks, buttonwood wetlands, mangrove wetlands, and freshwater wetlands.	The proposed uses of dicamba DGA are not expected to overlap with wetland, woodland or rocky habitats.	US FWS. 1999. South Florida multi-species recovery plan, Florida. United States Fish and Wildlife Service. http://www.fws.gov/verobeach/MSRPPDFs/KeyDeer.pdf.
Key Largo cotton mouse *(Peromyscus gossypinus allapaticola)*	Tropical hardwood hammock; upland forest; tall canopy (average 9.8 m) and an open understory; **c**anopy trees include black ironwood (*Krugiodendron ferreum*), gumbo limbo (*Bursera simaruba*) Jamaican dogwood (*Piscidia piscipula*), mahogany (*Swietenia mahagani*), pigeon plum (*Coccoloba diversifolia*), poisonwood (*Metopium toxiferum*), trangler fig (*Ficus aurea*), and wild tamarind (*Lysiloma latisiliquum*). Hammock understory contains torchwood (*Amyris elemifera*), milkbark (*Drypetes diversifolia*), wild coffee (*Psychotria nervosa*), marlberry (*Aroisia escallonioides*), stoppers (*Eugenia* spp.), soldierwood (*Colubrina elliptica*), crabwood (*Gymnanthes lucida*), and velvetseed (*Guettarda scabra*); ground cover contains cheese shrub (*Morinda royoc*) and snowberry (*Chicocoea alba*); adjacent *Salicornia* coastal strands, recently burned fern-dominated (*Pteridium aquilinum*) areas.	The proposed uses of dicamba DGA are not expected to overlap with wooded habitats.	US FWS. 2009. Key Largo Cotton Mouse (*Peromyscus gossypinus allapaticola*), 5-Year Review: Summary and Evaluation. Vero Beach, Florida. 19 pp. http://ecos.fws.gov/docs/five_year_review/doc2378.pdf. US FWS. 1999. Key Largo Cotton Mouse in South Florida Multi-Species Recovery Plan. Atlanta, Georgia. pgs. 4-79 - 4-95. 2172 pp. http://www.fws.gov/verobeach/MSRPPDFs/KeyLargoCottonmouse.pdf; http://ecos.fws.gov/docs/recovery_plan/990518_1.pdf.

Key Largo woodrat *(Neotoma floridana smalli)*	Habitat consists of tropical hardwood hammocks; mature and younger hardwood hammocks, as well as disturbed areas adjacent to mature hammocks.	The proposed uses of dicamba DGA are not expected to overlap with wooded habitats.	US FWS. 1999. Key Largo Woodrat (*Neotoma floridana smalli*) in South Florida Multi-Species Recovery Plan. Atlanta, Georgia. pgs. 4-195 - 4-216. 2172 pp. http://ecos.fws.gov/docs/recovery_plan/990518_1.pdf http://www.fws.gov/verobeach/MSRPPDFs/KeyLargoWoodrat.pdf
Kirtland's Warbler (Setophaga kirtlandii)	Kirtland's warblers generally occupy jack pine stands that are 5-23 years old and at least 30 acres in size. Stands with less than 20% canopy over are rarely used for nesting. Occupied stands usually occur on dry, excessively drained and nutrient poor glacial outwash sands. They are structurally homogenous with trees ranging from 1.7-5.0 m in height (US FWS, 2012, p. 24). Species is migratory and mobile species and breeding areas are found in Wisconsin.	The proposed dicamba DGA salt uses are not expected to overlap with jack pine stands.	USFWS. 2012. 5-Year Review. http://ecos.fws.gov/docs/five_year_review/doc4045.pdf
Lower Keys marsh rabbit *(Sylvilagus palustris hefneri)*	Found in salt marshes, freshwater bordered with hammocks and flatwoods; transition zone on grasses and sedges, grassy marshes and prairies; coastal berm. Species occasionally use low shrub marshes and mangrove communities; salt marsh-butonwood transition zones, freshwater wetlands; upland pinelands and hammocks.	The proposed uses of dicamba DGA are not expected to overlap with wetland or wooded habitats.	US FWS. 1999. Lower Keys Rabbit (*Sylvilagus palustris hefneri*) in South Florida Multi-Species Recovery Plan. Atlanta, Georgia. pgs. 4-151 - 4-172. 2172 pp. http://ecos.fws.gov/docs/recovery_plan/990518_1.pdf; and http://www.fws.gov/southeast/vbpdfs/species/mammals/lkmr.pdf US FWS. 2007. Lower Keys Rabbit (*Sylvilagus palustris hefneri*) 5-Year review: Summary and Evaluation. Vero Beach, Florida. http://ecos.fws.gov/docs/five_year_review/doc1110.pdf US FWS. 1990. Endangered and Threatened Wildlife and Plants; Endangered Status for

			the Lower Keys Rabbit and Threatened Status for the Squirrel Chimney Cave Shrimp. Federal Register Vol. 55, No. 120. June 21, 1990. pgs 25588-25591. http://ecos.fws.gov/docs/federal_register/fr1715.pdf
Lesser long-nosed bat *(Leptonycteris curasoae yerbabuenae)*	The bat has evolved an apparent mutualistic association with columnar cacti *Agave sp.* The bat is principally a nectar feeder, foraging on the flowers of *Agave*, and in some minor proportions consuming the pollen, fruits, and any incidental insects associated with the flowers. The bat uses caves and mines as day roosts.	The proposed dicamba DGA uses are not expected to overlap with the caves and mines the bat uses as day roosts and The bat's major resource need, *Agave* plants are not expected to be on soybean and cotton fields.	USFWS. 1995. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/970304.pdf
Mexican spotted owl (*Strix occidentalis lucida*)	Forest and canyonlands in SW U.S. (USFWS 2011, p. 7).	The proposed dicamba DGA uses are not expected to overlap with forests or Canyonlands.	USFWS 2011. Species specific recovery plan available on FWS website. http://ecos.fws.gov/docs/recovery_plan/FR00000557-%20BP031995%20Draft%20MSO%20Recovery%20Plan%20First%20Revision.pdf
Miami Blue Butterfly (Cyclargus *(=Hemiargus) thomasi bethunebakeri)*	Species is a coastal butterfly reported to occur in openings and around the edges of hardwood hammocks (forest habitats characterized by broad-leaved evergreens), and in other communities adjacent to the coast that are prone to frequent disturbances (e.g., coastal berm hammocks, dunes, and scrub).	The proposed uses of dicamba DGA are not expected to overlap with wooded, coastal or scrubland habitats.	US FWS. 2012. Listing of the Miami Blue Butterfly as Endangered Throughout its Range: Listing of the Cassius Blue, Ceraunus Blue, and Nickerbean Blue Butterflies as Threatened Due to Similarity of Appearance to the Miami Blue Butterfly in Coastal South and Central Florida: Final rule. http://www.gpo.gov/fdsys/pkg/FR-2012-04-06/pdf/2012-8088.pdf
Kanab ambersnail *(Oxyloma haydeni kanabensis)*	The known Kanab ambersnail populations generally occur within habitat conditions described as marshes and other wetlands watered by springs and seeps at the base of sandstone or limestone cliffs.	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats.	US FWS. 2011. Kanab ambersnail (Oxyloma haydeni kanabensis) 5-Year Review. http://ecos.fws.gov/docs/five_year_review/doc3885.pdf

	The sites this snail is found (Three Lakes and Vasey's Paradise), vary in their vegetation distribution and water flow, with the Three Lakes site being more of a marsh habitat, while the Vasey's Paradise site is a cool dolomitic spring habitat.		
Virginia fringed mountain snail *(Polygyriscus virginianus)*	Usually in areas where limestone is mixed with clay soil and is associated with permanently damp rock fragments and angular limestone pieces. These areas are heavily shaded and may be overgrown with honeysuckle. Living individuals occur in the soil at depths of four to twenty-four inches. Live snails have never been observed on the soil surface	The proposed uses of dicamba DGA are not expected to overlap with limestone outcrops.	US FWS species life-history profile http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=G00Z#lifeHistory
Narrow-headed gartersnake (*Thamnophis rufipunctatus*)	PCE's are: 1) stream habitat 2) up to 600 ft space on either side of bankful stage river w/ sufficient structural characteristics to support life-history functions, 3) prey base of fish, 4) absence or low levels only of nonnative sunfish and catfish, bullfrogs and/or crayfish.	The proposed uses of dicamba DGA are not expected to overlap with stream or floodplain habitats.	USFWS 2013. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northern Mexican Gartersnake and Narrow-Headed Gartersnake. Federal Register V78(132): 41550—41608 http://www.gpo.gov/fdsys/pkg/FR-2013-07-10/pdf/2013-16520.pdf
New Mexico meadow jumping mouse (*Zapus hudsonius luteus*)	PCE's are: 1) riparian communities along rivers, streams, springs and wetlands, 2) flowing water that provides saturated soils supporting tall herbaceous vegetation comprised mostly of sedges and forbs, sufficient areas along a stream, ditch or canal that contain suitable habitat, adjacent floodplain and upland areas extending ~100m from water's edge.	The proposed uses of dicamba DGA are not expected to overlap with riparian communities and saturated soils.	USFWS, 2013. Endangered and Threatened Wildlife and Plants; Proposed Designation of Critical Habitat for the New Mexico Meadow Jumping Mouse. Federal Register V78(119): 37328—37363 http://www.gpo.gov/fdsys/pkg/FR-2013-06-20/pdf/2013-14366.pdf)
Northeastern beach tiger beetle *(Cicindela dorsalis dorsalis)*	Open sand flats, dunes, water edges, beaches, woodland paths, and sparse grassy areas. Maryland (Calvert and Tangier Sound counties); Massachusetts (Coastal Massachusetts and	The proposed uses of dicamba DGA are not expected to overlap with beach habitats.	US FWS. 1994. Recovery Plan for Northeastern Beach Tiger Beetle http://ecos.fws.gov/docs/recovery_plan/940929b.pdf

	Islands);Virginia (Eastern Shore and Western Shore)		
Northern Mexican gartersnake (*Thamnophis eques megalops*)	PCE's are: 1) aquatic or riparian habitat, 2) up to 600 ft space on either side of bankful stage river w/ sufficient structural characteristics to support life-history functions 3) prey base of native amphibians and fish and 4) absence or low levels only of nonnative sunfish and catfish, bullfrogs and/or crayfish.	The proposed uses of dicamba DGA are not expected to overlap with stream or floodplain habitats	USFWS 2013. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northern Mexican Gartersnake and Narrow-Headed Gartersnake. Federal Register V78(132): 41550—41608 http://www.gpo.gov/fdsys/pkg/FR-2013-07-10/pdf/2013-16520.pdf
Pawnee montane skipper *(Hesperia leonardus montana)*	The skippers occur in Colorado (Teller, Park, Jefferson, and Douglas) in dry, open, Ponderosa pine woodlands where the slopes are moderately steep with soils derived from Pikes Peak granite. The understory is limited in the pine woodlands.	The proposed uses of dicamba DGA are not expected to overlap with woodland habitats.	US FWS. 1998. Recovery Plan for Pawnee Montane Skipper http://ecos.fws.gov/docs/recovery_plan/980921.pdf
Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*)	Coastal sand dunes & coastal scrub (USFWS 1987, p. 2); primary, secondary and interior or scrub dunes (USFWS 2007, p. 9)	The proposed dicamba DGA uses are not expected to overlap with sand dunes or coastal scrub.	USFWS. 1987. Recovery plan for the Choctawhatchee, Perdido Key and Alabama Beach Mouse. U.S. Fish and Wildlife Service, Atlanta, Georgia. 45 pp. Available online at: http://ecos.fws.gov/docs/recovery_plan/870812.pdf. USFWS. 2007. Perdido Key Beach Mouse (*Peromyscus polionotus trissyllepsis*), 5-Year Review: Summary and Evaluation. Panama City, Florida. 24 pp. Available online at: http://ecos.fws.gov/docs/five_year_review/doc1081.pdf.
Piping plover, Great Lakes watershed (Charadrius melodus)	The breeding habitat of the Great Lakes DPS of the piping plover is well defined by the Critical Habitat designation. Critical Habitat for this	The proposed dicamba DGA uses are not expected to overlap with sparsely vegetated sandy	USFWS. 2009. 5-Year Review. http://ecos.fws.gov/docs/five_year_review/doc3009.pdf

	DPS consists of approximately 200 miles of Great Lakes shoreline (extending 1640 ft inland) in 26 counties in Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, and New York. Additional Critical Habitat for wintering populations of this DPS are in the southeastern United States and other areas that are outside the scope of this analysis (USFWS, 2000; USFWS, 2009, p.2).	shorelines or islands of the Great Lakes.	USFWS. 2000. Federal Register Notice http://ecos.fws.gov/docs/federal_register/fr3648.pdf
Piping plover, except Great Lakes watershed (Charadrius melodus)	The northern Great Plains DPS of the piping plover utilizes four types of habitats for breeding: alkali lakes and wetlands, inland lakes (Lake of the Woods), reservoirs, and rivers. Most breeding occurs along alkali lakes and wetlands, where nesting sites are generally wide, gravelly, salt encrusted beaches with minimal vegetation. At inland lakes, they use barren to sparsely vegetated islands, beaches, and peninsulas. Sparsely vegetated sandbars and reservoir shorelines are preferred in riverine systems (US FWS, 2002, p. 57640).	The proposed dicamba DGA uses are not expected to overlap with shorelines, beaches, and sandbars of rivers and alkali wetlands.	USFWS. 2002. Federal Register Notice. http://ecos.fws.gov/docs/federal_register/fr3943.pdf
Puritan tiger beetle *(Cicindela puritana)*	The Maryland population (Calvert, Kent and Cecil Counties) is found in deep burrows, which they dig in sandy deposits on non-vegetated portions of the bluff face. The Connecticut population (Hartford; middlesex) is found in burrows among scattered	The proposed uses of dicamba DGA are not expected to overlap with beach habitats.	US FWS. 1993. Recovery Plan for the Puritan Tiger Beetle http://ecos.fws.gov/docs/recovery_plan/930929a.pdf

	herbaceous vegetation at the upper portions of sandy beaches and occasionally near the water's edge.		
Uncompahgre fritillary butterfly *(Boloria acrocnema)*	All colonies known to FWS occur in alpine environments, within large patches of snow willow and on northeast facing slopes.	The proposed uses of dicamba DGA are not expected to overlap with alpine habitats.	US FWS. 1994. Recovery Plan for *Boloria acrocnema* *http://ecos.fws.gov/docs/recovery_plan/940317.pdf*
Bluetail mole skink *(Eumeces egregius lividus)*	Habitat is primarily xeric (dry) upland communities above 30 m. The species relies on soils that have few root structures and sparse stands of vegetation but a large amount of debris providing shelter. These attributes are not consistent with cultivated row crop fields.	The proposed dicamba DGA use sites are not expected to provide appropriate habitat.	US FWS. 1999. Multi-Species Recovery Plan for South Florida: Bluetail Mole Skink. United States Fish and Wildlife Service. http://www.fws.gov/verobeach/MSRPPDFs/BluetailMoleSkink.pdf
Bog (=Muhlenberg) turtle *(Clemmys muhlenbergii)*	Wetland habitats including dry, wet, and periodically flooded micro-habitats and are often interspersed with agricultural areas and livestock grazing.	The proposed dicamba DGA uses are not expected to overlap with aquatic habitats.	US FWS. 2001. Recovery Plan for the Bog Turtle. http://ecos.fws.gov/docs/recovery_plan/010515.pdf
Cheat Mountain salamander *(Plethodon nettingi)*	This species occurs in red spruce and mixed deciduous forests. Microhabitats have high humidity, moist soil and cool temperatures. The forest floor is (usually) covered with liverwort (*Bazzania trilobata*) and contains rocks.	The proposed uses of dicamba DGA are not expected to overlap with forest habitats.	US FWS. 1991. Cheat Mountain salamander (Plethodon nettingi) recovery plan. United States Fish and Wildlife Service. http://ecos.fws.gov/docs/recovery_plan/910725.pdf USFWS. 2009. Cheat Mountain salamander (Plethodon nettingi) 5-year review: summary and evaluation. http://ecos.fws.gov/docs/five_year_review/doc3267.pdf.

Chiricahua leopard frog *(Rana chiricahuensis)*	Adults are primarily aquatic and found in a variety of aquatic habitats including cienegas, springs, pools, cattle tanks, lakes, reservoirs, streams, and rivers. The species also requires permanent or semi-permanent pools for breeding, water characterized by low levels of contaminants and moderate pH, and may be excluded or exhibit periodic die-offs where a pathogenic chytridiomycete fungus is present	The proposed uses of dicamba DGA are not expected to overlap with aquatic habitats.	US FWS. 2007. Chiricahua leopard frog (Rana chiricahuensis) final recovery plan. http://ecos.fws.gov/docs/recovery_plan/070604_v3.pdf.
Desert tortoise (*Gopherus agassizii)*	The Mojave population of the desert tortoise is most commonly found within the desert scrub vegetation type, primarily in creosote bush-scrub vegetation,but also in succulent scrub, cheesebush scrub, blackbush scrub, hopsage scrub, shadscale scrub, microphyll woodland, and Mojave saltbush-allscale scrub. Within the desert microphyll woodland, the desert tortoise occurs in blue palo verde-ironwood-smoke tree woodland. The desert tortoise also occurs in scrub-steppe vegetation types of the desert and semidesert grassland complex. Within these vegetation types, desert tortoises potentially can survive and reproduce where their basic habitat requirements are met. These requirements include a sufficient amount and quality of forage species; shelter sites for protection from predators and environmental extremes; suitable substrates for burrowing, nesting, and overwintering; various plants for shelter; and adequate area for movement, dispersal, and gene flow.	The proposed uses of dicamba DGA are not expected to overlap with the scrub-steppe vegetation types of the desert and semidesert grassland complex (Mojave population) or the steep rocky slopes, drought resistant scrub and tree habitat (Sonoran population) and the agricultural fields where it will be used are not expected to provide the soil and understory requirements of this species.	US FWS, 2011. Revised Recovery Plan for the Mojave Population of the Desert Tortoise (*Gopherus agassizii*). http://ecos.fws.gov/docs/recovery_plan/RRP%20for%20the%20Mojave%20Desert%20Tortoise%20-%20May%202011_1.pdf US FWS, 1994. Determination of Critical Habitat for the Mojave Population of the Desert Tortoise. http://ecos.fws.gov/docs/federal_register/fr2519.pdf

	In the Sonoran Desert, tortoises tend to inhabit bajadas (slopes at the base of a mountain) and steep, rocky slopes and are not common in the valleys) and are also found in the Sinaloan thornscrub, where vegetation is dominated by drought-resistant shrubs and deciduous trees.		
Jemez Mountains Salamander *(Plethodon neomexicanus)*	The strictly terrestrial Jemez Mountains salamander predominantly inhabits mixed-conifer forest, consisting primarily of Douglas fir, blue spruce, Engelman spruce, white fir, limber pine, Ponderosa pine, Rocky Mountain maple, and aspen (Populus tremuloides). Pure stands of Ponderosa pine, fir and aspen stands, and high-elevation meadows are not considered ideal habitats but species have been known to occur in such places.	The proposed uses of dicamba DGA are not expected to overlap with forest habitats.	US FWS species life-history profile. ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=D019#lifeHistory
Red-cockaded entire woodpecker (Picoides borealis)	Habitat: Forest, Savannah (open pine woodlands and savannahs with large old pines) (US FWS 2003, p. x) Habitat size (home range): 116 – 357 acres (US FWS 2003, p. 49)	Proposed dicamba DGA uses are not expected to overlap with forest or savannah.	USFWS. 2003. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/030320_2.pdf
Reticulated flatwoods salamander (*Ambystoma bishopi*)	Aquatic and terrestrial. Longleaf pine ecosystems (Coastal Plain in what were historically longleaf pine-wiregrass flatwoods and savannas). Adults spend most of their lives underground.	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2009. Federal Register, vol. 74, No. 26. 50 CFR 17. Endangered and threatened wildlife and plants; determination of endangered status of reticulated flatwoods salamander; designation of critical habitat for frosted flatwoods salamander and

	Breed in small, isolated ephemeral ponds. (USFWS 2009)		reticulated flatwoods salamander. United States Fish and Wildlife Service. Available on line at: http://www.gpo.gov/fdsys/pkg/FR-2009-02-10/pdf/E9-2403.pdf#page=1
Rice rat *(Oryzomys palustris natator)*	Found in scrub and fringe mangrove communities. Live on small wetland islands, 23 ha.	The proposed uses of dicamba DGA are not expected to overlap with wetland or scrubland habitats.	US FWS. 1999. South Florida multiple-species recovery plan. http://ecos.fws.gov/docs/recovery_plan/990518_1.pdf http://ecos.fws.gov/docs/recovery_plan/140903.pdf
Roseate tern (*Sterna dougallii dougallii*)	Rocky offshore islands with sparse vegetation; although Northeastern Roseate tern nest under vegetation or some other shelter (USFWS 1993, p. 3).	The proposed dicamba DGA uses are not expected to overlap with offshore islands.	USFWS 1993. Species specific recovery plan available on FWS website. http://ecos.fws.gov/docs/recovery_plan/930924_v2.pdf
Sand skink *(Neoseps reynoldsi)*	Habitat is primarily xeric (dry) upland communities between high pine and scrub.	The proposed uses of dicamba DGA are not expected to overlap with scrubland or high pine wooded habitats.	US FWS. 1999. Multi-Species Recovery Plan for South Florida: Sand Skink. United States Fish and Wildlife Service. http://www.fws.gov/verobeach/MSRPPDFs/SandSkink.pdf
Schaus swallowtail butterfly *(Heraclides aristodemus ponceanus)*	Occur exclusively in subtropical dry forests (hardwood hammocks) including areas that were formerly cleared and farmed, but have since regrown.	The proposed uses of dicamba DGA are not expected to overlap with forested areas or areas that were farmed but have since regrown.	US FWS. 1999. South Florida Multi-Species Recovery Plan: Schaus Swallowtail Butterfly. http://ecos.fws.gov/docs/recovery_plan/sfl_msrp/SFL_MSRP_Species.pdf
Shenandoah salamander *(Plethodon shenandoah)*	The species is found in forests, and dry, rocky, talus slopes, of mountains, generally facing north at elevations greater than 800 m in Shenandoah National park.	The proposed uses of dicamba DGA are not expected to overlap with forest habitats.	US FWS. 1994. Shenandoah salamander (Plethodon shenandoah Highton and Worthington) recovery plan. http://ecos.fws.gov/docs/recovery_plan/940929a.pdf

Sonora tiger Salamander *(Ambystoma tigrinum stebbinsi)*	Found in standing water, grassland and oak woodland terrestrial habitats as well as human-constructed ponds or cattle tanks Terrestrial adults most likely spend time in mammal burrows or buried in the ground	The proposed uses of dicamba DGA are not expected to overlap with aquatic, grassland or woodland habitats.	US FWS. 2002. Sonora tiger salamander recovery plan. http://ecos.fws.gov/docs/recovery_plan/020924.pdf.
Southeastern beach mouse *(Peromyscus polionotus niveiventris)*	Located on coastal sand dunes & coastal scrub, frontal (primary and secondary) and scrub dunes (including oak scrub), and inland habitats such as coastal strand woody plants. Habitat size is approximately 80.5 km, with young beach mice moving an average of 432 m (1,415 ft) before establishing a home range.	The proposed uses of dicamba DGA are not expected to overlap with scrubland or woodland habitats	US FWS. 2008. Southeastern Beach Mouse (*Peromyscus polionotus niveiventris*), 5-year Review: Summary and Evaluation. Jacksonville, Florida. 36 pp. http://ecos.fws.gov/docs/five_year_review/doc1888.pdf. US FWS. 1993. Recovery Plan for the Anastasia Island and Southeastern Beach Mouse. Atlanta Georgia. 30 pp. http://ecos.fws.gov/docs/recovery_plan/930923b.pdf.
Southwestern willow flycatcher (*Empidonax traillii extimus*)	Breeding: Forested wetlands or scrub-shrub wetlands-dense riparian habitat of rivers, swamps, wetlands, lakes (USFWS 2002, p. iv). Wintering: brushy savanna edges, second growth, shrubby clearings and pastures, woodlands near water (USFWS 2002, p. iv).	Recommend off-field status for row crop agriculture. According to the Critical Habitat designation document (USFWS 2013) essential characteristics for southwestern will flycatcher habit include riparian areas for flowing stream that support expansive riparian vegetation areas. Riparian trees and understory species are viewed as essential elements of flycatcher habitat. Row crop soy and corn are monocultures of non-riparian vegetation	USFWS 2002. Species specific recovery plan available on FWS website. http://ecos.fws.gov/docs/recovery_plans/2002/020830c.pdf USFWS. 2013. Designation of Southwestern Willow Flycatcher Critical Habitat: Final Rule. Federal Register Vol. 78 No.2.

		and consequently not suitable habitat for this species.	
Spruce-fir moss spider (*Microhexura montivaga*)	Typical habitat appears to be associated with moist, well-drained moss mats growing on rocks and boulders in well-shaded situations in mature high-elevation conifer forests dominated by Fraser fir, Abiesfraseri, often with scattered red spruce, Picea rubens. (US FWS 1998, p. iii)	The proposed dicamba DGA uses are not expected to overlap with high-elevation conifer forests.	US FWS, 1998, Recovery Plan. http://www.gpo.gov/fdsys/pkg/FR-2011-09-27/pdf/2011-24046.pdf
St. Andrew beach mouse (*Peromyscus polionotus peninsularis*)	Found on coastal dunes. Range of species is approximately 46 km.	The proposed uses of dicamba DGA are not expected to overlap with coastal dune habitats	US FWS. 2010. Recovery plan for St. Andrews Beach Mousse (*Peromyscus polionotus peninsularis).* United States Fish and Wildlife Service. http://ecos.fws.gov/docs/recovery_plan/20110104_SABM_recov_plan_FINAL.pdf
Stock Island tree snail *(Orthalicus reses (not incl. nesodryas)*	Survive best in hardwood hammocks with smooth-barked native trees that support relatively large amounts of lichen and algae. Species is entirely arboreal except when they move to the forest floor for nesting and traveling.	The proposed uses of dicamba DGA are not expected to overlap with forested habitats	US FWS. 1999. Multi-Species Recovery Plan for South Florida: Stock Island Tree Snail. http://ecos.fws.gov/docs/recovery_plan/sfl_msrp/SFL_MSRP_Species.pdf
California least tern *(Sterna antillarum browni)*	Coastal lagoons and estuaries (freshwater marshes, lakes, lagoons, beaches, and estuary areas. Additionally can be found in man-made habitats such as airports and land fields.	This species feeds exclusively on fish and are therefore not expected to be exposed to dicamba DGA.	US FWS. 1985. Revised California Least Tern Recover Plan. http://ecos.fws.gov/docs/recovery_plan/850927_w%20signature.pdf US FWS. 2006. California Least Tern (Sterna antillarum browni) 5-Year Review and Evaluation: http://ecos.fws.gov/docs/five_year_review/doc775.pdf
Florida grasshopper sparrow *(Ammodramus savannarum floridanus)*	Habitat is large (greater than 50 ha), treeless, and relatively poorly-drained grasslands that have a history of frequent fires. Average	The proposed dicamba DGA use sites are not expected to provide appropriate fire influenced habitat.	US FWS. 1999. South Florida multiple-species recovery plan.

	and maximum habitat size are 1.8 and 4.82 ha, respectively. The species requires relatively large open areas maintained by periodic fires. An analogy to row cropped areas is the effect of overgrazed grasslands with poorly structured and inappropriately dispersed habitat stands. These areas are not capable of maintaining population of the species. It is reasonable to expect that row-cropped agricultural fields provide even less suitable habitat than the already unsuitable overgrazed pasture lands.		http://ecos.fws.gov/docs/recovery_plan/140903.pdf http://www.fws.gov/verobeach/MSRPPDFs/FloridaGrasshopperSparrow.pdf
Masked bobwhite (quail) *(Colinus virginianus ridgwayi)*	Open savanna grassland within dry-tropic scrub. These birds are associated with weedy bottom lands, grassy and herb-strewn valleys, and forb-rich plains.	- Only known US population is in captive flock on the BANWR. Attempts to release the birds back to the wild have been unsuccessful and evidence of wild populations does not exist. "As of 2001, occurrence of wild masked bobwhite is nearly completely restricted to the captive flock occurring on the BANWR." - Habitat requirements include 15-30% scrub/shrub cover and a diverse range of grass/forb species (at least 10-12 different species). They do not use monocultures, even if it is an attractive food source. "Monocultures of even such important food species as vine mesquite grass and Johnson grass were avoided". - Once home ranges are established they do not leave their boundaries. - While this species has been seen in rangeland it has never been associated with row	US FWS. 1995. Masked Bobwhite Quail Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/950421.pdf

		crops (most likely because of the monoculture).	
Yuma clapper rail *(Rallus longirostris yumanensis)*	Salt to brackish water marshes, mangrove swamps, other tidal wetlands. Found in the lower Colorado River (LCR) and tributaries (Virgin River, Bill Williams River, lower Gila River [LGR]) in Arizona, California, Nevada; the Salton Sea in California; and the Cienegade Santa Clara and Colorado River Delta in Mexico	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats.	US FWS. 1983. Yuma Clapper Rail Recovery Plan (*Rallus longirostris yumanensis*) DRAFT FIRST REVISION http://ecos.fws.gov/docs/recovery_plan/Draft%20Yuma%20Clapper%20Rail%20Recovery%20Plan,%20First%20Revision.pdf
Hualapai Mexican vole *(Microtus mexicanus hualpaiensis)*	Woodland forest types containing grasses and grass-sedge habitats. associated with moist grass-sedge areas along permanent or semi-permanent waters fed by springs or seeps in either open forest or chapparal. Good cover of grasses, sedges and forbs is characteristic of this waterside vole habitat, which is usually found in narrow bands paralleling the water	The proposed uses of dicamba DGA are not expected to overlap with woodland habitats.	US FWS. 1991. Hualapai Mexican Vole Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/910819.pdf
Tern, least interior pop. (*Sterna antillarum*)	Species is a piscivore, feeding in shallow waters of rivers, streams (USFWS, 1990, p. 20). Beaches, sand pits, sandbars, islands and peninsulas are the principal breeding habitats of coastal areas and nesting can be close to water but is usually between the dune environment and the high tide line. Vegetation at coastal nesting areas is sparse, scattered and short. Riverine nesting areas are sparsely vegetated sand and gravel bars within a wide unobstructed river channel, or salt flats along lake shorelines. Nesting	The proposed dicamba DGA uses are not expected to overlap with riparian areas, including coastal areas.	USFWS. 1990. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/900919a.pdf

	occurs along river banks (US FWS, 1990, p. 20).		
Mount Graham red squirrel *(Tamiasciurus hudsonicus grahamensis)*	Pinaleño Mountains in the Coronado National Forest. The species inhabits upper elevation, mature to old-growth associations in mixed conifer and spruce-fir above approximately 2,425 m (8,000 ft). The majority of surviving red squirrels now occur at lower elevations in the mixed-conifer forest that extend well down the mountain	The proposed uses of dicamba DGA are not expected to overlap with forest habitats.	US FWS. 2011. Draft Mount Graham Red Squirrel Recovery Plan, First Revision http://ecos.fws.gov/docs/recovery_plan/FR00000388%20Draft%20Mount%20Graham%20Red%20Squirrel%20Recovery%20Plan%20First%20Revision%20Final.pdf
Preble's meadow jumping mouse *(Zapus hudsonius preblei)*	Heavily vegetated riparian habitats. Water source (creeks, streams, rivers), consisting of shrubs, forbs, grasses, woodland, and herbaceous species and can occur upland beyond floodplain.	Habitat for the PMJM is listed as "well developed riparian vegetation, adjacent relatively undisturbed grasslands, and a nearby water source". The mouse may travel up to 100m upland from the riparian zone but the habitat needs to be undisturbed grasslands. PCEs for the mouse include "riparian corridors… and additional adjacent floodplain and upland habitat with limited disturbance (including hayed fields, grazed pastures, other agricultural lands that are not plowed or disked regularly, etc)"	(US FWS. 1998. Endangered and Threatened Wildlife and Plants; Final Rule to List the Preble's Meadow Jumping Mouse as a Threatened Species. http://ecos.fws.gov/docs/federal_register/fr3260.pdf US FWS. 2007. Endangered and Threatened Wildlife and Plants; Revised Proposed Rule to Amend the Listing for the Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) to Specify Over What Portion of Its Range the Subspecies is Threatened; Proposed Rule. http://ecos.fws.gov/docs/five_year_review/doc1719.pdf.
New Mexican ridge-nosed rattlesnake *(Crotalus willardi obscurus)*	Mountains, elevated plateaus, and pine-oak vegetation	The proposed dicamba DGA uses are not expected to overlap with woodland habitats.	(US FWS. 1985. Recovery Plan for the New Mexican Ridge-Nosed Rattlesnake. http://ecos.fws.gov/docs/recovery_plan/850322.pdf
Wood stork (*Mycteria americana*)	Freshwater and estuarine Wetlands. (US FWS 1986, p. iii). Wood storks breed in FL, GA and SC. They migrate south in winter (US FWS 1986, p. 2).	The proposed dicamba DGA uses are not expected to overlap with wetlands.	USFWS. 1986. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/970127.pdf USFWS. 2006. Five year Review.

	Require a mosaic of wetlands with varying climatological and seasonal conditions around colonies and within the wintering habitat in the coastal plain of the Southeast U.S. (US FWS 2006, p. 12).		http://ecos.fws.gov/docs/five_year_review/doc1115.pdf

Species	Habitat	Rationale	Source
Aquatic Organisms			
Alamosa springsnail (*Tryonia alamosae*)	The Alamosa springsnail is found mainly where minor rivulets flow out of the main channel downstream of the springhead. In these situations, there is a mat of watercress and filamentous green algae over water 1—2 inches deep flowing over fine gravel and sand among rhyolitic cobbles and rocks. The species is found in slow current on gravel and among vegetation, and is most abundant where an organic film covers the pebbles and cobbles.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1994. Socorro and Alamosa Springsnail Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/940831b.pdf
Apache trout (*Oncorhynchus apache*)	Apache trout currently exist mainly in headwater areas upstream from natural and artificial barriers. This environment is subject to extreme variations in both temperature and flow.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2009. Apache Trout (Oncorhynchus apache) Recovery Plan, Second Revision http://ecos.fws.gov/docs/recovery_plan/090903.pdf
Arkansas River shiner (Notropis girardi)	Wilde et al. (2000) found no obvious selection for or avoidance of any particular habitat type (i.e., main channel, side channel, backwaters, and pools) by Arkansas River shiner. Arkansas River shiners did tend to select side channels and backwaters slightly more than expected based on the availability of these habitats (Wilde et al. 2000). Likewise, they appeared to make no obvious selection for, or avoidance of, any particular substrate type. Substrates (i.e., the river bed) in the Canadian River in New Mexico and Texas were predominantly sand, however, the Arkansas River shiner was observed to occur over silt slightly more than expected based on the availability of this substrate (Wilde et al. 2000) ;	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	US FWS. 2005. Federal Register Notice: Designation of Critical Habitat. http://ecos.fws.gov/docs/recovery_plan/950830.pdf

	preferred habitat for the Arkansas River shiner is the mainstem of larger plains rivers... historically inhabited the main channels of wide, shallow, sandy-bottomed rivers and larger streams of the Arkansas River basin (Gilbert 1980). Adults are uncommon in quiet pools or backwaters lacking streamflow, and almost never occurred in habitats having deep water and bottoms of mud or stone (Cross 1967) (US FWS 2005).		
Bean, Cumberland (pearlymussel) (Villosa trabalis)	Restricted typically to tributary streams of the upper reaches of the Tennessee and Cumberland Rivers. This species is most often found associated with clean, fast flowing water in stable substrate, which contains relatively firm rubble, gravel, and sand swept-free from siltation. Typically, *V. trabalis* is found buried in shallow riffle and shoal areas, often located under large rocks that must be removed by hand to inspect the habitat underneath. Ideal habitat conditions are difficult to find; much of the historical habitat for the species has likely been degraded and may be incapable of currently harboring the species (US FWS 2010, p. 7).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2010. 5 Year Review. http://ecos.fws.gov/docs/five_year_review/doc3244.pdf
Bean, purple (Villosa perpurpurea)	Inhabits small headwater streams (Neves 1991) to medium-sized rivers (Gordon 1991). It is found in moderate to fast-flowing riffles with sand, gravel, and cobble substrates (Neves 1991) and rarely occurs in deep pools or slack water (Ahlstedt 1991a). It is sometimes found out of the main current adjacent to water-willow beds and under flat rocks (Ahlstedt 1991a,	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2004. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/040524.pdf

	Gordon 1991) (US FWS 2004, p. 19).		
Bean, rayed (*Villosa fabalis*)	The rayed bean is generally known from smaller, headwater creeks, but occurrence records exist from larger rivers (Cummings and Mayer 1992, p. 142; Parmalee and Bogan 1998, p. 244). They are usually found in or near shoal or riffle (short, shallow length of stream where the stream flows more rapidly) areas, and in the shallow, wave-washed areas of glacial lakes, including Lake Erie (West et al. 2000, p. 253). In Lake Erie, the species is generally associated with islands in the western portion of the lake. Preferred substrates typically include gravel and sand. The rayed bean is oftentimes found among vegetation (water willow (Justicia americana) and water milfoil (Myriophyllum sp.)) in and adjacent to riffles and shoals (Watters 1988b, p. 15; West et al. 2000, p. 253) (US FWS 2012, p. 8633).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	US FWS 2012 - Federal Register Determination of Endangered Status. http://www.gpo.gov/fdsys/pkg/FR-2012-02-14/pdf/2012-2940.pdf
Beautiful shiner (*Cyprinella formosa*)	Found in small to medium streams with sand, gravel, and rock bottoms below 4500 ft elevation and is also found in artificial ponds.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species fact sheet http://www.fws.gov/southwest/es/arizona/Documents/Redbook/Beautiful%20Shiner.pdf
Birdwing pearlymussel (*Lemiox rimosus*)	The birdwing pearlymussel inhabits small to medium, low turbidity, cool-water, high to moderate gradient streams in the Cumberland and Tennessee River basins. The species is commonly found near riffles on sand and gravel substrates with firm rubble. Individuals have been found in waters ranging from six to seven feet deep.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species life history page http://ecos.fws.gov/docs/life_histories/F00I.html
Blackside dace (Phoxinus	This species inhabits cool, small, upland streams with moderate flows. The fish is	The proposed dicamba DGA uses are not expected to overlap	USFWS. 1988. Recovery Plan.

cumberlandensis)	generally associated with undercut stream banks and large rocks, and it is usually found within well-vegetated watersheds with good riparian vegetation (US FWS 1988, p. 6).	with rivers, streams, creeks, or other water bodies.	http://ecos.fws.gov/docs/recovery_plan/880817.pdf
Bonytail chub (*Gila elegans*)	This is a freshwater mainstream, big-river fish. It is also found in pools and eddies, with gravel, rocky, silt and/or silt-boulder substrates. The bonytail chub has also been found in rocky shoals and shorelines, and is adapted for swift, strong currents.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2002. Bonytail (Gila elegans) Recovery Goals. http://ecos.fws.gov/docs/recovery_plan/060727c.pdf
Canada lynx (*Lynx canadensis*)	PCE: Boreal forest landscapes with large populations of snowshoe hares. Distribution and abundance of prey and microclimate influence movement, hunting behavior, and den and resting site locations. Areas with dense cover.	The proposed dicamba DGA uses are not expected to overlap with boreal forests. The lynx's prey, snowshoe hares, also do not overlap with the proposed dicamba DGA use sites.	USFWS. 2014. Federal Register Notice: Designation of Critical Habitat http://www.gpo.gov/fdsys/pkg/FR-2014-09-12/pdf/2014-21013.pdf
Chihuahua chub (*Gila nigrescens*)	Deep pools, undercut banks, or over-hanging vegetation. Adults are in lateral scour pools, beneath undercut banks, under solid objects (e.g., logs, boulders) and/or adjacent to moderate to fast flowing water in small to medium sized streams. The species also utilizes corner and backwater pools containing large woody debris (also used) with extensive cover composed of organic debris or root wads of large trees. Pools are 1-2 m deep with water velocity <15 cm/sec and small grained substrates (sand to pea-sized). Juveniles are found in shallower water with or without cover in small and medium sized streams.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1986. Chihuahua Chub Recovery Plan http://ecos.fws.gov/docs/five_year_review/doc4325.pdf US FWS. 2007. http://ecos.fws.gov/docs/five_year_review/doc4325.pdf
Chipola slabshell (*Elliptio chipolaensis*)	The Chipola slabshell inhabits silty sand substrates of large creeks and the main channel of	The proposed dicamba DGA uses are not expected to overlap with rivers,	USFWS 2003. Recovery Plan for 7 mussels. Page 43.

	the Chipola River in slow to moderate current (Williams and Butler 1994). Specimens are generally found in sloping bank habitats. Nearly 70 percent of the specimens found during the status survey were associated with a sandy substrate (Brim Box and Williams 2000).	streams, creeks, or other water bodies.	http://ecos.fws.gov/docs/recovery_plan/030930.pdf
Choctaw bean (*Villosa choctawensis*)	It is found in medium creeks to medium rivers in stable substrates of silty sand to sandy clay with moderate current.	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2012. Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat: Final rule. Page 61669
Chupadera springsnail (*Pyrgulopsis chupaderae*)	Chupadera springsnail has been documented on two hillsides where groundwater discharges flow through volcanic gravels containing sand, mud, and aquatic plants with water temperatures ranging from 15 to 25 degrees Celsius (°C) (59 to 77 degrees Fahrenheit (°F)) and velocities ranging from 0.01 to 0.19 meters per second (m/s) (0.03 to 0.6 feet per second (ft/s))	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2012. Determination of Endangered Status for the Chupadera Springsnail and Designation of Critical Habitat: Final rule. http://www.gpo.gov/fdsys/pkg/FR-2012-07-12/pdf/2012-16988.pdf
Clubshell (*Pleurobema clava*)	Clubshell is generally found in clean, coarse sand and gravel in runs, often just downstream of a riffle, and cannot tolerate mud or slackwater conditions (USFWS, 1994).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1994. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/940921.pdf
Colorado pikeminnow (=squawfish) (*Ptychocheilus lucius*)	The adult Colorado pikeminnow requires pools, deep runs, and eddy habitats maintained by high spring flows.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2002. Colorado Pike Minnow (Ptychocheilus lucius) Recovery Goals http://ecos.fws.gov/docs/recovery_plan/020828b.pdf

Combshell, Cumberlandian (*Epioblasma brevidens*)	This species inhabits medium-sized streams to large rivers on shoals and riffles in coarse, sand, gravel, cobble, and boulders. It is not associated with small stream habitats and tends not to extend as far upstream in tributaries (US FWS 2004, p. 18).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2004. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/040524.pdf
Cracking pearlymussel, (*Hemistena lata)*	The cracking pearlymussel has undergone a substantial range reduction. It was historically distributed in the Ohio, Cumberland, and Tennessee River systems. The species has been extirpated throughout much of its range. It was last collected from Mussel Shoals, an 85 km reach of the Tennessee River in Alabama, prior to 1925 and is presumed to be extirpated from the shoal. It is presently known to survive at only a few shoals in the Clinch and Powell Rivers in Tennessee and Virginia, and it has likely been reduced to only three viable populations in these systems. The species possibly survives in the Green River, Kentucky, and below Pickwick Reservoir in the Tennessee River, Tennessee as well	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	http://ecos.fws.gov/docs/life_histories/F01X.html
Desert pupfish (*Cyprinodon macularius*)	Habitats have included clear, shallow waters with soft substrate associated with cienegas, springs, streams, margins of larger lakes and rivers, shoreline pools, and irrigation drains and ditches below 1,585 meters (5,200 feet) in elevation. Known natural populations are now restricted to two streams tributary, and in shoreline pools and irrigation drains of, the Salton Sea in California	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2010. Desert Pupfish (Cyprinodon macularius) 5-Year Review: Summary and Evaluation. http://ecos.fws.gov/docs/five_year_review/doc3573.pdf
Diamond Darter (*Crystallaria cincotta*)	Adult diamond darters and crystal darters typically have been captured in riffle-pool transition areas with predominately (greater than	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2013. Designation of Critical Habitat for the Diamond Darter (Crystallaria cincotta); Final Rule

	20 percent each) sand and gravel substrates.		http://www.gpo.gov/fdsys/pkg/FR-2013-08-22/pdf/2013-20449.pdf
Dromedary pearlymussel, (Dromus dromas)	This species is most often observed in clean, fast-flowing water in substrates that contain relatively firm rubble, gravel and sand substrates swept free from siltation. These mussels are usually found buried in the substrate in shallow riffle and shoal areas (US FWS, 1984, p. 8).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840709c.pdf
Duskytail darter, (Etheostoma percnurum)	This species inhabits rocky areas in gently flowing shallow pools and runs in large creeks and moderately large rivers in the Tennessee and Cumberland River Systems (US FWS, 1994, Executive Summary).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1994. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/duskytaildarter_RP.pdf
Dwarf wedgemussel (*Alasmidonta heterodon*)	The dwarf wedge mussel lives on muddy sand, sand, and gravel bottoms in creeks and rivers of varying sizes, in areas of slow to moderate current and little silt deposition.	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 1993. Dwarf Wedge Mussel recovery plan. Page 3.
Fanshell (*Cyprogenia stegaria*)	The fanshell inhabits gravel substrates in medium to large rivers of the Ohio River basin (US FWS, 1991, Executive Summary).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1991. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/910709.pdf
Fat three-ridge (mussel) (*Amblema neislerii*)	The fat threeridge inhabits the main channel of small to large rivers in slow to moderate current. Substrate used by this mussel varies from gravel to cobble to a mixture of sand and sandy mud (Williams and Butler 1994). Brim Box and Williams (2000) found 60 percent of the specimens were located in a sandy silt substrate.	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2003. Recovery Plan for 7 mussels. Page 42. http://ecos.fws.gov/docs/recovery_plan/030930.pdf
Finback whale, (*Balaenoptera physalus*)	Fin whales are found in deep, offshore waters of all major oceans, primarily in temperate to polar	The proposed dicamba DGA uses are not expected to	http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/finwhale.htm

	latitudes, and less commonly in the tropics. They occur year-round in a wide range of latitudes and longitudes, but the density of individuals in any one area changes seasonally.	overlap with coastal waters.	
Finerayed pigtoed (*Fusconaia cuneolus*)	This species is typically a riffle species that inhabits ford and shoal areas in free-flowing streams of moderate gradient (US FWS, 1984, p. 7).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/fine%20rayed%20recov%20plan.pdf
Fluted kidneyshell (P*tychobranchus subtentum*)	Associated with the Cumberland and Tennessee River drainages. Generally live embedded in the bottom of stable streams and other bodies of water, and within riffle areas of sufficient current velocities to remove finer sediments and provide well oxygenated waters (US FWS, 2013, p. 59560)	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2013. Federal Register Notice: Designation of Critical Habitat. http://www.gpo.gov/fdsys/pkg/FR-2013-09-26/pdf/2013-23357.pdf
Fuzzy pigtoe (*Pleurobema strodeanum*)	The fuzzy pigtoe is found in medium creeks to medium rivers in stable substrates of sand and silty sand with slow to moderate current.	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2012. Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat: Final rule. Page 61673
Gila chub (*Gila intermedia*)	Found in pools in smaller streams, cienegas, and artificial ponds. Highly secretive, adults prefer deeper, quieter waters in pools and eddies below riffles or runs, often remaining in cover from terrestrial vegetation, boulders, and fallen logs. Young-of-the year use the shallow margins of pools with aquatic vegetation or debris for cover. Older	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species life history page. http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=E02P#lifeHistory

	juveniles may be found in higher velocity runs and riffles.		
Gila topminnow (incl. Yaqui) (*Poeciliopsis occidentalis*)	Shallow, warm, fairly quiet waters in ponds, cienegas, tanks, pools, springs, small streams, and the margins of larger streams. Dense mats of algae and debris along the margins of the habitats are an important component for cover and foraging. Substrates of organic muds and detritus also provide foraging areas.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS Species life history page. http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=E00C#lifeHistory
Gila trout (*Oncorhynchus gilae*)	clean gravel, moderate to high gradient in perennial mountain streams	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2003. Gila trout recovery plan (third revision). http://ecos.fws.gov/docs/recovery_plan/030910.pdf
Green blossom (pearlymussel) (*Epioblasma torulosa gubernaculum*)	Clean, fast-flowing water in substrates that contain relatively firm rubble, gravel, and sand substrates swept free from siltation. These mussels are usually found buried in the substrate in shallow riffle and shoal areas *E. t. gubernacululm* was restricted to the high gradient rivers of the Appalachian mountains and the Cumberland Plateau	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1983. Recovery Plan Green-blossom Pearly Mussel Epioblasma (=Dysnomia) torulosa gubernaculum. http://ecos.fws.gov/docs/recovery_plan/060228.pdf
Greenback Cutthroat trout (*Oncorhynchus clarki stomias*)	Require clear, swift -flowing mountain streams with cover such as overhanging banks and vegetation. Riffle areas are used for spawning. Juveniles tend to shelter in shallow backwaters until large enough to fend for themselves in the mainstream.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species life-history page. http://ecos.fws.gov/docs/life_histories/E00F.html
Green sea turtle (Chelonia mydas)	Green turtles are primarily restricted to tropical and subtropical waters. In U.S. Atlantic and Gulf of Mexico waters, green turtles are found from Massachusetts to Texas and in the U.S. Virgin Islands and Puerto Rico...Seagrasses are the principal dietary component of juvenile and adult green turtles throughout the Wider Caribbean region	The proposed dicamba DGA uses are not expected to overlap with coastal waters.	NMFS, NOAA. 1998. Federal Register Notice: Designated critical habitat. http://ecos.fws.gov/docs/federal_register/fr3295.pdf

	(Bjorndal, 1995). (NMFS, NOAA 1998, p. 46694)		
Gulf moccasinshell (*Medionidus penicillatus*)	The Gulf moccasinshell inhabits the channels of small to medium-sized creeks to large rivers with sand and gravel or silty sand substrates in slow to moderate currents (Williams and Butler 1994; Garner, pers. comm. 2003).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2003. Recovery Plan for 7 mussels. Page 43. http://ecos.fws.gov/docs/recovery_plan/030930.pdf
Gulf sturgeon, (Acipenser oxyrinchus desotoi)	The Gulf sturgeon is an Anadromous fish which migrates from salt water into large coastal rivers to spawn and spend the warm months. The majority of its life is spent in fresh water (US FWS, 1995).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1995. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/950922.pdf
Hawksbill sea turtle, (Eretmochelys imbricata)	The hawksbill turtle occurs in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans. Coral reefs, like those found in the waters surrounding Mona and Monito Islands, are widely recognized as the primary foraging habitat of juvenile, subadult, and adult hawksbill turtles. This habitat association is directly related to the species' highly specific diet of sponges (Meylan, 1988). Hawksbills depend on coral reefs for food and shelter; therefore, the condition of reefs directly affects the hawksbill's well-being. (NMFS, NOAA 1998, p. 46695)	The proposed dicamba DGA uses are not expected to overlap with coastal waters.	NMFS, NOAA. 1998. Federal Register Notice: Designated critical habitat. http://ecos.fws.gov/docs/federal_register/fr3295.pdf
Hay's Spring amphipod (*Stygobromus hayi*)	The Hay's Spring amphipod inhabits a ground water outlet that feeds into a low gradient creek. Precise data on this habitat is lacking due to inaccessibility of habitat.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species life history page. http://ecos.fws.gov/docs/life_histories/K004.html
Humpback chub (*Gila cypha*)	Humpback chub are found in association with fast current, deep pool, and boulder habitats. They can occupy	The proposed dicamba DGA uses are not expected to overlap	US FWS. 1990. Recovery Plan for the Humpback Chub - 1990 2nd Revised Final Plan

	deep, swift riverine areas with large boulders and steep cliffs.	with aquatic environments.	http://ecos.fws.gov/docs/recovery_plan/900919c.pdf
Humpback whale (*Megaptera novaeangliae*)	During migration, humpbacks stay near the surface of the ocean. While feeding and calving, humpbacks prefer shallow waters. During calving, humpbacks are usually found in the warmest waters available at that latitude. Calving grounds are commonly near offshore reef systems, islands, or continental shores. Humpback feeding grounds are in cold, productive coastal waters.	The proposed dicamba DGA uses are not expected to overlap with coastal waters.	http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/humpbackwhale.htm
James spinymussel (*Pleurobema collina*)	This species lives in stream sites that vary in width from 10-75 feet and depth of 1/2 to 3 feet. It requires a slow to moderate water current with clean sand and cobble bottom sediments. The James spinymussel is limited to areas of unpolluted water, and may be more susceptible to competition from exotic clam species when its habitat is disturbed (Clark and Neves 1984, USFWS 1990).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	http://ecos.fws.gov/docs/life_histories/F025.html
Kemp's ridley sea turtle, (Lepidochelys kempii)	This life history pattern is characterized by three basic ecosystem zones: (1) Terrestrial zone (supralittoral) - the nesting beach where both oviposition and embryonic development occur; (2) Neritic zone - the nearshore (including bays and sounds) marine environment (from the surface to the sea floor) where water depths do not exceed 200 meters, including the continental shelf; and (3) Oceanic zone - the vast open	The proposed dicamba DGA uses are not expected to overlap with coastal waters.	NMFS, NOAA. 2011. Bi-national recovery plan for the kemp's ridley sea turtle. http://ecos.fws.gov/docs/recovery_plan/090116.pdf

	ocean environment (from the surface to the sea floor) where water depths are greater than 200 meters. (NMFS, NOAA 2011, p. I-8)		
Koster's springsnail (*Juturnia kosteri*)	They inhabit springs and spring-fed wetland systems with variable water temperatures and slow to moderate water velocities over compact substrate (material on the bottom of the stream) ranging from deep organic silts to gypsum sands and gravel. Additionally, the habitat of Koster's springsnail consists of soft substrates of springs and seeps.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2011. Designation of Critical Habitat for Roswell Springsnail, Koster's Springsnail, Noel's Amphipod, and Pecos Assiminea; Final Rule http://www.gpo.gov/fdsys/pkg/FR-2011-06-07/pdf/2011-13227.pdf
Leatherback sea turtle, (Dermochelys coriacea)	Leatherbacks are able to take advantage of a wide variety of marine ecosystems (reviewed by Saba 2013; see NOAA large marine ecosystem website: http://www.lme.noaa.gov/). Within these ecosystems, various oceanic features such as water temperature, downwelling, Ekman upwelling, sea surface height, chlorophyll-a concentration, and mesoscale eddies affect the presence of leatherbacks (Bailey et al. 2013; Benson et al. 2011). The physical characteristics observed within these marine ecosystems also affect the distribution and abundance of leatherback prey (reviewed by Saba 2013). (NFMS, NOAA 2013, p. 20-22).	The proposed dicamba DGA uses are not expected to overlap with coastal waters.	NMFS, NOAA. 2013. Five Year Review. http://ecos.fws.gov/docs/recovery_plan/090116.pdf
Lee County cave isopod (*Lirceus usdagalun*)	Found on the surfaces of small, submerged rocks and gravels in cave streams.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS 1997. Lee County Cave Isopod (*Lirceus usdagalun*) Recover Plan. http://ecos.fws.gov/docs/recovery_plan/970930c.pdf
Littlewing pearlymussel, (Pegias fabula)	This species inhabits small to medium, low turbidity, cool-water, high to moderate gradient streams in the Cumberland and Tennessee	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1989. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/890922.pdf

	River basins (US FWS, 1989, p. 5).		
Little Colorado spinedace (*Lepidomeda vittata*)	Freshwater springs, streams and rivers. Tends to prefer pools, but occurs sporadically throughout the habitat. Predominately in open pools with undercut banks and/or boulders for cover. During periods of drought spinedace are believed to persist in springs and intermittent streambed pools; and during flooding they tend to distribute themselves throughout the stream. Found in pools with slow to moderate current adjacent to riffles; during spate conditions, in eddies lateral to the current.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1997. Little Colorado River Spinedace Recovery Plan http://ecos.fws.gov/docs/recovery_plan/980109.pdf Federal Register/Vol. 52, No. 179. September 16, 1987, Little Colorado Spinedace Critical Habitat. http://ecos.fws.gov/docs/federal_register/fr1325.pdf
Loach minnow (*Tiaroga cobitis*)	Inhabits turbulent waters over gravel and/or cobble bottoms in riffles of mainstream rivers, fast-flowing streams, and tributaries. Due to a reduced gas bladder the species is restricted almost exclusively to a bottom-dwelling habit, swimming in swift water is only for brief moments. Most habitat is relatively shallow and the fish is found at elevations up to 2200 meters.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1991. Loach Minnow Recovery Plan http://ecos.fws.gov/docs/recovery_plan/910930f.pdf
Loggerhead <u>sea turtle, Northwest Atlantic DPS (Caretta caretta)</u>	The three basic ecosystems in which loggerheads live are the: 1. Terrestrial zone (supralittoral) - the nesting beach where both oviposition (egg laying) and embryonic development and hatching occur. 2. Neritic zone - the nearshore marine environment (from the surface to the sea floor) where water depths do not exceed 200 meters. The neritic zone generally includes the continental shelf, but in areas where the continental shelf is very narrow or nonexistent, the	The proposed dicamba DGA uses are not expected to overlap with coastal waters.	NMFS. NOAA. 2009. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/090116.pdf

	neritic zone conventionally extends to areas where water depths are less than 200 meters. 3. Oceanic zone - the vast open ocean environment (from the surface to the sea floor) where water depths are greater than 200 meters. (NMFS, NOAA 2009, p. I-20)		
Madison Cave isopod (*Antrolana lira*)	Flooded limestone caves beneath the Great Valley of Virginia and West Virginia where it swims freely through calcite-saturated waters of deep karst aquifers	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species life-history page. http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=K008#lifeHistory
Maryland darter (*Etheostoma sellare*)	Found in swiftly flowing streams (with rocky, rubble and gravel substrates), and prefers rock crevices and similar shelters in clean, well- oxygenated, parts of those streams.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	USFWS. 1985. Maryland darter revised recovery plan. http://ecos.fws.gov/docs/recovery_plan/851017.pdf
Mexican long-nosed bat (*Leptonycteris nivalis*)	The Mexican long-nosed bat has evolved an apparent mutualistic association with *Agave sp.* The bat is principally a nectar feeder, foraging on the flowers of *Agave*, and in some minor proportions consuming the pollen, fruits, and any incidental insects associated with the flowers. The bats occupy mid- to high- elevational desert scrub, open conifer-oak woodlands, and pine forest habitats in the Upper Sonoran and Transition Life Zones.	The proposed dicamba DGA uses are not expected to overlap with the desert scrub, open conifer-oak woodlands and pine forest habitats of the bat. The bat's major resource need, *Agave* plants are not expected to be on soybean and cotton fields.	USFWS. 1994. Recovery Plan. https://ecos.fws.gov/docs/recovery_plan/940908.pdf
Monkeyface, Appalachian (pearlymussel) (Quadrula sparsa)	This species is most often observed in clean-fast-flowing water in substrates that contain relatively firm rubble, gravel, and sand substrates swept free from siltation. These mussels are usually found buried in the substrate in shallow riffle and shoal areas (US FWS, 1984, p. 7).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840709.pdf

Monkeyface, Cumberland (pearlymussel) (Quadrula intermedia)	This species is most often observed in clean-fast-flowing water in substrates that contain relatively firm rubble, gravel, and sand substrates swept free from siltation. These mussels are usually found buried in the substrate in shallow riffle and shoal areas (US FWS, 1984, p. 9).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840709b.pdf
Narrow pigtoe (*Fusconaia escambia*)	It is found in medium creeks to medium rivers, in stable substrates of sand, sand and gravel, or silty sand, with slow to moderate current.	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2012. Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat: Final rule. Page 61671
Noel's Amphipod (*Gammarus desperatus*)	Inhabits shallow, cool, well-oxygenated waters of streams, ponds, ditches, sloughs, and springs.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2010. Noel's amphipod (*Gammarus desperatus*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc3600.pdf
North Atlantic Right Whale (*Eubalaena glacialis*)	The North Atlantic right whale primarily occurs in coastal or shelf waters, but may go into deeper waters. (NMFS 2004, p. v)	The proposed dicamba DGA uses are not expected to overlap with coastal waters.	NMFS. 2004. Recovery plan for the north Atlantic right whale (*Eubalaena glacialis*). Available online at: http://ecos.fws.gov/docs/recovery_plan/whale_right_northatlantic.pdf
Ochlockonee moccasinshell (*Medionidus simpsonianus*)	The Ochlockonee moccasinshell inhabits large creeks and the Ochlockonee River main stem in areas with current. Typical substrates are sand with some gravel (Williams and Butler 1994).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2003. Recovery Plan for 7 mussels. Page 43. http://ecos.fws.gov/docs/recovery_plan/030930.pdf
Oval pigtoe (*Pleurobema pyriforme*)	The oval pigtoe occurs in small to medium-sized creeks to small rivers	The proposed dicamba DGA uses are not expected to	USFWS 2003. Recovery Plan for 7 mussels. Page 43.

	where it inhabits silty sand to sand and gravel substrates, usually in slow to moderate current (Williams and Butler 1994; Garner, pers. comm. 2003). Stream channels appear to offer the best habitat for this species.	overlap with rivers, streams, creeks, or other water bodies.	http://ecos.fws.gov/docs/recovery_plan/030930.pdf
Oyster Mussel (*Epioblasma capsaeformis*)	This species is generally adapted to live in the gravel shoals of free-flowing rivers and streams (US FWS, 2004, Executive Summary).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2004. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/040524.pdf
Pecos assiminea snail (*Assiminea pecos*)	The Pecos assiminea requires saturated, moist soil at stream or spring-run margins and is found in wet mud or beneath mats of vegetation, usually within 1 inch (in) (2 to 3 centimeters (cm)) of flowing water. Spring complexes that contain flowing water create saturated soils that provide the specific habitat needed for population growth, sheltering, and normal behavior of the species. Although this snail seldom occurs immersed in water, the species cannot withstand permanent drying of springs or spring complexes. Consequently, wetland plant species are required to provide leaf litter (dead leaf material), shade, and appropriate microhabitat. Plant species such as *Scirpus americanus* (American three-square), *Eleocharis spp.* (spike rush), *Distichlis spicata* (inland saltgrass), and	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2011. Designation of Critical Habitat for Roswell Springsnail, Koster's Springsnail, Noel's Amphipod, and Pecos Assiminea; Final Rule. Page 33039. Available at: http://www.gpo.gov/fdsys/pkg/FR-2011-06-07/pdf/2011-13227.pdf

	Juncus spp. (rushes) provide the appropriate cover and shelter required by Pecos assiminea (NMDGF 2005, p. 13).		
Pecos bluntnose shiner (*Notropis simus pecosensis*)	Sandy substrate with low velocity flow, and at depths between 7-16 inches. Backwater, riffles, and pools are also used by younger individuals. Natural springs which are sources of continuous water flow also serve as habitat for Notropis simus pecosensis.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species life history page. http://ecos.fws.gov/docs/life_histories/E04F.html
Pecos gambusia (*Gambusia nobilis*)	*Gambusia nobilis* occurs abundantly in springheads and spring runs. Moderately abundant populations are also known from areas with little spring influence, but with abundant overhead cover, sedge covered marshes, and gypsum sinkholes. *G. nobilis* has been observed to occur from the surface to depths of three meter.	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS ECOS Life Histories for the Pecos gambusia (*Gambusia nobilis*) http://ecos.fws.gov/docs/life_histories/E00V.html
Pink Mucket (pearlymussel) (Lampsilis abrupta)	The pink mucket may still exist in stretches of the lower Ohio River (US FWS, 1985, p. 10). The pink mucket habitat is large rivers at least 60 feet wide, where it occurs at depths up to 25 feet deep. Currents are typically moderate to fast and substrates range from silt to boulders, rubble, gravel, and sand (US FWS, 1985, p. 11). The species seems to have adapted to living in impounded waters, at least in the upper reaches where the water is flowing (US FWS, 1985, p. 10).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1985. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/pink%20mucket%20rp.pdf
Purple bankclimber (mussel)	The purple bankclimber inhabits small to large river channels in slow to	The proposed dicamba DGA uses are not expected to	USFWS 2003. Recovery Plan for 7 mussels. Page 43.

(*Elliptoideus sloatianus*)	moderate current over sand or sand mixed with mud or gravel substrates (Williams and Butler 1994).	overlap with rivers, streams, creeks, or other water bodies.	http://ecos.fws.gov/docs/recovery_plan/030930.pdf
Rabbitsfoot (*Quadrula cylindrica cylindrica*)	Primarily an inhabitant of small to medium sized streams and some larger rivers. It usually occurs in shallow water areas along the bank and adjacent runs and shoals with reduced water velocity. They have been reported in deep water runs up to 12 feet depth. "Bottom substrates generally include gravel and sand" (US FWS, 2012, p. 63446).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Federal Register Notice. http://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24151.pdf
Razorback sucker (*Xyrauchen texanus*)	Fresh, large warm-water rivers: deep runs, eddies, backwaters, flooded off-channel. The species prefers shallow swift waters of mid-channel sandbars (less than 12ft deep) during the summer months, and slow runs, slack waters and eddies (2.0 to 4.6ft) in the winter.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2002. Razorback Sucker (*Xyrauchen texanus*) Recovery Goals. http://ecos.fws.gov/docs/recovery_plan/060727c.pdf
Riffleshell, northern (*Epioblasma torulosa rangiana)*	The habitat of the riffleshell occurs in packed sand and gravel in riffles and runs, and also in the western basin of Lake Erie where there is sufficient wave action to produce continuously moving water (US FWS, 1994, p. 18). FWS further describes the habitat as medium to large rivers where they are often associated with high water velocities, although they have also been documented in Lake Erie and in deep more slow-flowing rivers down to 20 feet (US FWS, 2009. p. 9).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1994. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/940921.pdf USFWS. 2009. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc3284.pdf
Rio Grande silvery minnow (*Hybognathus amarus*)	In general, the species is most often found in areas of low or moderate water velocity (e.g., eddies formed by debris piles, pools, backwaters, and embayments), and is rarely found in habitats with high	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1999. Rio Grande Silvery Minnow Recovery Plan (*Hybognathus amarus*) First Revision http://ecos.fws.gov/docs/recovery_plan/022210_v2.pdf

	water velocities, such as main channel runs, which are often deep and swift.		
Roanoke logperch (*Percina rex*)	The Roanoke logperch occupies medium to large warm-water streams and rivers of moderate gradient with relatively unsilted substrata. During different phases of life history and season, every major riverine habitat is exploited by the logperch. Except in winter, all age classes are intolerant of moderately to heavily silted substrata. It is found in two river systems in Virginia-The Roanoke River drainage.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species life history page. http://ecos.fws.gov/docs/life_histories/E01G.html
Round Ebonyshell (*Fusconaia rotulata*)	It occurs in small to medium rivers, typically in stable substrates of sand, small gravel, or sandy mud in slow to moderate current.	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2012. Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat: Final rule. Page 61668
Rough pigtoe, (*Pleurobema plenum*)	The rough pigtoe habitat is medium to large rivers, 60 feet or wider, in sand and gravel substrates. Very limited collection information suggests it occurs below spillways, in transition zones, and in sand and gravel substrates (US FWS, 1984, p. 8).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840806.pdf
Roswell springsnail (*Pyrgulopsis roswellensis*)	Springs and spring-fed wetland systems with slow to moderate flowing water velocities, deep organic silts to limestone cobble and gypsum substrates and stable water levels.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2012. Designation of Critical Habitat for Roswell Springsnail, Koster's Springsnail, Noel's Amphipod, and Pecos Assiminea; Final Rule http://www.gpo.gov/fdsys/pkg/FR-2011-06-07/pdf/2011-13227.pdf

Rough rabbitsfoot (*Quadrula cylindrica strigillata*)	Found in medium to large rivers with silt, sand gravel or cobble substrates, in eddies at edge of midstream currents. The species may be associated with macrophyte beds.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2004. Recovery Plan for Rough Rabbitsfoot (Quadrula cylindrica strigillata) http://ecos.fws.gov/docs/recovery_plan/040524.pdf
San Bernardino springsnail (*Pyrgulopsis bernardina*)	Associated with seeps, spring runs, and especially perennial spring systems that produce running water	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2012. Determination of Endangered Status for Three Forks Springsnail and Threatened Status for San Bernardino Springsnail Throughout Their Ranges and Designation of Critical Habitat for Both Species; Final Rule. http://www.gpo.gov/fdsys/pkg/FR-2012-04-17/pdf/2012-8811.pdf
Shiny entire pigtoe, (*Fusconaia cor)*	This species is typically a riffle species, found along fords and shoals of clear, moderate to fast-flowing streams and rivers with stable substrate. It does not inhabit deep pools or impounded areas. This species is usually found well-buried in the substrate during most of the year and is more readily visible in early summer (US FWS, 1984, p. 8).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840709d.pdf
Shortnose sturgeon (*Acipenser brevirostrum*)	Shortnose sturgeon are found in rivers, estuaries, and the sea, but populations are confined mostly to natal rivers and estuaries. The species appears to be estuarine anadromous in the southern part of its range, but in some northern rivers it is	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	NMFS 1998. Final Recovery Plan for the Shortnose Sturgeon (*Acipenser brevirostrum*). Page 25. Available at: http://ecos.fws.gov/docs/recovery_plan/sturgeon_shortnose_1.pdf

	"freshwater amphidromous", i.e., adults spawn in freshwater but regularly enter saltwater habitats during their life (Kieffer and Kynard 1993). Adults in southern rivers forage at the interface of fresh tidal water and saline estuaries and enter the upper reaches of rivers to spawn in early spring (Savannah River: Hall et al. 1991; Altamaha River: Heidt and Gilbert 1979; Flouronoy et al. 1992, Rogers and Weber 1995a; Ogeechee River: Weber 1996).		
Slabside pearlymussel, (*Pleuronaia dolabelloides*)	Associated with the Cumberland and Tennessee River drainages. Generally live embedded in the bottom of stable streams and other bodies of water, and within riffle areas of sufficient current velocities to remove finer sediments and provide well oxygenated waters (US FWS, 2013, p. 59560)	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2013. Federal Register Notice: Designation of Critical Habitat. http://www.gpo.gov/fdsys/pkg/FR-2013-09-26/pdf/2013-23357.pdf
<u>Slender chub (Erimystax cahni)</u>	The slender chub is restricted to the upper Tennessee River drainage in Tennessee and Virginia (US FWS 2014, p. 6)	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2014. 5 Year Review. http://ecos.fws.gov/docs/five_year_review/doc4357.pdf
Shiner, smalleye (*Notropis buccula*)	Occur in fairly shallow, flowing water, often less than 0.5 m deep with sandy substrates (US FWS 2014, p. 45252)	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2014. Designation of Critical Habitat. http://www.gpo.gov/fdsys/pkg/FR-2014-08-04/pdf/2014-17694.pdf
Smalltooth sawfish (Pristis pectinata)	Smalltooth sawfish are tropical marine and estuarine fish that have the northwestern terminus of their Atlantic range in the waters of the eastern United States. In the United States, smalltooth sawfish are generally a shallow water	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	NMFS, NOAA. 2001. Federal Register Notice: Proposed Endangered Status for a DPS of Smalltooth Sawfish. http://ecos.fws.gov/docs/federal_register/fr3741.pdf

	fish of inshore bars, mangrove edges, and seagrass beds, but are occasionally found in deeper coastal waters. (US FWS NMFS, NOAA 2001, p. 19416)		
Sheepnose mussel, (*Plethobasus cyphyus*)	The sheepnose is a larger-stream species occurring primarily in shallow shoal habitats with moderate to swift currents over coarse sand and gravel. Habitats with sheepnose may also have mud, cobble, and boulders. Sheepnose in larger rivers may occur at depths exceeding 6 m (US FWS, 2012, p 14916).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Federal Register Notice: Final Rule. http://www.gpo.gov/fdsys/pkg/FR-2012-03-13/pdf/2012-5603.pdf
Shinyrayed pocketbook (*Lampsilis subangulata*)	The shinyrayed pocketbook inhabits small to medium-sized creeks, to rivers in clean or silty sand substrates in slow to moderate current (Williams and Butler 1994; Garner, pers. comm. 2003). Specimens are often found in the interface of stream channel and sloping bank habitats, where sediment particle size and current strength are transitional. Clench and Turner (1956) noted it preferred small creeks and spring-fed rivers.	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2003. Recovery Plan for 7 mussels. Page 42. http://ecos.fws.gov/docs/recovery_plan/030930.pdf
Snuffbox Mussel (*Epioblasma triquetra*)	The habitat is described as swift currents and riffles, and shoals and wave-washed shores of lakes over gravel and sand with occasional cobble and boulders. They generally burrow deep into the substrate (US FWS, 2010, p 67554). This constitutes a wide diversity of habitats. However, they do not occur in impounded areas or reservoirs (except tailwaters) (US FWS, 2012, p 8652).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2010. Federal Register Notice: Listing. http://www.gpo.gov/fdsys/pkg/FR-2010-11-02/pdf/2010-27413.pdf#page=2 USFWS. 2012. Federal Register Notice: Final Rule. http://www.gpo.gov/fdsys/pkg/FR-2012-02-14/pdf/2012-2940.pdf

Spectaclecase (mussel) (*Cumberlandia monodonta*)	The spectaclecase generally inhabits large rivers where it occurs in microhabitats sheltered from the main force of current. It occurs in a variety of substrates from mud and sand to gravel, cobble, and boulders in relatively shallow riffles and shoals with a slow to swift current. It is most often found in firm mud between large rocks in quiet water very near the interface with swift currents (US FWS, 2012, p 14916).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Federal Register Notice: Final Rule. http://www.gpo.gov/fdsys/pkg/FR-2012-03-13/pdf/2012-5603.pdf
Spotfin chub (Erimonax monachus)	The species is an insectivore, feeding diurnally presumably by both sight and taste in benthic areas of slow to swift current over various substrates with little siltation. Streams may range from 15-60 m in width and, where occupied, 0.3-10.0 m in depth. Water temperature in their summer habitat usually reaches greater than 20°C, and submerged macrophytes are usually absent, occasionally common. The species has been observed associated with sand, gravel, rubble, boulder, and bedrock substrates (Jenkins and Burkhead, 1982) (US FWS 1983, p. 15).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1983. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/831121.pdf
Socorro isopod (*Thermosphaeroma thermophilus*)	Small pools and runs characterized by relatively stable temperatures and physical factors with algae covering most surfaces.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1982. Socorro Isopod Recover Plan. http://ecos.fws.gov/docs/recovery_plan/820216.pdf
Socorro springsnail (*Pyrgulopsis neomexicana*)	Occurs on stones and among aquatic plants. *Pyrgulopsis neornexicana* is also found in the uppermost layer of an organic muck substrate with slow moving currents in rivers and streams.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1991. Final Rule To List the Alamosa Springsnail and the Socorro Springsnail as Endangered http://ecos.fws.gov/docs/federal_register/fr1933.pdf
Sonora chub (*Gila ditaenia*)	Perennial and spatially intermittent small to moderately sized streams. It prefers pools near cliffs, boulders, or other cover in stream channels. The chub is restricted to one river system,	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1992. Sonora Chub Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/920930.pdf

	and as noted, is able to move through the system when flows are suitable.		US FWS. Species Fact Sheet for SONORA CHUB (Gila ditaenia) http://www.fws.gov/southwest/es/arizona/Documents/Redbook/Sonora%20Chub%20RB.pdf
Southern kidneyshell (*Ptychobranchus jonesi*)	It is typically found in medium creeks to small rivers in firm sand substrates with slow to moderate current (Williams et al. 2008, pp. 625).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2012. Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat: Final rule. Page 61668
Southern sandshell (*Hamiota (=Lampsilis) australis)*	The southern sandshell is typically found in small creeks and rivers in stable substrates of sand or mixtures of sand and fine gravel, with slow to moderate current.	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2012. Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat: Final rule. Page 61672
Spikedace (*Meda fulgida*)	Moderate to large perennial streams with moderate to swift currents. It inhabits shallow riffles with sand gravel and rubble substrates. Specific habitat consists of shear zones where rapid flow borders slower flow, areas of sheet flow at the upper end of mid-channel sand/gravel bars and eddies at downstream riffle edges. All suitable habitats are found under 2,000 meters elevation.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species life history page. http://ecos.fws.gov/docs/life_histories/E05J.html
Tan riffleshell *(Epioblasma florentina*	This species inhabits streams described as shallow and turbid with numerous riffles	The proposed dicamba DGA uses are not expected to overlap	USFWS. 1984. Recovery Plan.

walkeri (=E. walkeri)	and substrate consisting of loose rocks and gravel bars with an abundance of water willow (US FWS, 1984. P, 7).	with rivers, streams, creeks, or other water bodies.	http://ecos.fws.gov/docs/recovery_plan/tan%20riffleshell%20rp.pdf
Tapered pigtoe (*Fusconaia burkei*)	The tapered pigtoe is found in medium creeks to medium rivers in stable substrates of sand, small gravel, or sandy mud, with slow to moderate current (Williams et al. 2008, p. 296).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2012. Determination of Endangered Species Status for the Alabama Pearlshell, Round Ebonyshell, Southern Kidneyshell, and Choctaw Bean, and Threatened Species Status for the Tapered Pigtoe, Narrow Pigtoe, Southern Sandshell, and Fuzzy Pigtoe, and Designation of Critical Habitat: Final rule. Page 61670
Three Forks Springsnail (*Pyrgulopsis trivialis*)	Shallow waters up to 6 cm (2.35 in) deep, high conductivity, alkaline waters of pH 8, and suitable substrates that are typically firm, characterized by cobble, gravel, sand (and sometimes fine-grained mud), woody debris, and aquatic vegetation such as watercress.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2011. ; Proposed Endangered Status for the Three Forks Springsnail and San Bernardino Springsnail, and Proposed Designation of Critical Habitat; Proposed Rule http://www.gpo.gov/fdsys/pkg/FR-2011-04-12/pdf/2011-8176.pdf
Tubercled blossom (pearlymussel) (*Epioblasma torulosa torulosa*)	Large-river species that was endemic to the Ohio River system.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2011 Tubercled Blossom *Epioblasma torulosa torulosa* 5-Year Review: Summary and Evaluation. http://ecos.fws.gov/docs/five_year_review/doc3781.%20torulosa.pdf
Virgin River Chub (*Gila seminuda (=robusta)*)	Virgin River chubs are most often associated with deep runs or pool habitats of slow to moderate velocities with large boulders or instream cover, such as root snags. Adults and juveniles are often associated together within these habitats; however, the larger adults are collected most often in the deeper pool habitats within the river.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2013. Virgin River Fishes Recover Plan http://ecos.fws.gov/docs/recovery_plan/950419a.pdf

West Indian Manatee (*Trichechus manatus latirostris*)	This species lives in freshwater, brackish and marine habitats (US FWS, 2001, Executive Summary).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	US FWS. 2001. Recovery Plan- Third Revision. http://ecos.fws.gov/docs/recovery_plan/011030.pdf
Woundfin (*Plagopterus argentissimus*)	Rivers and creeks, depths between 0.15 and 0.42 m and velocities between 0.24 and 0.49 m/s and sandy substrates.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species life history page. http://ecos.fws.gov/docs/life_histories/E00Z.html
Yaqui catfish (*Ictalurus pricei*)	Larger rivers in areas of medium to slow	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1994. Yaqui Fishes Recovery Plan http://ecos.fws.gov/docs/recovery_plan/950329.pdf
Yaqui chub (*Gila purpurea*)	Inhabits deeper pools of small streams near undercut banks and debris between 1,219 - 1,828 m (4,000 - 6,000 ft). Is also found in pools associated with springheads. Also occurs in artificial ponds.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species Fact Sheet. http://www.fws.gov/southwest/es/arizona/Documents/Redbook/Yaqui%20Chub%20RB.pdf
Madtom, yellowfin (Noturus flavipinnis)	This species prefers pool habitats beneath cobble and small boulder substrates (Miller 2011). The strongest habitat models identified preferred pools for yellowfin madtoms as greater than 40 meters in length with gravel being the main substrate beneath cover rocks (Miller 2011). (US FWS, 2012, p. 16).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc4146.pdf
Zuni Bluehead Sucker (*Catostomus discobolus yarrowi*)	Stream reaches with clean, perennial water flowing over hard substrate (material on the stream bottom), such as bedrock. Habitat areas are generally shaded with water velocities of less than 0.1 meter per second (0.3 feet per second) in water that was 30 to 50 cm (12 to 20 in) deep with cobble, boulders, and bedrock substrate. Pools often edged by emergent aquatic plants and riparian vegetation.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2014. Endangered Species Status for the Zuni Bluehead Sucker; Final Rule http://www.gpo.gov/fdsys/pkg/FR-2014-07-24/pdf/2014-17205.pdf
American crocodile *(Crocodylus acutus)*	Found primarily in mangrove swamps and along low-energy mangrove-lined bays, creeks, and inland swamps. During the non-nesting	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 1999. South Florida Multi-Species Recovery Plan (68 spp.)

	season, they are found primarily in the fresh and brackish-water inland swamps, creeks, and bays, retreating further into the back country in fall and winter. Can be found in inland ponds and creeks, protected coves exposed shorelines mud flats.		http://ecos.fws.gov/docs/recovery_plan/sfl_msrp/SFL_MSRP_Species.pdf
Atlantic salt marsh snake *(Nerodia clarkii taeniata)*	The Atlantic salt marsh snake inhabits coastal salt marshes and mangrove swamps. Specifically, it occurs along shallow tidal creeks and pools, in a saline environment ranging from brackish to full strength. It is often associated with fiddler crab burrows.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Profile page. http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=C01T#lifeHistory
Elkhorn coral *(Acropora palmat)a*	Turbulent shallow water on the seaward face of reefs in water ranging from 1 to 5 m in depth. It has been found in waters up to 30 m in depth.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2008. Critical Habitat for Threatened Elkhorn and Staghorn Corals; Final Rule http://www.gpo.gov/fdsys/pkg/FR-2008-11-26/pdf/E8-27748.pdf#page=1
Okaloosa darter *(Etheostoma okaloosae)*	Fast-flowing streams. Bottoms are mostly sand, with detritus collecting in areas along the edges and eddy areas where the currents are deflected. Darete streams are heavily shade over most of their courses with ti-ti, alder, wax myrtly, oak, pine, juniper, and black gum.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. Species life history page http://ecos.fws.gov/docs/life_histories/E00H.html
Squirrel Chimney Cave shrimp *(Palaemonetes cumingii)*	Squirrel Chimney cave system. Entrance is a steep to vertical sloped sink with a shaft 3-6 ft wide and extends to the main cave and is referred to as a chimney. The cave has bedding plane tunnels, ledges, and a debris cone which opens to an air chamber.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2008. Squirrel Chimney Cave shrimp *(Palaemonetes cumingii)* 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1919.pdf
Staghorn coral *(Acropora cervicornis)*	Staghorn coral commonly grows in more protected, deeper water ranging from 5 to 20 m in depth and has been found in rare instances to 60 m.	The proposed dicamba DGA uses are not expected to overlap with aquatic environments.	US FWS. 2008. Critical Habitat for Threatened Elkhorn and Staghorn Corals; Final Rule http://www.gpo.gov/fdsys/pkg/FR-2008-11-26/pdf/E8-27748.pdf#page=1

Species	Habitat	Rationale	Source
Plants			
Acuna Cactus (*Echinomastus erectocentrus var. acunensis*)	The acuña cactus occurs in valleys and on small knolls and gravel ridges of up to 30 percent slope in the Palo-Verde-Saguaro Association of the Arizona Upland subdivision of the Sonoran desertscrub at 365 to 1,150 m (1,198 to 3,773 ft) in elevation. The plant is not found on all seemingly suitable habitat and microclimate (soil structure, chemistry, and moisture) may be important factors.	The proposed dicamba DGA uses are not expected to overlap with desert environments.	US FWS. Species life history page. http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=Q0OU#lifeHistory
American chaffseed, (*Schwalbea americana)*	Habitats described as pine flatwoods, fire-maintained savannas, ecotonal areas between peaty wetlands and xeric sandy soils, and other open grass-sedge systems (US FWS, 1995).	The proposed dicamba DGA uses are not expected to overlap with pine flatwoods, fire-maintained savannas, wetland or sedge dominated systems.	USFWS. 1995. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/950929c.pdf
American hart's tongue fern, (*Asplenium scolopendrium var. americanum*)	Early successional habitats Northern populations occur in forests of secondary growth where canopy openings are abundant. New York populations occur in conifer forests. Bryophyte beds are an important substrate.	The proposed dicamba DGA uses are not expected to overlap early successional forests, conifer forests or bryophyte beds where the species is found.	http://ecos.fws.gov/docs/recovery_plan/930915.pdf
Arizona Cliff-rose (*Purshia (=Cowania) subintegra*)	Dry. At each site *P. subintegra* is part of a locally unique vegetative community. The geographic and local distribution of *P. subintegra* appears to be limited by competition from other plant species rather than a requirement for a specific soil type. Distribution may be limited by competition from creosotebush.	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 2013. Arizona Cliffrose (Purshia subintegra) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc4260.pdf
Arizona hedgehog cactus	Plants are found on dacite or granite bedrock, open slopes, in narrow cracks between	The proposed uses of dicamba DGA are not	US FWS. 2008. 5-Year Reviews of 28 Southwestern Species

(*Echinocereus triglochidiatus var. arizonicus*)	boulders, and in the understoryof shrubs in the ecotone between Madrean EvergreenWoodland and Interior Chapparal.	expected to overlap with desert habitats.	http://www.gpo.gov/fdsys/pkg/FR-2008-03-20/pdf/E8-5632.pdf#page=1
Brady pincushion cactus (*Pediocactus bradyi*)	*Pediocactus bradyi* is restricted to habitat composed of Kaibab limestone chips overlying soil derived from Moenkopi shale and sandstone outcrops. Chert and quartzite pebbles eroded from the Shinarump member of the Chinle Formation are also present at some sites (USFWS 1985). The rock chips that overlay the soil have clear crystalline coatings and a whiter color that appears distinct from the adjacent brown limestones where few or no *P. bradyi* occur	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 2012. Brady Pincushion Cactus (Pediocactus bradyi) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc4036.pdf
Canby's dropwort (*Oxypolis canbyi*)	Coastal plains - specifically in pond cypress savannas, the shallows and edges of cypress pond/pine sloughs, and wet pine savannas. These are shallowly flooded, open habitats. Found in natural ponds dominated by cypress, grass-sedge dominated Carolina bays. (USFWS 1990) Wetlands (USFWS 2010)	The proposed dicamba DGA uses are not expected to overlap with wetlands.	1990 USFWS Canby's dropwort recovery plan 2010 USFWS Canby's dropwort 5-year review
Canelo Hills ladies'-tresses (*Spiranthes delitescens*)	Occurs in rare wetland habitats in southern Arizona and northern Sorona, Mexico called "cienegas." Ciengas are mid-level wetland communities, often surrounded by relatively arid environments, that are usually associated with perrenial springs or stream headwaters. They have permamently or seasonally saturated organic soils, and have a low probability of flooding or scouring.	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats.	US FWS. 1997. ETWP; Determination of Endangered Status for Three Wetland Species Found in Southern Arizona and Northern Sonora, Mexico (62 FR 665 689) http://ecos.fws.gov/docs/federal_register/fr3030.pdf
Carter's small-flowered flax	Proposed PCE's for this species are areas of pine	The proposed uses of dicamba DGA are not	US FWS. 2013. Designation of Critical Habitat for

(*Linum carteri carteri)*	rockland habitat with frequent disturbances (*e.g.* fire)	expected to overlap with pine rockland habitats with frequent disturbance regimes.	Brickellia mosieri (Florida Brickell-bush) and Linum carteri var. carteri (Carter's Small-flowered Flax). http://www.gpo.gov/fdsys/pkg/FR-2013-10-03/pdf/2013-24174.pdf
Clay-loving wild buckwheat (*Eriogonum pelinophilum*)	Distribution is linked to soil type. Found within swales and drainages. Mat saltbrush community.	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats.	US FWS. 2009. Clay-loving wild buckwheat 5-year review http://ecos.fws.gov/docs/five_year_review/doc2635.pdf
Cochise pincushion cactus (*Coryphantha robbinsorum*)	Bedrock and stony soils of the Permian Limestone Formation . Transition zone between the Chihuahuan desert scrub and the semi-desert grassland habitats. Occupies limestone hills. Grows on bedrock areas with very little soil in sunny, open, well-drained areas	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 1993. Cochise pincushion cactus (Coryphantha robbinsorum) recovery plan. http://ecos.fws.gov/docs/recovery_plan/930927c.pdf
Butterfly plant, Colorado (*Gaura neomexicana var. coloradensis*)	This species requires early- to mid-succession riparian habitat. It commonly occurs in habitat types that are usually intermediate in moisture between wet, streamside communities dominated by sedges, rushes, and cattails, and dry, upland short-grass prairie. Typically, Colorado butterfly plant habitat is open, without dense or overgrown vegetation (US FWS, 2010).	The proposed dicamba DGA uses are not expected to overlap with riparian habitat or upland prairies.	USFWS. 2010. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/Colorado%20Butterfly%20Plant%20Recovery%20Outline_Final_May%202010.pdf
Colorado hookless Cactus (*Sclerocactus glaucus*)	Populations of S. glaucus occur on alluvial benches and lower mesa slopes along the Green, Colorado, and Gunnison Rivers. Soils are usually coarse, gravelly river alluvium above the river flood plains. Mancos shale with volcanic cobbles and pebbles form surface material	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats.	US FWS. 2010. Recovery Outline for the Colorado hookless cactus (Sclerocactus glaucus) http://ecos.fws.gov/docs/recovery_plan/CO%20hookless%20cactus_recovery%20outline_Apr%202010.pdf
Cooley's meadowrue	Grassland/herbaceous, woody wetland, and	The proposed dicamba DGA uses are not expected to	1994 USFWS Recovery Plan

(*Thalictrum cooleyi*)	herbaceous wetlands (p. i). (USFWS 1994)	overlap with wetlands.	http://ecos.fws.gov/docs/recovery_plan/940421.pdf
DeBeque phacelia (*Phacelia submutica*)	DeBeque phacelia is restricted to exposures of chocolate to purplish brown and dark charcoal gray alkaline clay soils derived from the Atwell Gulch and Shire members of the Wasatch Formation. These expansive clay soils are found on moderately steep slopes, benches, and ridge tops adjacent to valley floors of the southern Piceance Basin in Mesa and Garfield Counties, Colorado. On these slopes and soils, DeBeque phacelia usually grows only on one unique small spot of ground that shows a slightly different texture, color, and crack pattern than the similar surrounding soils. We do not have a precise scientific description of the soil features required to support this species. The natural shrink-swell cracking process creates the conditions needed for the plants and seed bank to thrive. Its habitat lies at the interface of the North-Central Highlands and Rocky Mountain Section and the Intermountain Semi-desert and Desert Province.	The proposed uses of dicamba DGA are not expected to overlap with steep slopes, benches or ridge tops.	US FWS. 2013. Recovery Outline DeBeque phacelia (Phacelia submutica) http://ecos.fws.gov/docs/recovery_plan/Debeque%20Phacelia%20Recovery%20Outline.pdf
Dudley Bluffs bladderpod (*Lesquerella congesta*)	Found on drainages along barren outcrops formed by erosion by the downcutting of streams in the Piceance Basin. Grows on level surfaces at the points of ridges and on narrow outcrops of exposed, level, white shale . Surrounding hills and mesas are juniper and pinyon woodlands	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats.	US FWS. 1993. Dudley's bluff bladderpod (Lesquerella congestai) and Dudleys bluff twinpod (Physaria obcordata) recovery plan http://ecos.fws.gov/docs/recovery_plan/930813a.pdf
Dudley Bluffs twinpod (*Physaria obcordata*)	Found on drainages along barren outcrops formed by erosion by the downcutting of streams in the Piceance Basin. Grows on steep sideslopes. Surrounding hills	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats.	US FWS. 1993. Dudley's bluff bladderpod (Lesquerella congestai) and Dudleys bluff twinpod (Physaria obcordata) recovery plan

	and mesas are juniper and pinyon woodlands.		http://ecos.fws.gov/docs/recovery_plan/930813a.pdf
Eastern prairie fringed orchid (*Platanthera leucophaea*)	The eastern prairie fringed orchid occurs in a wide variety of habitats, from mesic prairie to wetland communities such as sedge meadows, marsh edges and even fens and sphagnum bogs. It requires full sunlight for optimum growth and flowering, which restricts it to grass- and sedge-dominated plant communities. The substrate of the sites where it occurs ranges from more or less neutral to mildly calcareous, typically glacial soils. It is often early successional, but can be maintained in mid- to late successional wetlands that remain open and sunny (US FWS, 1999, pp. 6-7).	The proposed dicamba DGA uses are not expected to overlap with grass or sedge-dominated plant communities.	USFWS. 1999. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/990929.pdf
Fickeisen Plains cactus (*Pediocactus peeblesianus fickeiseniae*)	Occurs on shallow soils derived from exposed layers of Kaibab limestone. Most populations occur on the margins of canyon rims, on flat terraces or benches, or on the toe of well-drained hills with less than 20 percent slope. Within the Plains and Great Basin grasslands and the Great Basin desert scrub vegetation communities.	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. Species life history page. http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q1C9#lifeHistory
Florida brickell-bush (*Brickellia mosieri*)	Proposed PCE's for this species are areas of pine rockland habitat with frequent disturbances (*e.g.* fire)	The proposed uses of dicamba DGA are not expected to overlap with pine rockland habitats with frequent disturbance regimes.	US FWS. 2013. Designation of Critical Habitat for Brickellia mosieri (Florida Brickell-bush) and Linum carteri var. carteri (Carter's Small-flowered Flax). http://www.gpo.gov/fdsys/pkg/FR-2013-10-03/pdf/2013-24174.pdf

Fringed campion (*Silene polypetala*)	Occurs in hardwood forests in bottomland and ravines. It is often on fairly steep slopes of deep ravines or north-facing hillsides, sometimes on nearly level ground, particularly in flatwoods developed on Iredell soils. Occurs mainly in small isolated patches of rich hardwood. The great majority of populations occur in the watershed of the Apalachicola River and its tributary, the Flint River. (USFWS 1996)	The proposed dicamba DGA uses are not expected to overlap with forests.	1996 USFWS Technical Agency Draft Recovery Plan for Fringed Campion (*Salene polypetula*) USFWS Species Profile: Fringed campion (*Silene polypetala*) (http://ecos.fws.gov/species Profile/profile/speciesProfil e.action?spcode=Q21P)
Gentian pinkroot (*Spigelia gentianoides*)	Well drained upland pinelands; longleaf pine-wiregrass ecosystem (USFWS 2012)	The proposed dicamba DGA uses are not expected to overlap with forests.	2012 US FWS Gentian pinkroot 5-Year Review
Gierisch mallow (*Sphaeralcea gierischii*)	Found on gypsum outcrops associated with the Harrisburg Member of the Kaibab Formation in northern Mohave County, Arizona and closely adjacent Washington County, Utah. The surrounding plant community is that of warm desertscrub (Mohave desertscrub)	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. Species profile page. http://ecos.fws.gov/speciesPro file/profile/speciesProfile.actio n?spcode=Q3LJ
Gypsum wild-buckwheat (*Eriogonum gypsophilum*)	Chihuahuan region of the Desert Scrub Formation. The climate is semi-arid and receives an average of about 14 inches of precipitation per year	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 1981. 50 CFR Part 17. Endangered and Threatened Plants; Determination of two New Mexico Plants to be Endangered Species and Threatened Species with Critical Habitat. Final Rule. Federal Register / Vol. 46, No. 12 / Monday, January 19, 1981 / Rules and Regulations. http://ecos.fws.gov/docs/feder al_register/fr515.pdf
Harperella (*Ptilimnium nodosum*)	Harperella is known from only two locations in North Carolina. One population occurs in the Tar River in Granville County. Another population was reintroduced to the Deep	The proposed dicamba DGA uses are not expected to overlap with river habitats.	USFWS. 1991. Recovery Plan. http://ecos.fws.gov/docs/rec overy_plan/910305b.pdf

	River recently after the original population known from that area disappeared. This population occurs in Chatham County, but the river serves as the divide between Chatham and Lee counties (US FWS, 1991).		
Holmgren milk-vetch (*Astragalus holmgreniorum*)	Grows on the shallow, sparsely vegetated soils derived primarily from the Virgin limestone member of the Moenkopi Formation. The species is a principal member of a warm-desert shrub vegetative community.	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 2006. Astragalus holmgreniorum (Holmgren Milk-Vetch) and Astragalus ampullarioides (Shivwits Milk-Vetch): Recovery Plan http://ecos.fws.gov/docs/recovery_plan/060929.pdf
Holy Ghost ipomopsis (*Ipomopsis sancti-spiritus*)	Holy Ghost ipomopsis is known from a single population in the Sangre de Cristo Mountains of San Miguel County in north-central New Mexico (Figure 2). Plants are relatively continuous in scattered patches for about 3.5 kilometers (km) (2.2 miles (mi)) of Holy Ghost Canyon beginning 1.6 km (1.0 mi) above the confluence with the Pecos River then up Holy Ghost Creek to the confluence with Doctor Creek. There are about 80 hectares (ha) (200 acres (ac)) of occupied habitat. The Santa Fe National Forest manages most of the habitat. The USFS maintains a campground and leases land in Holy Ghost Canyon as the Holy Ghost Summer Home Area. About 80 percent of the population grows on, or immediately adjacent to, the west-facing cutslopes along Forest Road 122 in Holy Ghost Canyon. Plant density varies from small dense patches (5 plants/m2)	The proposed uses of dicamba DGA are not expected to overlap with montane forest habitats.	US FWS. 2002. Holy Ghost Ipomopsis (Ipomopsis sancti-spiritus) Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/020926.pdf

	to single, isolated plants found greater than 50 m from others. The occupied habitat in Holy Ghost Canyon ranges in elevation from 2,350 - 2,500 m (7,730 - 8,220 ft). Holy Ghost ipomopsis occurs in the Rocky Mountain montane conifer forest plant community (Brown 1982). Commonly associated species are ponderosa pine (Pinus ponderosa), Douglas fir (Pseudotsuga menziesii), aspen (Populus tremuloides), Gambel oak (Quercus gambelii), mountain mahogany		
Houghton's goldenrod (*Solidago houghtonii*)	This plant grows on the shores of the Great Lakes, mainly Lake Huron and Lake Michigan, at the Michigan-Ontario border. (USFWS 2011)	The proposed dicamba DGA uses are not expected to overlap with shores.	2011 US FWS Houghton's Goldenrod (*Solidago houghtonii* A. Gray, Asteraceae) 5-Year Review: Summary and Evaluation
Huachuca water-umbel (*Lilaeopsis schaffneriana var. recurva*)	Cienegas (marshy wetlands) and associated vegetation within Sonoran desert scrub, grassland or oak woodland, and conifer forest	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 1997. Lilaeopsis schaffneriana ssp. recurva. http://ecos.fws.gov/docs/five_year_review/doc4435.pdf
Jones Cycladenia (*Cycladenia humilis var. jonesii*)	The species can be found in Eriogonum-Ephedra, mixed desert shrub, and scattered pinyon-juniper communities, at elevations ranging from 4,390 to 6,000 feet elevation in plant communities.	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 2008. Recover outline for the Jones Cycladenia (Cycladenia humilis var. jonesii) http://ecos.fws.gov/docs/recovery_plan/Jones%20cycladenia_123008.pdf
Kearney's blue-star (*Amsonia kearneyana*)	South Canyon in the Baboquivari Mountains, Brown Canyon, Jaguar Canyon, and Thomas Canyon. In two distinct habitats: open woodland on unconsolidated slopes of over 20 degrees, and canyon bottoms in full sun to partical shade. once thought to only occupy canyon bottoms, we now know that this is secondary habitat for the species, with most subpopulations being located	The proposed uses of dicamba DGA are not expected to overlap with woodland habitats.	US FWS. 2013. 5-Year-Review for Kearney Bluestar – 2013 http://ecos.fws.gov/docs/five_year_review/doc4261.pdf

	on steep, dry, and open woodland-dominated slopes		
Knowlton's cactus (*Pediocactus knowltonii*)	The species occurs on rolling, gravelly hills in a pinon-juniper-sagebrush community at about 1,900 meters (m) (6,200-6,300 feet (ft)).	The proposed uses of dicamba DGA are not expected to overlap with sagebrush habitats.	US FWS. 2010. Knowlton's Cactus (Pediocactus knowltonii) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc3082.pdf
Kuenzler hedgehog cactus (*Echinocereus fendleri var. kuenzleri*)	Throughout its range, pinkflower hedgehog cactus occurs in desert grasslands, honey mesquite (Prosopis glandulosa) and other desert shrubland communities, pinyon-juniper (Pinus-Juniperus spp.) woodlands dominated mostly by Colorado pinyon (P. edulis) and oneseed juniper (J. monosperma), and pine-oak (Quercus spp.) woodlands. At the Desert Laboratory in Arizona, pinkflower hedgehog cactus grows in a creosotebush/triangle bursage (Larrea tridentata/Ambrosia deltoidea) community. In a 1941 survey, pinkflower hedgehog cactus was rare in the Colorado River canyon, where it was usually found in association with Engelmann's hedgehog cactus (E. engelmannii).	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 1985. Recovery Plan for the Kuenzler's hedgehog cactus http://ecos.fws.gov/docs/recovery_plan/850328a.pdf
Ladies'-tresses, Ute (*Spiranthes diluvialis*)	Occurs in relatively low elevation riparian, spring, and lakeside wetland meadows. Endemic to mois soils in mesic or wet meadows near springs, lakes, or perrenial streams. Occur primarily in areas where the vegetation is relatively open and not overly dense or overgrown, but some populations are found in riparian woodlands. Observed to be shade-intolerant (US FWS, 1995).	The proposed dicamba DGA uses are not expected to overlap with riverine, spring, or lakeside wet meadows.	USFWS. 1995. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/950921.pdf USFWS. Species Profile Page. http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q2WA

	Occurs in relatively low elevation riparian, spring, and lakeside wetland meadows. Endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams. Occur primarily in areas where the vegetation is relatively open and not overly dense or overgrown, but some populations als found in riparian woodlands. Observed to be shade-intolerant (US FWS, Species Profile Page).		
Lee pincushion cactus (*Coryphantha sneedii var. leei*)	Chihuahuan desert scrub to conifer woodlands, rock outcrops (rarely alluvial rubble), usually narrowly confined to cracks in limestone	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 1986. Recovery Plan for the Sneed and Lee Pincushion Caciti http://ecos.fws.gov/docs/recovery_plan/860321b.pdf
Leedy's roseroot (*Rhodiola integrifolia ssp. leedyi*)	New York populations occur on cliffs along the western shore of Seneca lake. In Minnesota, populations occur on moderate cliffs, which are cooled by air exiting underground passages in the karst topography (US FWS, 1998).	The proposed dicamba DGA uses are not expected to overlap with cliffs.	USFWS. 1998. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/980925.pdf
Lewton's polygala (*Polygala lewtonii*)	This plant grows on the sandhills of Central Florida and the transition between sandhill and Florida scrub. The land is dominated by longleaf pine, turkey oak, and other oaks. It can also be found in recently cleared areas such as the dry, open clearings around power lines.	The proposed dicamba DGA uses are not expected to overlap with sandhills.	US FWS. 2010. Lewton's polygala (*Polygala lewtonii*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc3261.pdf
Mancos milk-vetch (*Astragalus humillimus*)	Semi-arid sandstone rimrock ledges and mesa tops. Usually found on large, usually flat sheets of sandstone and is clustered around bowl-like depressions on the bedrock. Also found in cracks and fissures in the	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 1989. Mancos milkvetch recovery plan http://ecos.fws.gov/docs/recovery_plan/891220.pdf

	sandstone and at the base of slickrock inclines.		
Mesa Verde cactus (*Sclerocactus mesae-verdae*)	In general, the cactus is restricted to the Mancos and Fruitland Shale Formations which have high alkalinity are gypsiferous and shrink-swell properties that make them harsh sites for plant life. The Mesa Verde cactus is most frequently found growing on the tops of hills or benches, slopes of hills and very rarely on level ground between the hills or benches.	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 1984. Mesa Verde Cactus Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840330a.pdf
Miccosukee gooseberry (*Ribes echinellum*)	Mixed mesophytic hardwoods (USFWS 2008)	The proposed dicamba DGA uses are not expected to overlap with forests.	2008 US FWS Miccosukee Gooseberry 5-Year Review
Michaux's sumac (*Rhus michauxii*)	It is endemic to the inner coastal plain and piedmont of the Carolinas, Georgia, and Florida, where it occupies sandy or rocky open woods. It appears to depend upon some form of disturbance to maintain the open quality of its habitat. (USFWS 1993)	The proposed dicamba DGA uses are not expected to overlap with sandy or rocky open woods.	1993 USFWS RECOVERY PLAN for Michaux's Sumac (*Rhus michauxii*) Sargent
Navajo sedge (*Carex specuicola*)	Endemic to Navajo nation, and is now restricted to Navajo Sandstone Formation bedrock seep-spring pockets or in hanging gardens within the Great Basin conifer woodland at an elevation of 1740m to 1824 m. May have occurred in lower riparian areas in other canyons on the Navajo Nation. Grows in variety of situations, from inaccessible sheer cliff faces to accessible alcoves. Dominant associated species include monkey flower (Mimulus eastwoodiae), helleborine (Epipactis gigantea), water bentgrass (Agrostis semiverticillata), sand bluestem (Andropogon hallii), thistle (Cirsium spp.) Foxtail barley (Hordeum	The proposed uses of dicamba DGA are not expected to overlap with hanging garden habitats.	US FWS. 1987. Navajo Sedge (Carex speculcola) Recovery Plan http://ecos.fws.gov/docs/recovery_plan/870924.pdf

	jubatum), and common reed (Phragmites communis).		
Nichol's Turk's head cactus (*Echinocactus horizonthalonius var. nicholii*)	The cactus grows in open areas and partially to shaded area s underneath the canopy of shrubs and trees, or shouldered next to rocks on steep slopes and within limestone outcrops.	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 2009. Nichol's Turk's Head Cactus (Echinocactus horizonthalonius var. nicholii) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc2509.pdf
North Park phacelia (*Phacelia formosula*)	Outcrops are rust-yellow sandstone and sandy areas along steep slopes, dissected by ravines, sparsely vegetated. More individuals are found on steep sided ravines. Other plants found in association include the genera Mentzelia, Chrysothamnus, Oryzopisis, Arenaria, Eriogonum, and Rosa	The proposed uses of dicamba DGA are not expected to overlap with steep slopes.	US FWS. 1986. North Park Phacelia (Phacelia formosula) Recovery Plan http://ecos.fws.gov/docs/recovery_plan/860321.pdf
Northeastern bulrush (*Scirpus ancistrochaetus*)	Found in ponds, wet depressions, or shallow sinkholes within small (generally less than one acre) wetland complexes. These weltands are characterized by seasonally variable water levels (p. i) In general, the northeastern bulrush tends to grow in acidic to circumneutral natural ponds, shall sinkoles, wet depressions (wet meadows and marshes) found in hilly country (p. 28). Wetlands occupied by the species in the northern part of its range do not appear to have any obvious unique habitat characteristics; indeed, many wetlands appear to have habitat suitable for the plant but do not harbor it (p. 28). Common to all of the ponds occupied by *S. ancistrochaetus*, however, are water levels that fluctuate seasonally and/or annually,	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats.	US FWS. 1993. Recovery Plan http://ecos.fws.gov/docs/recovery_plan/930825.pdf

	from inundation (in late winter and spring) to saturation (in summer and late fall) (p. 28).		
Northern wild monkshood (*Aconitum noveboracense*)	Typical habitat is shaded to partially shaded cliffs and talus slopes or in New York, also occurs in semi-shaded seepage springs at high elevation headwaters. Various bedrock types from sandstones to dolomite and others act as substrates. All habitats have a cold soil environment associated with active and continuous cold air drainage or cold ground water flowage out of the nearby bedrock. Typically cliff and talus slope populations are associated with openings or caves, often ice-filled, through which the cold air emanates (US FWS, 1983, p. 18-20).	The proposed dicamba DGA uses are not expected to overlap with cliffsides, rockfalls at cliff bases or springs associated with cold air or water.	USFWS. 1983. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/830923.pdf
Osterhout milkvetch (*Astragalus osterhoutii*)	Middle Park desert badlands surrounded by high ranges of the Rocky Mountains and characterized by open grassy vegetation with scattered shrubs of big sagebrush, rabbitbrushes, bitterbrush, horsebrush, winterfat, snowberry, and/or mountain mahogany. Osterhout milkvetch shows evidence of light grazing and can be found on old road cuts and fills, Occur within six (6) miles to the north and east of the town of Kremmling.	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 1992. 1992_USFWS_Osterhout milkvetch (Astragulus osterhoutii) and penland beardtongue (Penstemon penlandii) recovery plan http://ecos.fws.gov/docs/recovery_plan/920930c.pdf

Pagosa skyrocket (*Ipomopsis polyantha*)	Shale outcrops— The Pagosa Skyrocket is limited to the Mancos Shale	The proposed uses of dicamba DGA are not expected to overlap with shale outcrops.	US FWS. . ECOS: Pagosa skyrocket (Ipomopsis polyantha) Species Profile - Life History http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q2U7#lifeHistory
Parachute beardtongue (*Penstemon debilis*)	Steep, continually shifting surface layers of broken shale rubble, along with sparse (less than 10 percent cover) vegetation of other oil shale-specific plants on the Parachute Creek Member and Lower Part of the Green River geologic formations. Rocky Mountain Cliff and Canyon plant community.	The proposed uses of dicamba DGA are not expected to overlap with shale outcrops.	US FWS. 2013. Recovery Outline Parachute beardtongue (Penstemon debilis) http://ecos.fws.gov/docs/recovery_plan/Parachute%20Beardtongue%20Recovery%20Outline.pdf
Pecos (=puzzle, =paradox) sunflower (*Helianthus paradoxus*)	Pecos sunflower is a wetland plant that grows on wet, alkaline soils at spring seeps, wet meadows, stream courses and pond margins. It has seven widely spaced populations in west-central and eastern New Mexico and adjacent Trans-Pecos Texas. These populations are all dependent upon wetlands from natural groundwater deposits. Incompatible land uses, habitat degradation and loss, and groundwater withdrawals are historic and current threats to the survival of Pecos sunflower. (USFWS 2005)	The proposed dicamba DGA uses are not expected to overlap with wetlands.	USFWS 2005 Final Pecos Sunflower Recovery Plan Available at: http://www.fws.gov/southwest/es/documents/r2es/pecos_sunflower_final_recovery_plan.pdf
Peebles Navajo cactus (*Pediocactus peeblesianus var. peeblesianus*)	The species occurs in desert habitat and the transition to Great Basin grassland habitat.	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 2008. Peebles Navajo Cactus(Pediocactus peeblesianus var. peeblesianus) 5-Year Review:Summary and Evaluation

			http://ecos.fws.gov/docs/five_year_review/doc1960.pdf
Penland alpine fen mustard (*Eutrema penlandii*)	small calcareous wetlands, Oligotrophic rheotrophic alpine marshes	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats.	US FWS. 1993. Eutrema penlandii (Penland alpine mustard) Federal Register document http://ecos.fws.gov/docs/recovery_plan/920930c.pdf
Penland beardtongue (*Penstemon penlandii*)	Penstemon penlandii is found in co-existence with Astracialus osterhoutii and both are endemic to Middle Park, a high elevation sagebrush park at 7,500 feet, surrounded by various ranges of the Rocky Mountains, in Grand County, Colorado. It is found in badlands of Pierre Shales and of late Tertiary (Miocene Troublesome Formation) in siltstone sediments and the habitat is characterized by an open grassy vegetation with scattered shrubs of big sagebrush, rabbitbrushes, bitterbrush, horsebrush, winterfat, snowberry, and/or mountain mahogany	The proposed uses of dicamba DGA are not expected to overlap with sagebrush habitats.	US FWS. 1992. OSTERIIOUT KILKVETCH (Astra~a1us osterhoutil) PENLAND BEAROTONGUE (Penstemon Denlandil) Recovery Plan http://ecos.fws.gov/docs/recovery_plan/920930c.pdf
Peter's Mountain mallow (*Iliamna corei*)	Iliamna corei occurs in the shallow soil of the Clinch sandstone outcrops on the northwest-facing slope of Peters Mountain	The proposed uses of dicamba DGA are not expected to overlap with sandstone outcrops.	US FWS. 1990. Peters Mountain Mallow (Iliamna corei (Sherli) Sherff) RECOVERY PLAN http://ecos.fws.gov/docs/recovery_plan/900928a.pdf
Pima pineapple cactus (*Coryphantha scheeri var. robustispina*)	Desert scrubland or the ecotone between desert scrubland and desert grasslands on flat terrain.	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 2007. Pima Pineapple Cactus 5-Year Review Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1041.pdf
Roan Mountain bluet, (Hedyotis purpurea var. montana)	This species grows in shallow soils and crevices of cliffs and outcrops and on thin rocky soils of grassy balds (US FWS, 1996).	The proposed dicamba DGA uses are not expected to overlap with cliffs and outcrops.	USFWS. 1996. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/960513.pdf
Rock gnome lichen (*Gymnoderma lineare*)	Rock gnome lichen is primarily limited to vertical rock faces where seepage water from forest	The proposed dicamba DGA uses are not expected to overlap with high	http://www.fws.gov/raleigh/species/es_rock_gnome_lichen.html

	soils above flows during (and only during) very wet times. It appears the species needs a moderate amount of light, but that it cannot tolerate high-intensity solar radiation. It does well on moist, generally open, sites, with northern exposures, but needs at least partial canopy coverage where the aspect is southern or western Rock gnome lichen is known from the Southern Appalachian Mountains of North Carolina and South Carolina, Tennessee, and Georgia, in areas of high humidity, either at high elevations, where it is frequently bathed in fog, or in deep gorges at lower elevations.	elevation vertical rock faces where the species occurs.	
Running buffalo clover (*Trifolium stoloniferum*)	Running buffalo clover occurs in mesic habitats of partial to filtered sunlight, where there is a prolonged pattern of moderate periodic disturbance, such as mowing, trampling, or grazing. It is most often found in regions underlain with limestone or other calcareous bedrock. Specific habitats include mesic woodlands, savannahs, floodplains, stream banks, sandbars, grazed woodlots, mowed paths (e.g. cemeteries, parks), old logging roads, jeep trails, ATV trails, skid trails, mowed wildlife openings within mature forest, and steep ravines. It has been suggested that the original habitat may have been open woods or	The proposed dicamba DGA uses are not expected to overlap with mesic habitats where the clover is expected to be found.	USFWS. 2007. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/070627.pdf

	savannah, and bison herbivory on associated species may have kept the habitats open (US FWS, 2007, p. 12.).		
Sacramento Mountains thistle (*Cirsium vinaceum*)	Occur in wetlands, or subirrigated areas associated with springs, streams, and seeps. Most existing populations are in mixed conifer/mountain meadow settings. Riparian habitat on wet travertine deposits. It typically has meadows and streams on steep slopes with little other vegetation, including grass	The proposed uses of dicamba DGA are not expected to overlap with wetland habitats.	US FWS. 1993. Sacramento mountains thistle (Cirsium vinaceum) recovery plan. http://ecos.fws.gov/docs/recovery_plan/930927a.pdf
Sacramento prickly poppy (*Argemone pleiacantha ssp. pinnatisecta*)	Occurs in steep, rocky canyons between the pinyon/juniper zone of the Chihuahuan Desert Scrublands and Grasslands (1,310 m [4,300 ft]), and the lower edge of the ponderosa pine community of the Great Basin Conifer Woodlands (2,164 m [7,100 ft]). Habitats include arid canyon bottoms, dry terraces above riparian areas, and stream banks, as well as areas around springs and seeps. Plants grow directly in the rocks and gravel of stream beds; on vegetated bars of silt, gravel, and rock; on cut slopes; and on terraces above stream channels.	The proposed uses of dicamba DGA are not expected to overlap with canyon habitats.	US FWS. 2013. Sacramento prickly poppy 5-year review http://ecos.fws.gov/docs/five_year_review/doc4324.pdf
San Francisco Peaks ragwort (*Packera franciscana*)	Found on the talus slopes in the alpine fellfield on the San Francisco Peaks. 3,445-3,780 m. Ground surface is gravelly and existing boulders are more rounded with better lichen development that in the boulder field. Plant common in fine-medium grain soils on inclines from moderate to 60%; aspect ranged from 45-315 degrees, with largest population/greatest densities on slopes with aspects from	The proposed uses of dicamba DGA are not expected to overlap with alpine habitats.	US FWS. 1987. Recovery Plan for San Francisco Peaks Groundsel Senecio franciscanus Greene http://ecos.fws.gov/docs/recovery_plan/870721.pdf

	180-270 degrees. Vegetation here is of low stature, sparse, characterized by herbs, grasses, occasional shrubs, and at timberline by dwarf trees.		
Sandplain gerardii (*Agalinis acuta*)	Typically occurs on dry, sandy, poor-nutrient soils of sparsely vegetated sandplain environments and serpentine barrens. Lives in grassland communities.	The proposed uses of dicamba DGA are not expected to overlap with grassland habitats.	US FWS. 1989. Sandplain gerardia recovery plan http://ecos.fws.gov/docs/recovery_plan/890920.pdf
Scrub mint (*Dicerandra frutescens*)	*Dicerandra frutescens* is mostly restricted to excessively drained, yellow sandy soils of the Astatula and Paola soil types. However, it has been found on a moderately well-drained, yellow sand of the Orsino type. The plant requires periodic fire to maintain populations and populations decline in areas without fire in as little as five years. Row crop lands are expected to be maintained in a fireless state continually and it is not reasonable to assume that population of this species persist in row cropped areas.	The proposed 2,4-D choline use sites are not expected to provide appropriate fire influenced habitat.	US FWS. 2009. Scrub Mint (*Dicerandra frutescens*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc2492.pdf
Seabeach amaranth (*Amaranthus pumilus*)	Barrier island beaches of the Atlantic coast, inlets, temporary habitats, may move as areas become suitable or unsuitable habitat. Overwash flats at accreting ends of islands, lower foredunes and upper strands of noneroding beaches (landward of the wrackline). Does not occur on well-vegetated sites. (USFWS 1996)	The proposed dicamba DGA uses are not expected to overlap with beaches.	1996 Weakley, Bucher, Murdock U.S. Fish and Wildlife Service. 1996. Recovery Plan for Seabeach Amaranth.(*Amaranthuspumilius) Rafinesque)*. Atlanta, Georgia. http://ecos.fws.gov/docs/recovery_plan/961112b.pdf. 2007 USFWS Seabeach Amaranth Five-Year Review; http://ecos.fws.gov/docs/five_year_review/doc1068.pdf
Sensitive joint-vetch (*Aeschynomene virginica*)	Occurs in fresh to slightly brackish tidal river systems, within the intertidal zone where populations are flooded	The proposed dicamba DGA uses are not expected to overlap with wetlands.	1995 USFWS Sensitive joint-vetch recovery plan 2012 USFWS Sensitive joint-vetch 5-year review

	twice daily. Typically occur in the estuarine meander zone of tidal rivers where sediments transported from upriver settle out and extensive marshes form. Need disturbed/open habitats such as: accreting point bars that have not yet been colonized by perennial species, low swales within extensive marshes, areas of nutrient deficiencies in saturated organic sediments, or areas of muskrat herbivory. (USFWS 1995) Majority are found in natural tidal marsh habitats, but also a few documented cases of a pocket marsh wetland, edge of a moist soybean field, and a mowed grassy strip between a manmade drainage channel and dirt road. (USFWS 2012)		
Sentry milk-vetch (*Astragalus cremnophylax var. cremnophylax*)	Found on scarcely visible cracks in Kaibab limestone, in sand-filled hollows in rock, or on shallow gravelly soils.	The proposed uses of dicamba DGA are not expected to overlap with limestone outcrops.	US FWS. 2009. Sentry milk-vetch 5-Year Review http://ecos.fws.gov/docs/action_plans/doc3054.pdf
Shale barren rock cress (*Arabis serotina*)	This plant grows on the soils of the restricted to shale barrens and adjacent woodlands found in western Virginia and eastern West Virginia. Shale barren is a designation for a shale slope of the region with an open, scrubby growth of pine, oak, red cedar, and other woody species adapted to the xeric conditions. Amidst the woody growth, which may form a canopy cover of less than 10%, an open herbaceous cover is found with species	The proposed uses of dicamba DGA are not expected to overlap with shale barren or woodland habitats.	US FWS. 1991. SHALE BARREN ROCK (Arabis serotina) Recovery Plan http://ecos.fws.gov/docs/recovery_plan/910815.pdf

	also adapted to the harsh conditions.		
Siler pincushion cactus (*Pediocactus (=Echinocactus,=Utahia) sileri*)	Badland like rolling hills.	The proposed uses of dicamba DGA are not expected to overlap with desert habitats.	US FWS. 1986. Recovery Plan for the Pediocactus sileri http://ecos.fws.gov/docs/recovery_plan/860414b.pdf
Small-anthered bittercress (*Cardamine micranthera*)	Native to small streambank seeps, adjacent sandbars, and stream edges in the Dan River drainage of the North Carolina and Virginia piedmont. (USFWS 1991) This plant occurs in moist and wet, shady areas near streams and in dim woodlands. Small-anthered bittercress is known only from the Dan River basin in north-central North Carolina (Stokes County) and south-central Virginia (Patrick County). (USFWS 1998)	The proposed dicamba DGA uses are not expected to overlap with stream edges.	1991 USFWS Recovery Plan for the Small-anthered bittercress *Cardamine micranthera* 1998 USFWS Recovery Plan for the *Cardamine micranthera*
Small whorled pogonia (*Isotria medeoloides*)	The small whorled pogonia occurs on upland sites in mixed-deciduous or mixed deciduous/coniferous forests that are generally in second- or third-growth successional stages. It occurs on both fairly young and maturing forest stands. Most occurrences include sparse to moderate ground cover in the species' microhabitat, a relatively open understory canopy, and proximity to features that create long persisting breaks in the forest canopy. Soils at most sites are highly acidic and nutrient poor, with moderately high soil	The proposed dicamba DGA uses are not expected to overlap with mixed deciduous/coniferous forests.	USFWS. 1992. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/921113b.pdf

	moisture values. Light availability could be a limiting factor for this species. The one Illinois site is unusual in being on a dry, steep, thinly forested slope atop a vertical sandstone bluff. The one Ohio site is along the Ohio River in a typical Appalachian-type forest association (US FWS, 1992, pp. 23-24).		
Smooth coneflower (*Echinacea laevigata*)	The habitat of smooth coneflower consists of open woods, cedar barrens, roadsides, clearcuts, dry limestone bluffs, and power line rights-of-way, usually on magnesium- and calcium-rich soils associated with amphibolite, dolomite, or limestone (USFWS 2011)	The proposed dicamba DGA uses are not expected to overlap with open woods, barrens, or bluffs.	2011 USFWS Smooth Coneflower (*Echinacea laevigata*) 5-Year Review: Summary and Evaluation
Sneed pincushion cactus (*Coryphantha sneedii var. sneedii*)	The Sneed and Lee pincushion cacti grow in semi-desert grassland (Brown, 1982). The Sneed pincushion cactus is restricted to limestone and grows in cracks on vertical cliffs or ledges. The Sneed pincushion cactus grows at an elevation of 1,200-2,350 m in areas where the average precipitation varies from 19.7 to 40 cm per year. Edaphic requirements are poorly understood. (USFWS 1986)	The proposed dicamba DGA uses are not expected to overlap with semi-desert grasslands.	1986 USFWS Recovery Plan for the Sneed and Lee Pincushion Cacti. Pages 8-9. Available at: http://ecos.fws.gov/docs/recovery_plan/860321b.pdf
Swamp pink (*Helonias bullata*)	Swamp pink is found in a variety of wetland habitats, including swampy forested wetlands bordering small streams; headwater wetlands; sphagnous, hummocky, dense Atlantic white cedar swamps; Blue Ridge swamps; meadows; bogs;	The proposed dicamba DGA uses are not expected to overlap with wetlands.	1991 USFWS Swamp Pink (*Helonias bullata*) Recovery Plan Available at: http://ecos.fws.gov/docs/recovery_plan/910930c.pdf

	and spring seepage areas (USFWS 1991)		
Todsen's pennyroyal *(Hedeoma todsenii)*	Todsen's pennyroyal occurs in the Great Basin Conifer Woodland community where piñon pine (Pinus edulis) and one seed juniper (Juniperus monosperma) are the dominant species (Brown and Lowe 1980). Besides piñon and juniper, other common associates with Todsen's pennyroyal include mountain mahogany (Cercocarpus montanus), yellowleaf sil ktassel (Garrya flavescens), wavyleaf oak (Quercus undu/ata), white ragweed (Hymenopappus radiatus), snakeweed (Gutierrezia sp.), and muhly grass (Muhienbergia sp.). Todsen's pennyroyal does not appear to associate consistently with any particular species. It grows (and flowers) in the shade of piñon pines and junipers, and in woodland openings with thin grasses (mostly Muhienbergia sp.). At some sites, it is absent from thickets of wavyleaf oak; at other sites, flowering plants are under wavyleaf oak and other shrubs (The Nature Conservancy, New Mexico Field Office 1 990; Sarah Wood, pers. comm. 1993). Todsen's pennyroyal is restricted to loose, gypseous-Plants grow in loose limestone substrates associated with or positioned gypseous-limestone immediately below the Permian Yeso Formation soils on north-facing (NMFRCD 1991) Most plants are on steep (20 70 slopes degree), north-facing slopes, with a surface of scree or	The proposed uses of dicamba DGA are not expected to overlap with woodland habitats.	US FWS. 2001. Todsen's Pennyroyal Recovery Plan - 2001 http://ecos.fws.gov/docs/recovery_plan/010131.pdf

	gravelly cobble; however, some plants at Mountain Lion Peak are on small, nearly level terraces along intermittent streams. The substrates have a thin layer of conifer litter over a mixture of limestone and finer materials.		
Virginia round-leaf birch (*Betula uber*)	Transitional between the oak-pine and maple-beech-birch associations, with some tendencies toward the elm-ash-cottonwood association because of the riparian setting. Disturbance and moderate levels of incoming solar radiation associated with seedling establishment	The proposed uses of dicamba DGA are not expected to overlap with forest habitats.	US FWS. 1990. 1990_USFWS_Virginia round-leaf birch (Betula uber) recovery plan http://ecos.fws.gov/docs/recovery_plan/900924a.pdf
Virginia sneezeweed (*Helenium virginicum*)	Seasonal wetlands, sink hole ponds varying from forest settings to farm pond margins.	The proposed dicamba DGA uses are not expected to overlap sink hole ponds and seasonal wetlands.	http://ecos.fws.gov/docs/recovery_plan/001002.pdf
Spiraea, Virginia (*Spiraea virginiana*)	*Spiraea virginiana* is found along the banks of high gradient sections of second and third order streams, or on meander scrolls and point bars, natural levees, and other braided features of lower reaches (often near the stream mouth). The habitat is in oft-disturbed early successional areas. Occasional flood scouring reduces shading and seems to be essential, although the spiraea can tolerate some overstory growth (US FWS, 1992, pp.17-18.).	The proposed dicamba DGA uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1992. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/921113a.pdf
Welsh's milkweed (*Asclepias welshii*)	Aeolian sand dunes in a plant community dominated by sand mulesears with prominent groves of ponderosa pine and clumps of Gambel oak. Vegetation surrounding the sand dune habitat is dominated by	The proposed uses of dicamba DGA are not expected to overlap with woodland or sagebrush habitats.	US FWS. 1992. Welsh's Milkweed (Asclepias welshii) Recovery Plan http://ecos.fws.gov/docs/recovery_plan/920930a.pdf

	pinyon-juniper woodlands with sagebrush.		
Zuni fleabane (*Erigeron rhizomatus*)	Found on red detrital clay with steep easily erodable slopes that do not crust over. Associated with pinyon-juniper woodland. Prefers slopes of up to 40 degrtees, usually with a north-facing aspect, but it also occurs on eastern and western exposures. It never occurs on slopes with a southern aspect.	The proposed uses of dicamba DGA are not expected to overlap with woodland habitats.	US FWS. 1988. Zuni fleabane recovery plan http://ecos.fws.gov/docs/recovery_plan/880930.pdf
Aboriginal Prickly-apple (*Harrisia aboriginum*)	This cactus occurs in Florida in coastal strand vegetation (relatively low salt-tolerant shrubs and grasses), tropical coastal hammocks with trees including gumbo limbo (*Bursera simaruba*), wild lime (*Zanthoxylum fagara*), or live oak (*Quercus virginiana*). Populations are likely to be on shell mounds created by pre-European local residents, or at least on sites with shelly substrates. Plants may be quite close to the mangrove zone	The proposed uses of dicamba DGA are not expected to overlap with habitats on shelly substrates or vegetation that is at all salt-tolerant.	US FWS. Species life history page. http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q0DR
Apalachicola rosemary (*Conradina glabra*)	Xeric longleaf pine communities; prefers sunny or lightly shaded areas. Edges of steephead ravines, upland pine-wiregrass vegetation, also found in right-of-ways, edges of roads in pine plantations	The proposed uses of dicamba DGA are not expected to overlap with woody habitats.	US FWS. 2009. *Conradina glabra* (Apalachicola rosemary) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc2421.pdf
Avon Park harebells (*Crotalaria avonensis*)	Sparsely vegetated, xeric white sand scrub. Prefers (but does not require) open scrub, with less vegetation cover and more bare sand.	The proposed uses of dicamba DGA are not expected to overlap with scrubland habitats or areas of bare sand.	Avon Park harebells (*Crotalaria avonensis*) 5-Year Review: Summary and Evaluation US FWS. 2007. http://ecos.fws.gov/docs/five_year_review/doc1067.pdf
Beach jacquemontii (*Jacquemontia reclinata*)	Jacquemontia reclinata requires open areas that are typically found on the crest and lee sides of stable dunes (Austin 1979), and may also invade and restabilize maritime hammock or coastal strand communities that have been disturbed by tropical storms, hurricanes, and	The proposed uses of dicamba DGA are not expected to overlap with sand dune or maritime habitats.	US FWS. 1999. South Florida Field Office Multi-Species Recovery Plan http://ecos.fws.gov/docs/recovery_plan/140903.pdf

	possibly fire. Common vegetative associates found with *J. reclinata* include sea grape (*Coccoloba uvifera*), cabbage palm (*Sabal palmetto*), poisonwood (*Metopium toxiferum*), Madagascar periwinkle (*Catharanthus roseus*), Croton involucrata, gopher apple (*Licania michauxii*), prickly pear cactus (*Opuntia* sp.), sandspurs (*Cenchrus* spp.), sea oats (*Uniola paniculata)* and other shrubs and dwarfed trees. It is also an inhabitant of disturbed or sunny areas In the tropical maritime hammock (hardwood forest) or the coastal strand vegetation, typically with sea grape (Coccoloba uvifera) and other shrubs and dwarfed trees. It usually occurs with more or less weedy plants such as Madagascar periwinkle (*Catharanthus roseus*) and sand spurs (*Cenchrus* spp.). It occasionally occurs in the beach dune community with sea oats (*Uniola paniculata*).		
Beautiful pawpaw (*Deeringothamnus pulchellus*)	Pristine and modified pine flatwoods, roadsides, and mowed areas	The proposed uses of dicamba DGA are not expected to overlap with woodland habitats or roadsides and mowed areas.	US FWS. 2009. Beautiful pawpaw (*Deeringothamnus pulchellus*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc2588.pdf
Britton's beargrass (*Nolina brittoniana*)	Occurs in scrub, high pineland, and even occasionally in hammocks.	The proposed uses of dicamba DGA are not expected to overlap with scrubland or woodland habitats.	US FWS. 1996. Recovery Plan for Nineteen Central Florida Scrub and High Pineland Plants (revised) (960622) http://ecos.fws.gov/docs/recovery_plan/960622.pdf
Brooksville bellflower (*Campanula robinsiae*)	Deciduous forest: Occurs on pond margins, wet prairies, and seepage areas in adjacent hardwood forests, Also along the margins of marshes. Important characteristic is	The proposed uses of dicamba DGA are not expected to overlap with forested or wetland habitats	US FWS. 1994. Recovery plan Brooksville bellflower (*Campanula robinsiae*) and Cooley's water willow (*Justicia cooleyi*).

	that the water line fluctuates. Often the Brooksville bellflower's habitat is surrounded by pastures		http://ecos.fws.gov/docs/recovery_plan/940620b.pdf
Cape Sable Thoroughwort (*Chromolaena frustrata*)	Grows in open canopy habitats in coastal berms and coastal rock barrens, and in semi-open to closed canopy habitats, including buttonwood forests, coastal hardwood hammocks, and rockland hammocks. *C. frustrata* is often found in the shade of associated canopy and subcanopy plant species	The proposed uses of dicamba DGA are not expected to overlap with coastal or woodland habitats	US FWS. 2014. Designation of Critical Habitat for *Chromolaena frustrata* (Cape Sable Thoroughwort); Final Rule http://www.gpo.gov/fdsys/pkg/FR-2014-01-08/pdf/2013-31576.pdf
Carter's mustard (*Warea carteri*)	Found almost exclusively in upland areas. It is found primarily in sandhills and scrubby flatwoods, and often at the ecotone between these two vegetation types. In the northern part of its range, most sites are on sandhill. Near the south end of its range (e.g., ABS), Carter's mustard is found primarily in scrubby flatwoods. Also grows along sandy trails and roadsides.	The proposed uses of dicamba DGA are not expected to overlap with sandhills or flatwoods habitats.	US FWS 2008. Carter's mustard (*Warea carteri*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1977.pdf
Chapman rhododendron (*Rhododendron chapmanii*)	Transitional area between upland mesic or scrubby flatwoods and floodplain swamps or baygalls. Also found in mesic pine flatwoods or on the lower elevations of sandhills. Fire dependent community. Camp Blanding population grows on the edge of a xeric hammock next to a stream bank. The Camp Blanding sites are dominated by sand live oak (*Quercus germinata*), laural oak (*Q. hemisphaerica*), and water oak (*Q. nigra*). Gulf and Liberty/Gadsden populations are dominated by wiregrass, longleaf pine and/or slash pine.	The proposed uses of dicamba DGA are not expected to overlap with wetland or woodland habitats and are not expected to be associated with frequent fires.	US FWS. 2010. Chapman's Rhododendron (*Rhododendron minus var. chapmanii*) 5 year Review: Summary and Evaluation. http://ecos.fws.gov/docs/five_year_review/doc3201.pdf

Cooley's water-willow (*Justicia cooleyi*)	Hardwood forests and hardwood pine forests. Also found along roadways among species of various grasses and herbs.	The proposed uses of dicamba DGA are not expected to overlap with forested habitats or along roadways.	US FWS. 1994. Brooksville bellflower and Cooley's water-will recovery plan. http://ecos.fws.gov/docs/recovery_plan/940620b.pdf
Crenulate lead-plant (*Amorpha crenulata*)	Historically, this species occupied the ecotone between wet prairie and pine rockland, but wet prairie habitat no longer exists in the sites containing the two largest natural populations, and pine rockland is rare. Prefers open sun to partial shade sites.	The proposed uses of dicamba DGA are not expected to overlap with wetland, forested or rockland habitats.	US FWS. 2007. Crenulate lead-plant (*Amorpha crenulata*) 5-Year Review: Summary and Evaluation. http://ecos.fws.gov/docs/five_year_review/doc1111.pdf
Deltoid spurge (*Chamaesyce deltoidea* ssp. *deltoidea*)	Pine rocklands of Miami Rock Ridge. Open shrub canopy, exposed limestone, and minimal litter	The proposed uses of dicamba DGA are not expected to overlap with wooded habitats and exposed soils.	US FWS. 2010. Deltoid Spurge (*Chamaesyce deltoidea* ssp. *deltoidea*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc3243.pdf
Etonia rosemary (*Conradina etonia*)	Deep white sand scrub with shrubby evergreen oaks and sand pines; occur in natural openings/disturbed areas	The proposed uses of dicamba DGA are not expected to overlap with scrubland wooded habitats	US FWS. 1994. Etonia rosemary recovery plan http://ecos.fws.gov/docs/recovery_plan/940927c.pdf
Florida bonamia (*Bonamia grandiflora*)	Occurs mainly in scrub, but occasionally occurs in high pinelands in the Ocala National Forest (pg 14); In Ocala National Forest, the bonamia has been observed in the following stand condition classes of sand pine: regeneration, seedling and sapling, immature poletimber, mature poletimber (pg 15).	The proposed uses of dicamba DGA are not expected to overlap with scrubland or wooded habitats.	US FWS. 1996. Recovery Plan for Nineteen Central Florida Scrub and High Pineland Plants (revised) (960622) http://ecos.fws.gov/docs/recovery_plan/960622.pdf
Florida golden aster (*Chrysopsis floridana*)	Prefers open, sandy areas within the sand pine scrub community. They have been found growing in the ecotone between scrub and other communities. Historically, *C. floridana* was known to occur in scrub habitat on coastal dunes, and was reintroduced to this habitat type at Fort Desoto County Park.	The proposed uses of dicamba DGA are not expected to overlap with scrubland or wooded habitats.	US FWS. 2009. Florida Golden-aster 5-year review http://ecos.fws.gov/docs/five_year_review/doc2411.pdf

Florida perforate cladonia (*Cladonia perforata*)	This lichen occurs on a barrier island in the Florida panhandle (Okaloosa County) and in scrub vegetation	The proposed uses of dicamba DGA are not expected to overlap with barrier island or scrubland habitats.	US FWS. 1999. South Florida Multi-Species Recovery Plan (68 spp.) http://ecos.fws.gov/docs/recovery_plan/140903.pdf
Florida Semaphore Cactus (*Consolea corallicola*)	Occurs on **r**ockland hammocks; coastal berm, and buttonwood forests. *Consolea corallicola* also occurs on sandy soils and limestone rockland soils with little organic matter and seems to prefer areas where canopy cover and sun exposure are moderate.	The proposed uses of dicamba DGA are not expected to overlap with rocky, coastal or wooded habitats.	US FWS. 2013. Determination of Endangered Status for *Chromolaena frustrata* (Cape Sable Thoroughwort), *Consolea corallicola* (Florida Semaphore Cactus), and *Harrisia aboriginum* (Aboriginal Prickly-Apple); Final Rule http://www.gpo.gov/fdsys/pkg/FR-2013-10-24/pdf/2013-24177.pdf
Florida skullcap (*Scutellaria floridana*)	The primary habitat of Florida skullcap is wet longleaf pine flatwoods and wet prairie, within the grassy seepage bog communities at the edge of forested or shrubby wetlands, a habitat defined as a fire-dependent community. It is also found in the ecotones between mesic flatwoods and swamps sites or grassy margins of wetland habitats, and somewhat disturbed wetland savanna. Florida skullcap can be found growing in full sun or light shade.	The proposed uses of dicamba DGA are not expected to overlap with wetland or forested habitats or in areas with frequent fire disturbance.	US FWS. 2009. Scutellaria floridana (*Florida skullcap)* 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc2416.pdf
Florida torreya (*Torreya taxifolia*)	The Florida torreya is a dioecious coniferous tree found in the slope forest (FNAI 2010) that cover hammocks, steep, deeply shaded limestone slopes and wooded ravines along the east side of the Apalachicola River in Florida (Fig. 1), and adjacent Lake Seminole in Georgia. Soils in these areas are within the orders Alfisols and Mollisols. (USFWS 2010)	The proposed dicamba DGA uses are not expected to overlap with forests.	USFWS 2010. Torreya taxifolia (*Florida torreya*) 5-Year Review. Page 13. Available at: http://ecos.fws.gov/docs/five_year_review/doc3258.pdf
Florida ziziphus	Seems to prefer high pine habitats or the transition zone	The proposed uses of dicamba DGA are not	US FWS. 2009. Florida Ziziphus

(*Ziziphus celata*)	between scrubby flatwoods and high pine. In general habitat characterization for this particular species is extremely complexed. Many of the known sites are in pasture and one site in particular is identified as a Remnant Sandhill. Another site in particular is described as open Oak Hickory, yellow sand scrub.	expected to overlap with wooded habitats.	(*Ziziphus celata*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc2587.pdf
Four-petal pawpaw (*Asimina tetramera*)	Found on sand pine scrub vegetation on old, coastal dunes 1979). The species grows in excessively-drained, quartz sand of both the Paola and the St. Lucie soil series showing a preference for the Paola soils. *Asimina tetramera* is found in various seral stages of sand pine scrub, ranging from open [no canopy] to mature [closed canopy] and is adapted to infrequent, intense fires, perhaps every 20 to 80 years.	The proposed uses of dicamba DGA are not expected to overlap with scrubland or wooded habitats.	US FWS. 1999. South Florida Multi-Species Recovery Plan (68 spp.) http://ecos.fws.gov/docs/recovery_plan/sfl_msrp/SFL_MSRP_Species.pdf
Fragrant prickly-apple (*Cereus eriophorus* var. *fragrans*)	The plant's favored natural habitat is mostly coastal hammocks with some shade, as the cactus can become desiccated in full sun. Coastal hammocks of this kind have become uncommon as they have been cleared for development and heavily fragmented	The proposed uses of dicamba DGA are not expected to overlap with coastal habitats with shade.	US FWS. 2010. Fragrant prickly-apple (*Cereus eriophorus* var. *fragrans*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc3246.pdf
Garber's spurge (*Chamaesyce garberi*)	Garber's spurge occurs at low elevations either on thin sandy soils composed largely of Pamlico sands or directly on limestone. It is found in a variety of open to moderately shaded habitat types. In pine rocklands, it grows out of crevices in oolitic limestone. On Cape Sable, Everglades NP, it has been reported from hammock edges, open grassy prairies, and backdune swales. In the Florida Keys, it grows on semi-exposed limestone shores, open calcareous salt flats, pine rocklands, calcareous sands	The proposed dicamba DGA uses are not expected to overlap with pine rocklands, limestone crevices, the Everglades National Park, and the Florida Keys.	US FWS. 1999. South Florida Multi-Species Recovery Plan (68 spp.) http://ecos.fws.gov/docs/recovery_plan/140903.pdf

	of beach ridges, and along disturbed roadsides.		
Garrett's mint (*Dicerandra christmanii*)	*Dicerandra christmanii* is found within openings in sclerophyllous oak scrub. As a gap species, it prefers open areas and does not grow vigorously when in shaded conditions. The habitat is yellow-sand Florida scrub dominated by sand pines (*Pinus clausa*), several species of oak, and scrub hickory.	The proposed dicamba DGA uses are not expected to overlap with oak scrub, sand pines, and scrub hickory.	US FWS 2009. Garrett's Mint (*Dicerandra christmanii*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc2545.pdf
Godfrey's butterwort (*Pinguicula ionantha*)	Occurs in herb bog habitats embedded in longleaf pine savannas. Specifically, it is found between a lower elevation habitat dominated by pond cypress overstory and a slightly higher elevation pine flatwoods dominated by an overstory of longleaf pine. This species inhabits seepage bogs, deep swampy bogs, ditches, and depressions in grassy pine flatwoods and savannas (p. 11).	The proposed dicamba DGA uses are not expected to overlap with longleaf pine savannas.	US FWS. 2009. *Pinguicula ionantha* Godfrey's butterwort 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc2590.pdf
Harper's beauty (*Harperocallis flava*)	Gentle slopes, seepage savannas between pinelands, and cypress swamps to open roadside depressions. Observed in pine flatwoods bog areas surrounded with titi (*Cyrilla racemiflora*), wiregrass (*Aristida stricta*), and slash pine (Pinus elliottii), along roadsides, in damp roadside ditches adjacent to planted pines near flatwoods. Wet prairie in transitions to wetter shrub zones and roadside ditches. Wet prairie is characterized as a treeless plain with sparse to dense ground cover of grasses and herbs, dominated by wiregrass in the Apalachicola NF; low relatively flat poorly drained terrain of the coastal plain, seasonally innundated for 50-100 days each years, burns every 2-4 years. Fire prone habitat.	The proposed uses of dicamba DGA are not expected to overlap with savannas and pine flatwoods bog areas.	US FWS. 2009. *Harperocallis flava* Harper's beauty 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc2579.pdf

Highlands scrub hypericum (*Hypericum cumulicola*)	Highlands scrub hypericutn is found almost exclusively in upland areas with excessively-drained white sand. It is found primarily in rosemary scrub but also in xeric scrubby flatwoods. These areas have fire return intervals of 5-30 years or 10-100 years. The species is not found in all areas of suitable habitat probably because of dispersal limitations.	The proposed dicamba DGA uses are not expected to overlap with white sand areas.	US FWS 2008. beauty Highlands scrub hypericum (*Hypericum cumulicola*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1959.pdf
Johnson's seagrass (*Halophila johnsonii*)	Estuarine/Marine Submerged Environments. Lagoons along approximately 200 km of coastline in southeastern Florida between Sebastian Inlet and north Biscayne Bay. Extending from intertidal to 3m of depth	The proposed dicamba DGA uses are not expected to overlap with lagoons and other aquatic habitats.	US FWS. 2002. Endangered and Threatened Species; Notice of Availability for the Final Recovery Plan for Johnson's Seagrass http://ecos.fws.gov/docs/federal_register/fr3965.pdf
Key tree cactus (*Pilosocereus robinii*)	This cactus grows in upland tropical hardwood hammocks on limestone or coral substrates. It sometimes grows on sparsely vegetated coral rock and just above the high tide mark.	The proposed dicamba DGA uses are not expected to overlap with upland tropical hardwood hammocks on limestone or coral substrates.	US FWS. 2010. Key tree-cactus (*Pilosocereus robinii*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc3278.pdf
Knieskern's Beaked-rush (*Rhynchospora knieskernii*)	Occurs in groundwater-influenced, fluctuating, successional habitats. Found on bare substrates with sparse vegetation. Requires disturbance and is an early successional species. Historical records indicate species occupied wet open areas in fire-dependent pitch pine forests. Species is now found in human-influenced sites such as the edges of abandoned clay, sand, and gravel pits; borrow pits that are functioning as vernal pools; ditches; unimproved roads; cranberry bogs; and railroad and powerline rights-of-way	The proposed dicamba DGA uses are not expected to overlap with the edges of abandoned clay, sand, and gravel pits; borrow pits that are functioning as vernal pools; ditches; unimproved roads; cranberry bogs; and railroad and powerline rights-of-way.	US FWS. 1993. Knieskern's Beaked-rush (Ii) Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/930929b.pdf
Lakela's mint (*Dicerandra immaculata*)	*Dicerandra immaculata* is found in open scrub, sand pine scrub, and sandhills on remnants of old coastal dunes.	The proposed uses of dicamba DGA are not expected to overlap with scrub and sandhills habitats.	US FWS. 2008. Lakela's mint (*Dicerandra immaculata*) 5-Year Review: Summary and Evaluation

			http://ecos.fws.gov/docs/five_year_review/doc1984.pdf
Longspurred mint (*Dicerandra cornutissima*)	Endemic to sand pine scrub habitat of Florida. Occurs southwest of Ocala in the Sumter Upland in Marion County along and west of Interstate Highway 75 and formerly in northern Sumter County. The longspurred mint prefers sunny spots with bare sand. The plant is restricted to the margins of scrub vegetation that occurs in patches surrounded by long leaf pine-turkey oak sandhill vegetation	The proposed dicamba DGA uses are not expected to overlap with sand pine scrub habitat.	US FWS. 1987. Recovery Plan for Three Florida Mints. http://ecos.fws.gov/docs/recovery_plan/060313d.pdf
Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*)	Lake Okeechobee and the other along the St. Johns River. Limited to areas along the shoreline and a few islands in the lake and along the St. Johns River	The proposed dicamba DGA uses are not expected to overlap with lakes and rivers.	US FWS. 2009. Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc2583.pdf
Papery whitlow-wort (*Paronychia chartacea*)	Rosemary scrub, or the rosemary phase of sand pine scrub. The fire cycle in rosemary scrub can range from 10 to as long as 100 years The shrub matrix is interspersed with open sandy areas that contain a cover of herbs and lichens. These gaps are more persistent in rosemary scrubs than in scrubby flatwoods. Within these scrub communities, papery whitlow-wort is more abundant in disturbed, sandy habitats such as road rights-of-way and recently cleared high Pine. In rosemary scrub paper whitlow-wort can become very abundant after a fire or on disturbed sites such as along fire lanes or trails. The subspecies *P. chartacea* ssp. *minima* occurs in the Florida panhandle in coarse white sand along margins of	The proposed uses of dicamba DGA are not expected to overlap with rosemary scrub or sand pine scrub.	US FWS. 1999. Multi-Species Recovery Plan for South Florida http://ecos.fws.gov/docs/recovery_plan/sfl_msrp/SFL_MSRP_Species.pdf.

	karst lakes (Anderson 1991). It is apparently favored by mild disturbance. It often occurs in nearly pure stands.		
Pigeon wings (*Clitoria fragrans*)	Range of xeric upland sites. Primarily in sandhill and oak-hickory scrub or oak scrub.	The proposed dicamba DGA uses are not expected to overlap with sandhill or scrub habitats.	US FWS. 2008. Pigeon wings (*Clitoria fragrans*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1976.pdf
Pygmy fringe-tree (*Chionanthus pygmaeus*)	Inhabits excessively drained sandy soils on the Lake Wales Ridge (and historically on the Mount Dora Range) of central Florida. These high ridges are blanketed with soils that are classified as Quartzipsamments. This species is found on the low-nutrient St. Lucie fine sand which is subject to rapid drying. Chionanthus pygmaeus occurs primarily in scrub as well as high pine, dry hammocks, and transitional habitats. It may form thickets along with evergreen oaks and other shrubs It may be the dominant plant, co-dominant plant or subdominant plant.	The proposed dicamba DGA uses are not expected to overlap with scrub and hammocks.	US FWS. 1999. Multi-Species Recovery Plan for South Florida http://ecos.fws.gov/docs/recovery_plan/sfl_msrp/SFL_MSRP_Species.pdf
Rugel's pawpaw (*Deeringothamnus rugelii*)	Grassy flatlands/mesic/wet flatwoods at Volusia County conservation land. The habitat at this site is dominated by mature longleaf pine and an intact groundcover, which frequently includes wiregrass in abundance. Open sandy patches that have been controlled under natural situations with fire. Fire is needed to create habitat for this species. Slash pine flatwoods with an understory consisting of grasses and sedges	The proposed dicamba DGA uses are not expected to overlap with flatwoods habitats.	US FWS. 2008. Rugel's pawpaw (*Deeringothamnus rugelii*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1990.pdf
Sandlace (*Polygonella myriophylla*)	This plant is a member of the Florida scrub plant community. It occurs in dry white-sand scrub dominated by Florida rosemary, as well as oak scrub, flatwoods,	The proposed dicamba DGA uses are not expected to overlap with scrub communities	US FWS. 2010. Sandlace (*Polygonella myriophylla*) 5-Year Review: Summary and Evaluation.

	roadsides, and occasionally sandhills		http://ecos.fws.gov/docs/five_year_review/doc3277.pdf
Scrub blazingstar (*Liatris ohlingerae*)	Occurs in rosemary scrub or 'rosemary balds' as they are also known, is a unique community type within the Florida scrub ecosystem. Rosemary scrub is largely dominated by Florida rosemary (*Ceratiola ericoides*) and has extremely well-drained, droughty, low-nutrient sandy soils. Rosemary scrub appears as small 'islands' separated from each other, often by considerable distances. Scrubby flatwoods often surround rosemary scrub, dominated by clonal oaks (*Quercus* spp.). Also colonizes anthropogenic sites within its natural habitat, such as fire lanes and roadsides. Occurrences of scrub blazingstar are generally small, with scattered plants at low densities over large areas.	The proposed dicamba DGA uses are not expected to overlap with rosemary scrub or rosemary balds habitat.	US FWS. 2010. Scrub Blazingstar (*Liatris ohlingerae*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc3269.pdf
Scrub buckwheat (*Eriogonum longifolium* var. *gnaphalifolium*)	Scrub buckwheat occurs in habitats intermediate between scrub and sandhills (high pine) and in turkey oak barrens from Putnam County to Highlands County).	The proposed dicamba DGA uses are not expected to overlap with scrub and sandhills habitat.	US FWS. 2010. Scrub buckwheat (*Eriogonum longifolium* var. *gnaphalifolium*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1926.pdf
Scrub lupine (*Lupinus aridorum*)	Coastal scrub habitat in two distinct areas: Western Orange County (Orlando area) and North-central Polk County on the Winter Haven Ridge near Auburndale and Winter Haven, on sites that total only about 540 acres.	The proposed dicamba DGA uses are not expected to overlap with coastal scrub habitat.	US FWS. 1996. Recovery Plan for Nineteen Florida Scrub and High Pineland Plant Species. http://ecos.fws.gov/docs/recovery_plan/960622.pdf
Scrub plum (*Prunus geniculata*)	Found in both scrub and high pineland. It should probably be sought in ecotones or scrubby high pineland. (pg. 33)	The proposed dicamba DGA uses are not expected to overlap with scrub and high pineland.	US FWS. 1996. Recovery Plan for Nineteen Florida Scrub and High Pineland Plant Species. http://ecos.fws.gov/docs/recovery_plan/960622.pdf

Short-leaved rosemary (*Conradina brevifolia*)	This plant grows in Florida scrub habitat on white sand substrates among sand pines and oaks.	The proposed dicamba DGA uses are not expected to overlap with scrub habitat.	US FWS. 2008. Short-leaved rosemary (*Conradina brevifolia*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1943.pdf
Small's milkpea (*Galactia smallii*)	Pine Rockland habitat. Small's milkpea prefers open sun and little shade and can be threatened by shading from hardwoods and displacement by invasive exotic species in the absence of periodic fires. Disturbance, such as prescribed fire, is a necessary management tool to maintain suitable habitat for the species	The proposed dicamba DGA uses are not expected to overlap with pine rockland habitat.	US FWS. 2010. Small's Milkpea (*Galactia smallii*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc3257.pdf
Snakeroot (*Eryngium cuneifolium*)	Open sand gaps in white sand scrub, primarily Florida rosemary scrub 'balds', characterized by xeric conditions, relatively sparse vegetation, persistent gaps, and longer fire-return intervals than oak (Quercus spp.) and sand pine (Pinus clausa) dominated scrubs (pg. 6); restricted to open areas of well-drained white sand in Florida rosemary scrub that is very xeric with persistent gaps and longer fire-return intervals than other types of scrub (pg. 11)	The proposed dicamba DGA uses are not expected to overlap with scrub habitats.	US FWS. 2010. Snakeroot (*Eryngium cuneifolium*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc3248.pdf
Telephus spurge (*Euphorbia telephioides*)	Xeric to mesic pine flatwoods and in scrubby pinewoods. Occasionally found in wetlands with seepage slope species and in small clumps of wiregrass surrounded by cyprus or pine.	The proposed dicamba DGA uses are not expected to overlap with woods or wetlands.	US. FWS. 2008. Euphorbia telephioides (*Telephus spurge*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1884.pdf
Tiny polygala (*Polygala smallii*)	Occurs in four distinct habitats with similar characteristics: pine rockland, scrub, high pine, and open coastal spoil which are pyrogenic-extremely dry and prone to periodic natural fire.	The proposed dicamba DGA uses are not expected to overlap with pine rockland, scrub, high pine, and open coastal spoil.	US FWS. 1999. Multi-Species Recovery Plan for South Florida http://ecos.fws.gov/docs/recovery_plan/sfl_msrp/SFL_MSRP_Species.pdf
White birds-in-a-nest (*Macbridea alba*)	In general, plants are found in mesic pine flatwoods, wet savannas, seepage slopes, and ecotones between pine flatwoods and titi-swamps. The wettest sites occupied by	The proposed dicamba DGA salt uses are not expected to overlap with mesic pine flatwoods, wet	US FWS. 2009. *Macbridea alba* (White birds-in-a-nest) 5-Year Review: Summary and Evaluation

	these plants are grassy seepage bogs on gentle slopes at the edge of forested or shrubby wetlands. White birds-in-a-nest also occurs in drier sites along longleaf pine and runner oaks, as well as along associated roadsides.	savannas and seepage slopes.	http://ecos.fws.gov/docs/five_year_review/doc2371.pdf
Wide-leaf warea (*Warea amplexifolia*)	Endemic to the high pine (or sandhill) habitat of Lake Wales Ridge in Lake, Polk, Osceola, and Orange County, Fl. This habitat has a relatively high diversity of herbaceous ground cover maintained by patchy summer fires sparked by lightning. It grows well in open, sandy patches and does not tolerate shading by dense shrubs or trees.	The proposed dicamba DGA uses are not expected to overlap with pine habitat.	US FWS. 2007. Wide-leaf warea (*Warea amplexifolia*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc1096.pdf
Wireweed (*Polygonella basiramia*)	It occurs in scrub dominated by Florida rosemary, sand pine, other pines, and oaks. The plant occurs in openings in the scrub which are maintained by periodic wildfires. Other plants in this habitat include *Calamintha ashei*, *Cnidoscolus stimulosus, Eryngium cuneifolium*, *Euphorbia floridana, Hypericum cumulicola*, *Lechea cernua, Licania michauxii, Paronychia chartacea, Polanisia tenuifolia, Polygonella polygama, Selagniella arenicola*, and *Stipulicida setacea*	The proposed dicamba DGA uses are not expected to overlap with scrub habitat.	US FWS. 2010. Wireweed (*Polygonella basiramia*) 5-Year Review: Summary and Evaluation http://ecos.fws.gov/docs/five_year_review/doc3280.pdf

Appendix 3

Critical Habitat Designations and PCE Descriptions

Summary of 14 Listed Species Identified as being on Agricultural Fields with and without Critical Habitat Designations for the 11 States (AZ, CO, DE, FL, MD, NM, NJ, NY, PA, VA, WV) Assessed for Dicamba DGA salt

Species Name	Primary Constituent Elements (PCE)	Source
	Species with Critical Habitat Designations (6 Species)[3]	
California condor (*Gymnogyps californianus*)	PCEs: The following areas of land, water and airspace with spatial bounds described in the critical habitat source documentation: Sespe-Piru Condor Area, Matilllja Condor Area, Sisquoc-San Rafael Condor Area, Mountain-Beartrap Condor Area, Mt. Pinos Condor Area, Blue Ridge Condor Area, Tejon Ranch, Kern County rangelands and Tulare County rangelands.	http://ecos.fws.gov/docs/federal_register/fr161.pdf
Gray wolf (*Canis lupis*)	PCE: Not specified.	http://ecos.fws.gov/docs/federal_register/fr186.pdf
Indiana bat (*Myotis sodalis)*	Critical habitat designations are either mines or caves.	http://ecos.fws.gov/docs/federal_register/fr161.pdf
Jaguar *(Panthera onca)*	PCEs: Expansive open spaces in the southwestern United States of at least 100 km2 (38.6 mi2) in size which: (1) Provide connectivity to Mexico; (2) Contain adequate levels of native prey species, including deer and javelina, as well as medium-sized prey such as coatis, skunks, raccoons, or jackrabbits; (3) Include surface water sources available within 20 km (12.4 mi) of each other; (4) Contain from greater than 1 to 50 percent canopy cover within Madrean evergreen woodland, generally recognized by a mixture of oak (*Quercus* spp.), juniper (*Juniperus* spp.), and pine (*Pinus* spp.) trees on the landscape, or semidesert grassland vegetation communities, usually characterized by *Pleuraphis mutica* (tobosagrass) or *Bouteloua eriopoda* (black grama) along with other grasses; (5) Are characterized by intermediately, moderately, or highly rugged terrain; (6) Are below 2,000 m (6,562 feet) in elevation; and (7) Are characterized by minimal to no human population density, no major roads, or no stable nighttime lighting over any 1-km2 (0.4-mi2) area.	http://www.gpo.gov/fdsys/pkg/FR-2014-03-05/pdf/2014-03485.pdf
Virginia big-eared bat (*Corynorhinus (=Plecotus) townsendii virginianus*)	Critical habitat designations are caves.	http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A080#crithab http://ecos.fws.gov/docs/federal_register/fr366.pdf
Whooping crane (*Grus americana*)	PCE: All areas proposed in this rule would provide food, water, and other nutritional or physiological needs of the	http://ecos.fws.gov/docs/federal_register/fr237.pdf

[3] Critical habitat designation status determined using U.S. Fish & Wildlife Service's Environmental Conservation Online System (ECOS) species profiles.

	whooping crane during spring or fall migration. Consumption of some cereal crops in adjacent croplands during migration period. Direct relatable resources to agricultural field possibly treated with 2,4-D choline.	
Species without critical habitat designations (8 species)		
Audubon crested caracara (*Polyborus plancus audubonii*)	None	http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B06Q
Delmarva Peninsula fox squirrel (*Sciurus niger cinereus)*	None	http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A00B
Eastern indigo snake (*Drymarchon corais couperi*)	None	http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C026#crithab
Florida panther (*Puma (=Felis) concolor coryi*)	None	http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A008
Lesser prairie-chicken (*Tympanuchus pallidicinctus*)	None	http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0AZ#crithab
Ocelot (*Leopardus (Felis) pardalis*)	None	http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A084#crithab
Red wolf (*Canis rufus*)	None	http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A00F#crithab
Sonoran pronghorn (*Antilocapra americana sonoriensis*)	None	http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A009

Summary of Listed Species Identified as being off Agricultural Fields without Critical Habitat[4] (191 species)

Alamosa springsnail(*Tryonia alamosae*)
American chaffseed (*Schwalbea americana*)
American hart's-tongue fern (*Asplenium scolopendrium var. americanum*)
Anastasia Island beach mouse *(Peromyscus polionotus phasma)*
Apache trout (*Oncorhynchus apache*)
Apalachicola rosemary (*Conradina glabra*)
Appalachian Monkeyface, Appalachian (pearlymussel) (*Quadrula sparsa*)
Arizona Cliff-rose (*Purshia (=Cowania) subintegra*)
Arizona hedgehog cactus (*Echinocereus triglochidiatus var. arizonicus*)
Atlantic salt marsh snake (*Nerodia clarkii taeniata*)
Avon Park harebells (*Crotalaria avonensis*)
Bachman's warbler (=wood) (*Vermivora bachmanii*)
Beach jacquemontii (*Jacquemontia reclinata*)
Beautiful pawpaw (*Deeringothamnus pulchellus*)
Birdwing pearlymussel (*Lemiox rimosus*)
Black-footed ferret (*Mustela nigripes*)
Blackside dace (*Phoxinus cumberlandensis*)
Bluetail mole skink *(Eumeces egregius lividus)*
Bog (=Muhlenberg) turtle *(Clemmys muhlenbergii)*
Brady pincushion cactus (*Pediocactus bradyi*)
Britton's beargrass (*Nolina brittoniana*)
Brooksville bellflower (*Campanula robinsiae*)
California least tern *(Sterna antillarum browni)*
Canada lynx (*Lynx canadensis)*
Canby's dropwort (*Oxypolis canbyi*)
Canelo Hills ladies'-tresses (*Spiranthes delitescens*)
Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*)
Carter's mustard (*Warea carteri*)
Chapman rhododendron (*Rhododendron chapmanii*)
Cheat Mountain salamander (*Plethodon nettingi*)
Chittenango ovate amber snail (*Succinea chittenangoensis*)
Clubshell (*Pleurobema clava*)
Cochise pincushion cactus (*Coryphantha robbinsorum*)
Colorado hookless cactus (*Sclerocactus glaucus*)
Cooley's meadowrue (*Thalictrum cooleyi*)
Cooley's water-willow (*Justicia cooleyi*)
Cracking pearlymussel (*Hemistena lata*)
Crenulate lead-plant (*Amorpha crenulata*)
Cumberland bean (pearlymussel) (*Villosa trabalis*)
Cumberland monkeyface (pearlymussel) (*Quadrula intermedia*)
Deltoid spurge (*Chamaesyce deltoidea ssp. deltoidea*)
Dromedary pearlymussel (*Dromus dromas*)
Dudley Bluffs bladderpod (*Lesquerella congesta*)
Dudley Bluffs twinpod (*Physaria obcordata*)
Duskytail darter (*Etheostoma percnurum*)
Dwarf wedgemussel (*Alasmidonta heterodon*)
Eastern prairie fringed orchid (*Platanthera leucophaea*)

[4] Critical habitat designation status determined using U.S. Fish & Wildlife Service's Environmental Conservation Online System (ECOS) species profiles.

Etonia rosemary (*Conradina etonia*)
Fanshell (*Cyprogenia stegaria*)
Finback whale (*Balaenoptera physalus*)
Finerayed pigtoe (*Fusconaia cuneolus*)
Flat-spired three-toothed snail (*Triodopsis platysayoides*)
Florida bonamia (*Bonamia grandiflora*)
Florida Bonneted bat *(Eumops floridanus)*
Florida golden aster (*Chrysopsis floridana*)
Florida grasshopper sparrow *(Ammodramus savannarum floridanus)*
Florida perforate cladonia (*Cladonia perforata*)
Florida salt marsh vole *(Microtus pennsylvanicus dukecampbelli)*
Florida scrub-jay *(Aphelocoma coerulescens)*
Florida skullcap (*Scutellaria floridana*)
Florida torreya (*Torreya taxifolia*)
Florida ziziphus (*Ziziphus celata*)
Four-petal pawpaw (*Asimina tetramera*)
Fragrant prickly-apple (*Cereus eriophorus var. fragrans*)
Fringed campion (*Silene polypetala*)
Garber's spurge (*Chamaesyce garberi*)
Garrett's mint (*Dicerandra christmanii*)
Gentian pinkroot (*Spigelia gentianoides*)
Gila topminnow (incl. Yaqui)(*Poeciliopsis occidentalis*)
Gila trout (*Oncorhynchus gilae*)
Godfrey's butterwort (*Pinguicula ionantha*)
Gray bat (*Myotis grisescens*)
Green blossom (pearlymussel)(*Epioblasma torulosa gubernaculum*)
Greenback Cutthroat trout (*Oncorhynchus clarki stomias*)
Harperella (*Ptilimnium nodosum*)
Harper's beauty (*Harperocallis flava*)
Hay's Spring amphipod (*Stygobromus hayi*)
Highlands scrub hypericum (*Hypericum cumulicola*)
Holy Ghost ipomopsis (*Ipomopsis sancti-spiritus*)
Houghton's goldenrod (*Solidago houghtonii*)
Hualapai Mexican vole *(Microtus mexicanus hualpaiensis)*
Humpback whale (*Megaptera novaeangliae*)
James spinymussel (*Pleurobema collina*)
Jones cycladenia (*Cycladenia humilis var. jonesii*)
Kearney's blue-star (*Amsonia kearneyana*)
Kemp's ridley sea turtle (*Lepidochelys kempii*)
Key deer *(Odocoileus virginianus clavium)*
Key tree cactus (*Pilosocereus robinii*)
Kirtland's warbler (*Setophaga kirtlandii*)
Knieskern's beaked-rush (*Rhynchospora knieskernii*)
Knowlton's cactus (*Pediocactus knowltonii*)
Kuenzler hedgehog cactus (*Echinocereus fendleri var. kuenzleri*)
Lakela's mint (*Dicerandra immaculata*)
Least tern (*Sterna antillarum*)
Lee County cave isopod (*Lirceus usdagalun*)
Leedy's Roseroot (*Rhodiola integrifolia ssp. leedyi*)
Lee pincushion cactus (*Coryphantha sneedii var. leei*)
Lewton's polygala (*Polygala lewtonii*)
Littlewing pearlymussel (*Pegias fabula*)
Longspurred mint (*Dicerandra cornutissima*)

Lower Keys marsh rabbit *(Sylvilagus palustris hefneri)*
Madison Cave isopod (*Antrolana lira*)
Mancos milk-vetch (*Astragalus humillimus*)
Masked bobwhite (quail) *(Colinus virginianus ridgwayi)*
Mesa Verde cactus (*Sclerocactus mesae-verdae*)
Miami Blue Butterfly (Cyclargus *(=Hemiargus) thomasi bethunebakeri)*
Miccosukee gooseberry (*Ribes echinellum*)
Michaux's sumac (*Rhus michauxii*)
Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*)
Nichol's Turk's head cactus (*Echinocactus horizonthalonius var. nicholii*)
North Park phacelia (*Phacelia formosula*)
Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*)
Northeastern bulrush (*Scirpus ancistrochaetus*)
Northern monkshood (*Aconitum noveboracense*)
Northern riffleshell (*Epioblasma torulosa rangiana*)
Okaloosa darter (*Etheostoma okaloosae*)
Okeechobee gourd (*Cucurbita okeechobeensis ssp. okeechobeensis*)
Osterhout milkvetch (*Astragalus osterhoutii*)
Papery whitlow-wort (*Paronychia chartacea*)
Pecos gambusia (*Gambusia nobilis*)
Peebles Navajo cactus (*Pediocactus peeblesianus var. peeblesianus*)
Penland alpine fen mustard (*Eutrema penlandii*)
Penland beardtongue (*Penstemon penlandii*)
Peter's mountain mallow (*Iliamna corei*)
Pigeon wings (*Clitoria fragrans*)
Pima pineapple cactus (*Coryphantha scheeri var. robustispina*)
Pink mucket (pearlymussel) (*Lampsilis abrupta*)
Puritan tiger beetle (*Cicindela puritana*)
Pygmy fringe-tree (*Chionanthus pygmaeus*)
Rayed bean (*Villosa fabalis*)
Red-cockaded woodpecker (*Picoides borealis*)
Roan Mountain bluet (*Hedyotis purpurea var. montana*)
Roanoke logperch (*Percina rex*)
Rock gnome lichen (*Gymnoderma lineare*)
Roseate tern (*Sterna dougallii dougallii*)
Rough pigtoe (*Pleurobema plenum*)
Rugel's pawpaw (*Deeringothamnus rugelii*)
Running buffalo clover (*Trifolium stoloniferum*)
Sacramento prickly poppy (*Argemone pleiacantha ssp. pinnatisecta*)
Sand skink *(Neoseps reynoldsi)*
Sandlace (*Polygonella myriophylla*)
Sandplain gerardii (*Agalinis acuta*)
Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*)
Scrub blazingstar (*Liatris ohlingerae*)
Scrub buckwheat (*Eriogonum longifolium var. gnaphalifolium*)
Scrub lupine (*Lupinus aridorum*)
Scrub mint (*Dicerandra frutescens*)
Scrub plum (*Prunus geniculata*)
Seabeach amaranth (*Amaranthus pumilus*)
Sensitive joint-vetch (*Aeschynomene virginica*)
Sentry milk-vetch (*Astragalus cremnophylax var. cremnophylax*)
Shale barren rock cress (*Arabis serotina*)
Sheepnose mussel (*Plethobasus cyphyus)*

Shenandoah salamander (*Plethodon shenandoah*)
Shiny pigtoe (*Fusconaia cor*)
Short-leaved rosemary (*Conradina brevifolia*)
Shortnose sturgeon (*Acipenser brevirostrum*)
Siler pincushion cactus (*Pediocactus (=Echinocactus,=Utahia) sileri*)
Small whorled pogonia (*Isotria medeoloides*)
Small-anthered bittercress (*Cardamine micranthera*)
Small's milkpea (*Galactia smallii*)
Smalltooth sawfish (*Pristis pectinata*)
Smooth coneflower (*Echinacea laevigata*)
Snakeroot (*Eryngium cuneifolium*)
Sneed pincushion cactus (*Coryphantha sneedii var. sneedii*)
Snuffbox mussel (*Epioblasma triquetra*)
Socorro isopod (*Thermosphaeroma thermophilus*)
Socorro springsnail (*Pyrgulopsis neomexicana*)
Sonora tiger Salamander *(Ambystoma tigrinum stebbinsi)*
Southeastern beach mouse *(Peromyscus polionotus niveiventris)*
Southern sandshell (*Hamiota (=Lampsilis) australis*)
Spectaclecase (mussel) (*Cumberlandia monodonta*)
Squirrel Chimney Cave shrimp (*Palaemonetes cumingii*)
Stock Island tree snail (*Orthalicus reses*)
Swamp pink (*Helonias bullata*)
Tan Riffleshell (*Epioblasma florentina walkeri (=E. walkeri)*)
Telephus spurge (*Euphorbia telephioides*)
Tiny polygala (*Polygala smallii*)
Tubercled blossom (pearlymussel) (*Epioblasma torulosa torulosa*)
Uncompahgre fritillary butterfly (*Boloria acrocnema*)
Ute Ladies'-Tresses, (*Spiranthes diluvialis*)
Virginia fringed mountain snail (*Polygyriscus virginianus*)
Virginia round-leaf birch (*Betula uber*)
Virginia sneezeweed (*Helenium virginicum*)
Virginia spiraea (*Spiraea virginiana*)
White birds-in-a-nest (*Macbridea alba*)
Wide-leaf warea (*Warea amplexifolia*)
Wireweed (*Polygonella basiramia*)
Wood stork (*Mycteria americana*)
Yuma clapper rail *(Rallus longirostris yumanensis)*
Zuni fleabane (*Erigeron rhizomatus*)

Summary of Listed Species Identified as being off Agricultural Fields with Critical Habitat[5] (117 species)

Aboriginal prickly-apple (*Harrisia aboriginum*)
Acuna Cactus (*Echinomastus erectocentrus var. acunensis*)
American crocodile (*Crocodylus acutus*)
Arkansas River shiner (*Notropis girardi*)
Bartram's Hairstreak Butterfly *(Strymon acis bartrami)*
Beautiful shiner (*Cyprinella formosa*)
Bonytail chub (*Gila elegans*)

[5] Critical habitat designation status determined using U.S. Fish & Wildlife Service's Environmental Conservation Online System (ECOS) species profiles.

Cape Sable seaside sparrow *(Ammodramus maritimus mirabilis)*
Cape Sable thoroughwort (*Chromolaena frustrata*)
Carter's small-flowered flax (*Linum carteri carteri*)—(*proposed*)
Chihuahua chub (*Gila nigrescens*)
Chipola slabshell (*Elliptio chipolaensis*)
Chiricahua leopard frog (*Rana (=Lithobates) chiricahuensis*)
Choctaw bean (*Villosa choctawensis*)
Choctawhatchee beach mouse *(Peromyscus polionotus allophrys)*
Chupadera springsnail (*Pyrgulopsis chupaderae*)
Clay-loving wild buckwheat (*Eriogonum pelinophilum*)
Colorado Butterfly Plant (*Gaura neomexicana* var. *coloradensis*)
Colorado pikeminnow (=squawfish)(*Ptychocheilus lucius*)
Cumberlandian combshell (*Epioblasma brevidens*)
DeBeque phacelia (*Phacelia submutica*)
Desert tortoise (*Gopherus agassizii)*
Desert pupfish (*Cyprinodon macularius*)
Diamond darter (*Crystallaria cincotta*)
Elkhorn coral (*Acropora palmate*)
Everglade snail kite *(Rostrhamus sociabilis plumbeus)*
Fat three-ridge (mussel) (*Amblema neislerii*)
Fickeisen Plains cactus (*Pediocactus peeblesianus fickeiseniae*)
Florida brickell-bush (*Brickellia mosieri*)—(*Proposed*)
Florida Leafwing Butterfly *(Anaea troglodyta floridalis)*
Florida semaphore cactus (*Consolea corallicola*)
Fluted kidneyshell (*Ptychobranchus subtentum*)
Frosted flatwoods salamander (*Ambystoma cingulatum*)
Fuzzy pigtoe (*Pleurobema strodeanum*)
Gierisch mallow (*Sphaeralcea gierischii*)
Gila chub (*Gila intermedia*)
Green sea turtle (*Chelonia mydas*)
Gulf moccasinshell (*Medionidus penicillatus*)
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)
Gypsum wild-buckwheat (*Eriogonum gypsophilum*)
Hawksbill sea turtle (*Eretmochelys imbricata*)
Holmgren milk-vetch (*Astragalus holmgreniorum*)
Huachuca water-umbel (*Lilaeopsis schaffneriana var. recurva*)
Humpback chub (*Gila cypha*)
Jemez Mountains salamander (*Plethodon neomexicanus*)
Johnson's seagrass (*Halophila johnsonii*)
Kanab ambersnail *(Oxyloma haydeni kanabensis)—(proposed)*
Karner blue butterfly (*Lycaeides melissa samuelis*)
Key Largo cotton mouse *(Peromyscus gossypinus allapaticola)—(proposed)*
Key Largo woodrat *(Neotoma floridana smalli)*
Koster's springsnail (*Juturnia kosteri*)
Leatherback sea turtle (*Dermochelys coriacea*)
Lesser long-nosed bat *(Leptonycteris curasoae yerbabuenae)*
Little Colorado spinedace (*Lepidomeda vittata*)
Loach minnow (*Tiaroga cobitis*)
Loggerhead sea turtle (*Caretta caretta*)
Maryland darter (*Etheostoma sellare*)
Mexican long-nosed bat (*Leptonycteris nivalis*)
Mexican spotted owl (*Strix occidentalis lucida*)
Mount Graham red squirrel *(Tamiasciurus hudsonicus grahamensis)*

Narrow pigtoe (*Fusconaia escambia*)
Narrow-headed gartersnake (*Thamnophis rufipunctatus*)—(*Proposed)*
Navajo sedge (*Carex specuicola*)
New Mexican ridge-nosed rattlesnake (*Crotalus willardi obscurus*)
New Mexico meadow jumping mouse (*Zapus hudsonius luteus*)—(*Proposed*)
Noel's amphipod (*Gammarus desperatus*)
North Atlantic right whale (*Eubalaena glacialis*)
Northern Mexican gartersnake (*Thamnophis eques megalops*)—(*Proposed*)
Ochlockonee moccasinshell (*Medionidus simpsonianus*)
Oval pigtoe (*Pleurobema pyriforme pyriforme*)
Ovate clubshell (*Pleurobema perovatum*)
Oyster mussel (*Epioblasma capsaeformis*)
Pagosa skyrocket (*Ipomopsis polyantha*)
Parachute beardtongue (*Penstemon debilis*)
Pawnee montane skipper (*Hesperia leonardus montana*)
Pecos (=puzzle, =paradox) sunflower (*Helianthus paradoxus*)
Pecos assiminea snail (*Assiminea pecos*)
Pecos bluntnose shiner (*Notropis simus pecosensis*)
Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*)
Piping plover (*Charadrius melodus*)
Preble's meadow jumping mouse (*Zapus hudsonius preblei*)
Purple bankclimber (mussel) (*Elliptoideus sloatianus*)
Bean, Purple (*Villosa perpurpurea*)
Rabbitsfoot (*Quadrula cylindrica cylindrica*)
Razorback sucke r(*Xyrauchen texanus*)
Reticulated flatwoods salamander (*Ambystoma bishopi*)
Rice rat *(Oryzomys palustris natator)*
Rio Grande silvery minnow (*Hybognathus amarus*)
Roswell springsnail (*Pyrgulopsis roswellensis*)
Rough rabbitsfoot (*Quadrula cylindrica strigillata*)
Round ebonyshell (*Fusconaia rotulata*)
Sacramento Mountains thistle (*Cirsium vinaceum*)
San Bernardino springsnail (*Pyrgulopsis bernardina*)
San Francisco Peaks ragwort (*Packera franciscana*)
Shinyrayed pocketbook (*Lampsilis subangulata*)
Slabside pearlymussel (*Pleuronaia dolabelloides*)
Slender chub (*Erimystax cahni*)
Smalleye shiner (*Notropis buccula*)
Sonora chub (*Gila ditaenia*)
Southern kidneyshell (*Ptychobranchus jonesi*)
Southwestern willow flycatcher (*Empidonax traillii extimus*)
Spikedace (*Meda fulgida*)
Spotfin chub (*Erimonax monachus*)
Spruce-fir moss spider (*Microhexura montivaga*)
St. Andrew beach mouse (*Peromyscus polionotus peninsularis*)
Staghorn coral (*Acropora cervicornis*)
Tapered pigtoe (*Fusconaia burkei*)
Three Forks Springsnail (*Pyrgulopsis trivialis*)
Todsen's pennyroyal (*Hedeoma todsenii*)
Virgin River Chub (*Gila seminuda (=robusta*))
West Indian manatee (*Trichechus manatus latirostris*)
Welsh's milkweed (*Asclepias welshii*)
Woundfin (*Plagopterus argentissimus*)

Yaqui catfish (*Ictalurus pricei*)
Yaqui chub (*Gila purpurea*)
Yellowfin Madtom (*Noturus flavipinnis*)
Zuni bluehead sucker (*Catostomus discobolus yarrowi*)

EFED has become aware of several sources of information that suggest that the current assessment of the use of dicamba DGA salt on soybean and cotton may not be fully accounting for drift, volatility, reproductive effects, and how visual damage (i.e. plant damage) may relate to EFED's standard endpoints (e.g. plant height). EFED believes that additional information is needed to fully evaluate these new lines of evidence (as described below) and suggests that the following list of issues be requested from Monsanto.

EFED's assessment for the use of dicamba DGA salt on soybean and cotton is currently based on applications made by a single nozzle and pressure configuration. While it is critical that EFED independently evaluate all lines of evidence which support or contradict the current assessment, we will consider differences between the current assessment and the new information. However, the conditions (e.g. nozzle type) of each study, or line of evidence submitted, must be documented so that EFED can evaluate the impact those similarities and differences may have on the assessment conclusions.

Effects Endpoint –

- Available open literature data suggests that 20% visual injury has been linked to effects on growth and yield.
- Based on slides from AR and MS, 20% visual injury was observed up to 175ft from the treated field for 0.5 lb/A applications of dicamba. This distance is greater than the 70ft buffer proposed by Monsanto.
- **<u>Information EFED needs to address this issue:</u> study reports and data from the field studies contracted by Monsanto in AR, MS and TN that measured plant height, yield and % visual injury so that statistics can be calculated on the various endpoints.**

Drift –

- Incidents submitted to the Agency, as well as data presented by independent researchers, suggest that risks from drift extend beyond the 70ft and 100ft buffers proposed by Monsanto.
- The AR Plant Board has established a 400 ft buffer around the edges of the treated field.
- Monsanto presented information on additional incidents and field research that has not been submitted to the Agency for review. The information presented on the incidents was incomplete and does not allow for a complete understanding of the potential risks from drift observed.
- **<u>Information EFED needs to address this issue:</u>**
    - **Study reports and data from the field studies contracted by Monsanto in AR, MS and TN that measured plant height, yield and % visual injury so that statistics can be calculated on the various endpoints.**
    - **Complete information on the incidents observed during the 2012, 2013, and 2014 growing seasons, including the nature of the effects observed and distance from site of application.**

Volatility –

- After reviewing the case file for Incident #I026579 submitted by the MO Department of Agriculture, EFED believes there is sufficient information to support a determination that this incident resulted from exposure to vapor drift of dicamba.
- Data presented by independent researchers suggest that volatility is a concern.
- Monsanto presented information on an additional product, VaporGrip, which is purported to reduce the potential for volatility. Data on this product have not been submitted to the Agency.

- **<u>Information EFED needs to address this issue:</u> To understand the conditions under which volatilization may occur, EFED will need the following data for each formulation of dicamba:**
    - **1) A set of laboratory volatility studies (guideline 835.1410), under different sets of conditions, including those likely to cause volatilization. This should include at least one test under high temperature and humidity conditions (over 80°F and 90% RH).**
    - **2) A set of field volatility studies (guideline 835.8100) conducted under conditions similar to those found in the laboratory volatility studies to cause volatilization, that measure effects on plants as a function of distance from the treated field**

Progeny (Reproductive) Effects –

- In addition to the data presented by an independent researcher, there are several open literature studies that discuss the potential for progeny (reproductive) effects related to dicamba exposure. This data raises a concern that hasn't previously been assessed.
- **<u>Information EFED needs to address this issue:</u> any studies or information that can elucidate this issue further**.

THE LEARNING XPERIENCE

Educating Key Stakeholders for Commercialization of the Roundup Ready® Xtend Crop System

ROUNDUP READY PLUS™
WEED MANAGEMENT SOLUTIONS

ROUNDUP READY® XTEND CROP SYSTEM

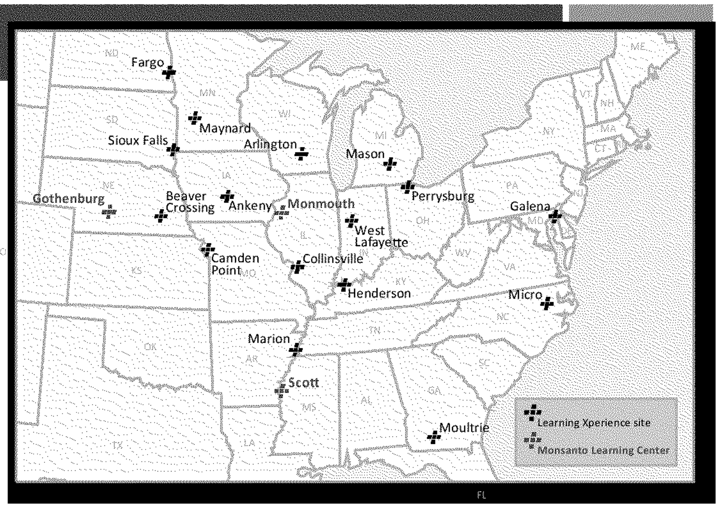
The Roundup Ready® Xtend Crop System will be a component of Roundup Ready PLUS Weed Management Solutions, a centralized resource from Monsanto to help protect farmers' yield potential by providing local recommendations for effective, economical and sustainable weed control.

A robust learning program is underway to prepare retailers, applicators and farmers for the planned 2014 commercial introduction of the Roundup Ready® Xtend Crop System, pending regulatory approvals. Designed to give farmers consistent, flexible control of tough-to-control and resistant weeds, the Roundup Ready Xtend Crop System will introduce Roundup Ready® 2 Xtend soybeans, which contain glyphosate plus dicamba tolerance. Since education efforts began in summer 2012, Monsanto has already educated more than 1,200 sales and technical employees on application requirements for Roundup Ready 2 Xtend soybeans and dicamba herbicides used in the system.

COMPREHENSIVE FIELD TRAINING

In 2013, the focus of training e orts will shift to external audiences via local, in- eld training events called The Roundup Ready *Learning Xperience*. Nineteen event locations have been selected to show that the system will work across many di erent environments. The curriculum of each Learning Xperience will be based on Roundup Ready PLUS™ Weed Management Solutions:

- E ective, economical and sustainable weed control program
- Weed management recommendations based on region and developed in conjunction with leading university weed scientists, agronomists and industry partners
- Farmer incentives to use endorsed herbicides in a system with multiple modes of action
- Education and training regarding the best use of current products and application requirements of the Roundup Ready Xtend Crop System



Learning Xperience participants will learn how to use Roundup Ready PLUS platform recommendations in Roundup Ready 2 Xtend soybeans and other Roundup Ready® crops. They also will receive training on the system's application requirements and important, new herbicide label language, pending regulatory approval.

Each Learning Xperience site will contain plots that demonstrate the application requirements and local Roundup Ready PLUS platform recommendations in action, as well as small-field trials that showcase the efficacy and crop safety of the Roundup Ready Xtend Crop System. Each site also will have a large-scale trial grown as part of Monsanto's Roundup Ready®2 Xtend Ground Breakers® Field Trials Under Permit program.* The Learning Xperience will be open to farmers, sales professionals, applicators and other agricultural stakeholders.

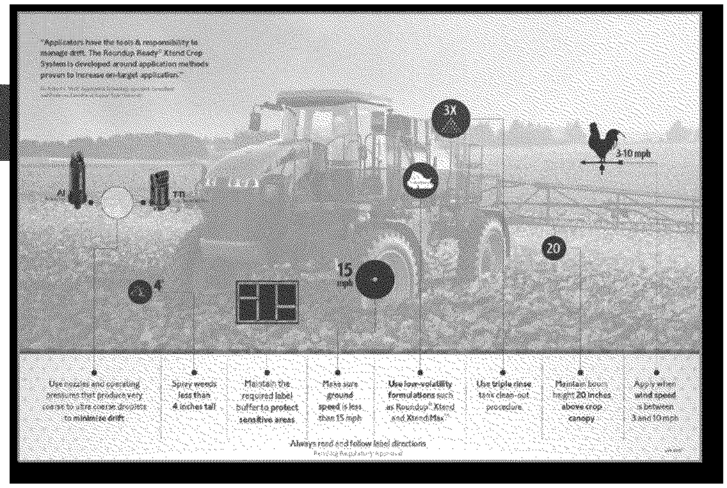
*Ground Breakers Field Trials Under Permit is Monsanto's on-farm trial program that gives farmers first-hand experience with pipeline products under large-scale planting conditions. The program allows farmers to observe product performance and benefits, and provide feedback and data to support commercial decisions. Approximately 100 growers in 16 states will have the opportunity to experience the Roundup Ready Xtend Crop System on their farms in 2013.

mUlTiple modes oF learning

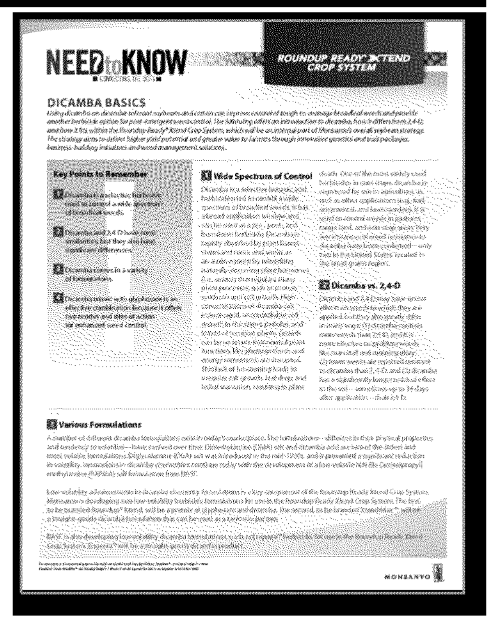
The Roundup Ready Xtend Crop System launch team will deploy a number of training resources that concentrate on teaching audience members how to manage various forms of off-target movement of dicamba, as well as application tools, techniques and requirements of the Roundup Ready Xtend Crop System. Resources will include:

- Digital learning tools, including webinars, educational videos, computer-based training, and knowledge assessment surveys to reinforce the field training and extend the learning experience to audiences not able to visit a site in person.
- Printed reference materials, including training toolkits, "Need-to-Know" literature, application requirements brochures and learning modules that can be incorporatedinto state extension pesticide application training and certification programs.

These resources and the Learning Xperience sites will reinforce the importance of effective, sustainable weed management solutions for today — and tomorrow.



APPLICATION REQUIREMENTS FLYER



NEED-TO-KNOW LITERATURE

Visit or contact us at **www.roundupreadypUs.com** for more information about:

- Roundup Ready PLUS Weed Management Solutions
- The Roundup Ready Xtend Crop System
- Summer 2013 Learning Xperience events

For more information about participating in a Learning Xperience, you can also contact your local seed dealer or Monsanto representative.

MONSANTO

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

OFFICE OF
CHEMICAL SAFETY AND
POLLUTION PREVENTION

PC Code: **128931**
DP Barcode: **D378444**

MEMORANDUM

DATE: March 8, 2011

SUBJECT: Ecological Risk Assessment for Dicamba and its Degradate, 3,6-dichlorosalicylic acid (DCSA), for the Proposed New Use on Dicamba-Tolerant Soybean (MON 87708).

TO: Michael Walsh, Risk Manager Reviewer
Kathryn Montague, Risk Manager, RM 23
Registration Division (7505P)

FROM: Iwona L. Maher, Chemist, ERB6 (for I Maher) 3-8-11
Michael Wagman, Biologist, ERB6 M Wagman 3/8/11
Environmental Fate and Effects Division (7507P)

THROUGH: Mark Corbin, Branch Chief, ERB6 3-8-11
Environmental Fate and Effects Division (7507P)

The Environmental Fate and Effects Division (EFED) has completed a review of the new use request for the herbicide dicamba [M1691 Herbicide, EPA Reg. No. 524-582 (56.8% diglycolamine salt of dicamba (DGA); PC code 128931)] for use on dicamba-tolerant soybeans (MON 87708). Dicamba is currently registered for use on soybeans at applications rates similar to those proposed for the new use. The use of dicamba on soybeans was assessed by the Environmental Fate and Effects Division (EFED) in 2005 (USEPA, 2005, D317696). The primary difference between the proposed new use on soybeans and the previous soybean use assessed is the timing of the applications. The current registration for dicamba use on soybeans is limited to pre-emergence applications; however, for the proposed new use on dicamba-tolerant soybeans, dicamba could be applied pre-emergence and/or post-emergence. Therefore, an abbreviated ecological risk assessment is provided. Details on the fate and transport properties and effects data for dicamba can be found in the attached assessments.

Based on the proposed maximum application rates, there is a potential for direct adverse effects to listed and non-listed birds (acute exposure), listed and non-listed mammals (chronic exposure), listed vascular aquatic plants, and listed and non-listed terrestrial dicots from the proposed new use. This assessment uses new submitted information on the toxicity of diglycolamine salt of dicamba (DGA) to terrestrial plants. Although for monocots toxicity of the DGA salt formuation is decreased compared to TGAI dicamba acid, the vegetative vigor data indicate that toxicity in the DGA salt formulation is enhanced for dicots. It is unclear if the enhanced toxicity to dicots is due to synergistic effects with surfactants and adjuvants in the formulation used (Clarity Herbicide, EPA Reg No. 7969-137, 56.8% DGA salt) or due to the DGA salt itself. The study with TGAI dicamba acid did not use surfactants or adjuvants. Although levels of concern were not exceeded for listed and non-listed species of monocots, exceedances for monocots would occur if toxicity data for dicamba acid was used in place of the data for the DGA salt. Risks to aquatic animals from chronic exposure to dicamba could not be assessed at this time because of a lack of data; therefore, since risk to these taxa cannot be precluded, it is assumed.

At this time, no federally-listed taxa can be excluded from the potential for direct and/or indirect effects from the proposed new use of dicamba, since there is a potential for indirect effects to taxa that might rely on plants, birds, aquatic animals, and/or mammals for some stage of their life-cycle. A complete co-occurrence analysis could not be completed for listed species at this time, since the specific use site associated with the proposed new use of dicamba (dicamba-tolerant soybeans) is not available for analysis in LOCATES. Therefore, without further refinement, no species currently listed as federally threatened or endangered can be excluded from the potential for adverse effects from the proposed new use of dicamba. Details regarding the environmental fate, ecological effects and ecological risks associated with the proposed new uses of dicamba are discussed in the sections that follow.

The following studies are identified as data gaps for dicamba and should be required to address the uncertainties described in this assessment:

850.1400	Chronic freshwater fish toxicity (TGAI)
850.1300	Chronic freshwater invertebrate toxicity (TGAI)
850.1400	Chronic estuarine/marine fish toxicity (TGAI)
850.1350	Chronic estuarine/marine invertebrate toxicity(TGAI)
850.2200	Avian acute oral toxicity (with a passerine species)
850.4250	Terrestrial plant toxicity (Tier II vegetative vigor, with lettuce using TEP)
850.5400	Green algae toxicity (TGAI)

Bridging data were submitted indicating that the dicamba salts will be rapidly converted to the free acid of dicamba (MRID 43288001). Additionally, effects data provided indicate equatoxicity of the acid and salts (based on acid equivalents). EFED determined that fate studies conducted with dicamba acid provide "surrogate data" for the dicamba salts and that toxicity data across the acid and salts could generally be combined.

Although the risks, based on standard risk assessment methods used by the Environmental Fate and Effects Division (EFED), are not expected to differ from the previous assessment done for dicamba use on soybeans (because the rates are similar to those already assessed), there is potential for other ecological concerns that would not normally be captured using our standard risk assessment methods. These concerns are related to a potential increase in usage of dicamba products and the proposed changes in the timing of applications. In general, there is also a potential for increased susceptibility of late season plants to direct impact from off-site transport. Thus, unlike previous assessments of dicamba the risk conclusions in this assessment have increased uncertainty.

PROBLEM FORMULATION

Dicamba was first registered in the United States in 1967 and is widely used in agricultural, industrial and residential settings. Dicamba is a benzoic acid herbicide similar in structure and mode of action to phenoxy herbicides. Dicamba controls annual, biennial and perennial broadleaf weeds in crops and grasslands, and it is used to control brush and bracken in pastures. Dicamba is formulated primarily as a salt in an aqueous solution. Supported forms are: dicamba acid (29801), dicamba dimethylamine salt - DMA (29802), dicamba sodium salt (29806), dicamba diglycoamine salt - DGA (128931), dicamba isopropylamine salt (128944) and dicamba potassium salt (129043).

This assessment is for the new use request for the herbicide dicamba [M1691 Herbicide, EPA Reg. No. 524-582 (56.8% diglycolamine salt of dicamba (DGA); PC code 128931)] for use on dicamba-tolerant soybeans (MON 87708). Dicamba is currently registered for use on soybeans at applications rates similar to those proposed for the new use. The primary difference between the proposed new use on soybeans and the one proposed here is the timing of the applications. The current registration for dicamba use on soybeans is limited to pre-emergence applications. For the proposed new use on dicamba-tolerant soybeans, dicamba could be applied pre-emergence and/or post-emergence. Additionally, the maximum current application rate for soybeans (single application and maximum yearly applications) is 2.0 lb acid equivalent (a.e.)/acre. For the proposed new use on dicamba-tolerant soybeans, the maximum single application rate is 1 lb a.e./acre and the maximum yearly application rate is 2.0 lb a.e./acre.

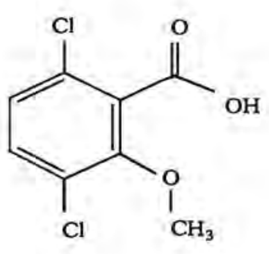
The major degradate under anaerobic conditions is 3,6-dichlorosalicylic acid (DCSA) which is persistent, comprising > 60% of the applied after 365 days of anaerobic incubation in sediment:pond water system (Stable, MRID 43245208). DCSA is formed in aerobic soil under laboratory conditions at the maximum of 17.4 % of the applied parent. Toxicity data for DCSA and mammals have been submitted to the Agency. Based on available data, DCSA appears to be less toxic or equally toxic as the parent (see **Table 1**). Therefore, this assessment will consider the parent and its degradate DCSA (with the assumption that dicamba and DCSA are equatoxic).

TABLE 1. Toxicity Data for the Dicamba Degradate DCSA (no registrant-submitted toxicity data are available for the degradate).

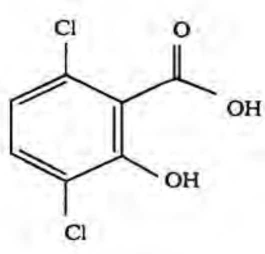
SOURCE	DICAMBA	DCSA
SUBMITTED DATA (Most Sensitive)		
Acute oral Rat (LD_{50}; mg/kg-bw)	2,740	2,641 (MRID 47899504)
Chronic rat (NOAEC; mg/kg-bw)	45 (based on decreased pup weight at 136 mg a.e./kg-bw)	37 (based on decreased parental body weight) (MRID 47899517)
Acute oral Avian (LD_{50}; mg/kg-bw)	188	--
Acute Fish (LC_{50}; mg/L)	28	--
Chronic Fish (NOAEC; mg/L)	--	--
Acute FW Invertebrate (EC_{50}; mg/L)	34.6	--
Chronic FW Invertebrate (NOAEC; mg/L)	--	--
NV Aquatic Plant (EC_{50}; mg/L)	0.061	--
V Aquatic Plant (EC_{50}; mg/L)	>3.25	--
Acute Honeybees (LD_{50}; µg/bee)	>90.65	--
PPDB (EU) WEBSITE[1]		
Acute oral Rat (LD_{50}; mg/kg-bw)	1,581	>1,560
Acute oral Avian (LD_{50}; mg/kg-bw)	1,373	--
Acute Fish (LC_{50}; mg/L)	>100	>100
Chronic Fish (NOAEC; mg/L)	--	--
Acute FW Invertebrate (EC_{50}; mg/L)	>110.7	89
Chronic FW Invertebrate (NOAEC; mg/L)	97	--
NV Aquatic Plant (EC_{50}; mg/L)	1.8	138
V Aquatic Plant (EC_{50}; mg/L)	>3.25	>73
Acute Honeybees (LD_{50}; µg/bee)	>100	--
Acute Earthworms (LC_{50}; mg/kg)	>1,000	>1,000

1 Pesticide Properties Database (PPDB) (http://sitem.herts.ac.uk/aeru/footprint/en/index.htm)

Figure 1: Chemical Structures for Dicamba and its Degradate DCSA



Dicamba
3,6-dichloro-o-anisic acid



DCSA
3,6-dichlorosalicylic acid

BACKGROUND

The most recent regulatory actions for dicamba include the following:

- US EPA/EFED (2010) Reduced Risk Request for Dicamba Herbicide Over-The-Top of Dicamba-Tolerant Soybean. May 27, 2010.
- US EPA. (2010) EFED Response to a FIFRA Section 18 Emergency Exemption for Dicamba co-formulated with 2,4-D (Latigo™) Use on Teff grown for grain, seed, and hay to control broadleaf weeds. Requested by the Oregon Department of Agriculture. May 24, 2010. D377095
- US EPA (2006) Reregistration Eligibility Decision for Dicamba and Dicamba Salts. June 8, 2006.
- US EPA (2005) Drinking water assessment for dicamba on sugarcane. May 31, 2005. D317705
- US EPA (2005) EFED Reregistration Chapter for Dicamba/Dicamba Salts. August 31, 2005. D317696

Consistent with the previous assessments, the environmental fate and effects data used in this assessment will be bridged across the dicamba acid and all of the supported dicamba salts (MRID 43288001). EFED established a strategy for bridging the environmental fate and effects data requirements for the dicamba sodium and potassium salts, dimethylamine salt (DMA), isopropylamine salt and diglycoamine salt (DGA) to the dicamba acid. Bridging data were submitted indicating that the dicamba salts will be rapidly converted to the free acid of dicamba. Additionally, effects data provided indicate equatoxicity of the acid and salts (based on acid equivalents). EFED determined that fate studies conducted with dicamba acid provide "surrogate data" for the dicamba salts and that toxicity data across the acid and salts could generally be combined.

MODE OF ACTION

Dicamba is a benzoic acid herbicide similar in structure and mode of action to phenoxy herbicides. Like the phenoxy herbicides, dicamba mimics auxins, a type of plant hormone and causes abnormal cell growth by affecting cell division. Dicamba acts systematically in plants after it is absorbed through leaves and roots. It is easily transported throughout the plant and accumulates in new leaves.

USE CHARACTERIZATION

Monsanto Company submitted a new use request for the herbicide dicamba [M1691 Herbicide, EPA Reg. No. 524-582 (56.8% diglycolamine salt of dicamba)] for use on dicamba-tolerant soybeans (MON 87708). M1691 Herbicide is a water-soluble formulation intended for control and suppression of many broadleaf weeds, woody brush and vines. **Table 2** presents the proposed application rates to the dicamba-tolerant soybean. Rates for dicamba salts are normalized to dicamba acid equivalent per acre (a.e./A).

<u>Product Information</u>
Product Name: M1691 Herbicide
Active Ingredient: Diglycolamine salt of dicamba (3,4-dichloro-o-anisic acid)*............56.8%
Other Ingredients..43.2%
Total..100.0%
*Contains 38.5%, 3,6-dichloro-o-anisic acid (4 pounds acid equivalent per US gallon or 480 grams per liter).

TABLE 2. Dicamba DGA Proposed[1] Use Pattern for Dicamba-Tolerant Soybean.

<table>
<tr><th>Crop</th><th colspan="2">Maximum Individual Application Rate[3] lbs dicamba a.e./A</th><th>Number of Applications</th><th>Minimum Application Interval (days)</th><th colspan="2">Max Annual Application Rate in lbs dicamba a.e./A/year</th><th>Application Method</th></tr>
<tr><td rowspan="2">Dicamba-tolerant soybean MON 87708</td><td>Pre-emergence (pre-plant, at planting, or prior to crop emergence)[2]</td><td>1.0</td><td>NS</td><td>Pre-plant, at planting or prior to crop emergence</td><td>1.0</td><td rowspan="2">2.0</td><td rowspan="2">Ground spray</td></tr>
<tr><td>Post-emergence[1] (Preharvest)</td><td>0.5</td><td>2[4]</td><td>From V3 (emergence) to before R1 (early flower) reproductive stage of soybean</td><td>1.0</td></tr>
<tr><td colspan="8">1- M1691 Herbicide
2- Registered uses
3- "Acid equivalent"
4- Calculated by dividing the max application rate by the max individual application rate.</td></tr>
</table>

Proposed preharvest interval for soybean forage and hay are 7 and 14 days, respectively. The herbicide can be tank mixed with other products. According to the proposed label, aerial applications of dicamba to dicamba-tolerant soybeans is not allowed (*i.e.*, it is limited to ground applications).

Currently, BASF maintains registration for dicamba as the dimethylamine (DMA), diglycolamine (DGA), isopropylamine (IPA), sodium (NA) and potassium (K) salts. To date dicamba salts have registered uses on right-of-way areas, asparagus, barley, corn, grasses grown in pasture and regland, oats, proso millet, rye, sorghum, soybeans (preemergent), sugarcane, wheat, and uses on golf courses and residential loans. Chemical structures of dicamba salts are provided in Table 1, Attachment I.

The proposed dicamba registration is for use on dicamba-tolerant soybean (MON 87708). Dicamba-tolerant soybeans (MON 87708) are not currently available for sale in the United States, therefore, maps of specific use-sites are not available. However, maps for soybean acreage can be used as a proxy under the assumption that dicamba-tolerant soybeans could be grown wherever soybeans are grown. Based on National Agricultural Statistics Service (NASS) 2009 data, soybeans are grown primarily in the central portions of the United States (see **Fig. 2**). These represent potential use sites for use of dicamba on dicamba-tolerant soybeans.

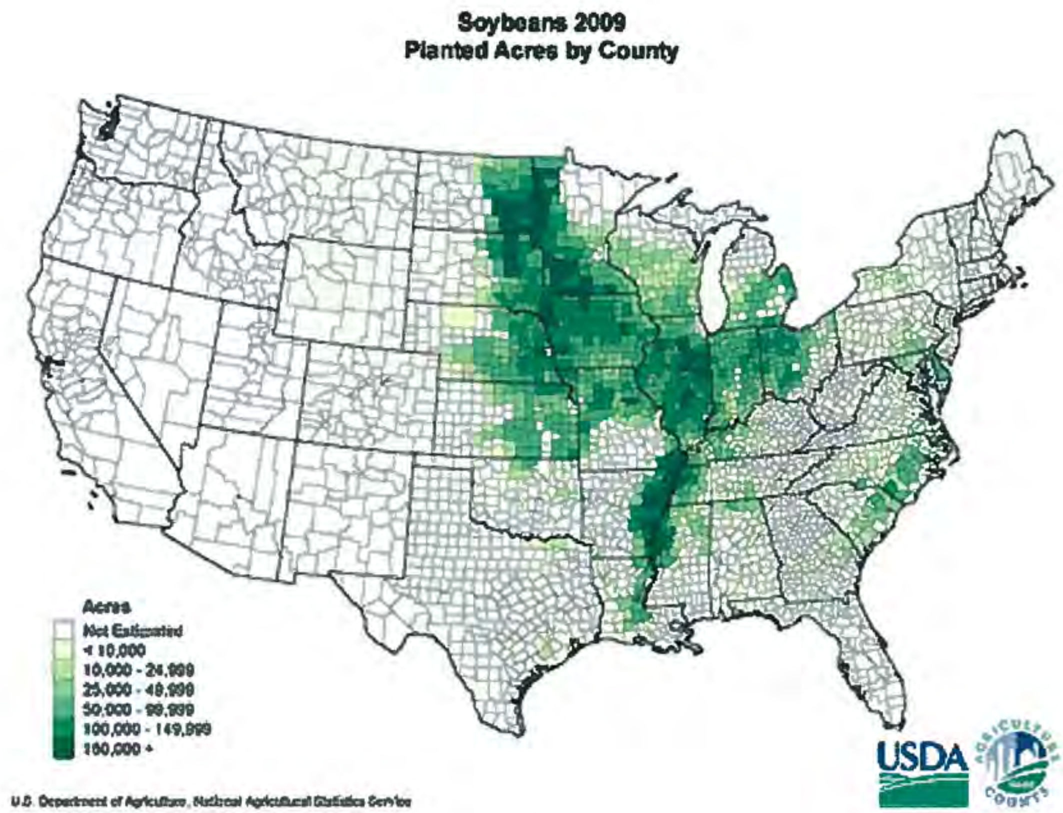


FIGURE 2. Acres of Soybeans Grown By County in the United Stated in 2009 (based on information from USDA-NASS) (http://www.nass.usda.gov/Charts_and_Maps/Crops_County/sb-pl.asp).

ENVIRONMENTAL FATE CHARACTERISTIC

Dicamba is a benzoic acid herbicide applied to leaves or to soil as a growth regulator, and is absorbed by leaves and roots moving throughout the plant. In some plants, it may accumulate in the tips of leaves. Some plants can metabolize or break down dicamba.

Dicamba is very soluble (6,100 ppm) and very mobile (K_{oc} = 13.4) in the laboratory, and is not expected to bioaccumulate in aquatic organisms because it is an anion at environmental pHs (pKa = 1.9). The active ingredient can reach surface water via run-off, spray drift during application, and vapor drift/volatilization. Multiple literature studies show that there is a high vapor drift from soybean fields resulting in non-target plant injury[1]. Since dicamba is not persistent under aerobic conditions, very little dicamba is expected to leach to groundwater. In two acceptable field dissipation studies conducted with dimethylamine salt of dicamba, dicamba was found in soil segments deeper than 10 cm (half-life range = 4.4 to 19.8 days, MRID 43651405, MRID 43651407). Any dicamba reaching anaerobic ground water would be

[1] Al-Khatib and Tamhane, 1999; Auch and Arnold, 1978; Everitt and Keeling, 2009; Kelley et al., 2005; Hamilton and Arle, 1979; Lanini, 2000; Marple et al., 2008; Wall, 1994; Weidenhamer et al., 1989; Wax et al., 1969.

somewhat persistent (due to its anaerobic half-life of 141 days).

Aerobic soil metabolism is the main degradative process for dicamba (6 days, MRID 43245207). Dicamba is stable to abiotic hydrolysis at all pH's and photodegrades slowly in water and on soil and is more persistent under anaerobic conditions in soil:water systems in the laboratory (141 days, MRID 43245208). A supplemental aerobic aquatic metabolism study of dicamba indicates that dicamba degrades more rapidly in aquatic systems when sediment is present. Its aerobic soil metabolism half-life in sediment:water system is about 24 days.

The major degradate under anaerobic conditions is 3,6-dichlorosalicylic acid (DCSA) which is persistent, comprising > 60% of the applied after 365 days of anaerobic incubation in sediment:pond water system (Stable, MRID# 43245208). DCSA is non-persistent when formed under aerobic conditions and degrades roughly at the same rate as the parent (8.2 days, MRID 43245207). DCSA was also found in the two acceptable field studies in soil segments deeper than 10 cm, and is believed to be persistent if it was to reach anaerobic ground water. The degradate is formed in aerobic soil under laboratory conditions at the maximum of 17.4 % of the applied parent. Other minor dicamba degradates of concern are DCGA and 5-OH-dicamba, and both are less toxic than the parent and DCSA. The formation of DCGA in the laboratory studies did not exceed 3.64%, and the formation of 5-OH dicamba did not exceed 1.9 % in soil/water system during anaerobic aquatic degradation of dicamba under laboratory condition.

Dicamba nomenclature including selected physical-chemical and fate properties for dicamba are provided below in Table 3. Chemical structures of dicamba and dicamba salts are presented in Table 1, Attachment I. The maximum percent formations of dicamba's metabolites are provided in Table 2, Appendix I. Further details regarding fate and transport laboratory and field studies submitted for dicamba can be found in the EFED Reregistration Chapter (US EPA, 2005).

TABLE 3. Selected Physical-Chemical and Fate Properties of Dicamba Acid.

CAS Name	3,6-dichloro-2-methoxybenzoic acid
IUPAC Name	3,6-dichloro-o-anisic acid
CAS No	1918-00-9
PC Code	029801
Empirical Formula	$C_8H_6Cl_2O_3$
Molecular Weight	221.04
Common Name	Dicamba
Formulated Product	Banex; Banlen; Banval; Banvel; Banvel 10G; Banvel 4E; Banvel 5G; Banvel CST; Banvel D; Banvel XG; dianat; Dicambe; Dicamba; Dicamba ; dicamba + 2,4-D; dicamba + atrazine; dicamba (amine); Clarity; Marksman; MDBA; Mediben; Velsicol 58-CS-11; Velsicol compound "R"
Pesticide Type	Herbicide
Chemical Family	Benzoic acid
Color/Form	Colorless crystals
Odor	Odorless
Melting Point	114 - 116°C (Kidd and James, 1991))

Flash Point	199°C (Gosselin, 1984)
Relative Density	1.57 g/ml at 25°C (Spectrum Laboratories: Chemical Fact Sheet)
Water Solubility	6100 mg/L SANDOZE Safety Data Sheet (Nov, 1989) 8240 mg/L at 25°C (Toxicology and Regulatory Affairs Flemington, NJ) 6500 mg/L at 25°C (Kidd and James, 1991)
Solubility in other solvents	Acetone 810 g/L at 25°C Dichloromethane 260 g/L at 25°C Dioxane 1.18 kg/L at 25°C Ethanol 922 g/L at 25°C Toluene 130 g/L at 25°C Xylene 8 g/L at 25°C (Worthing 1987)
Vapor Pressure	3.41 E-05 torr (25°C) SANDOZE Safety Data Sheet (Nov, 1989) 3.4 E-05 torr (25°C) (Kidd and James, 1991))
Henry's Law Constant	1.79 E-08 (ARS Pesticide Properties Database)
pKa	1.87 (MRID 43288001)
K_d(Freundlich) K_{oc}	0.07 - 0.53 mL/g (MRID 42774101) 3.45 - 21.1 mL/g (MRID 42774101)

Aquatic Exposure Estimates

The Tier II modeling was performed for dicamba acid and its major degradate DCSA using PRZM (v3.12.2; May 12, 2005)/EXAMS (v. 2.98.04.06; April 25, 2005) coupled with the standard pond scenario. Standard Mississippi soybean scenario was selected to assess runoff potential from vulnerable use sites. The modeling scenario for DCSA was based on the following: (1) assuming 17.4% conversion from parent DCSA and (2) using molecular weight conversion to adjust from parent application rate to DCSA application rate. **Tables 4** and **5** list the input parameters used for the PRZM/EXAMS modeling of dicamba acid and DCSA degradate.

TABLE 4. PRZM/EXAMS Input Parameters for Dicamba.

Model Input Variable	Input Value	Source and Comments	
Application rate (kg ai/hectare)	Soybean: 1.12; 0.56; 0.56	M1691; EPA Reg. No. 524-582	
Number of appl./season	Soybean: 3	M1691; EPA Reg. No. 524-582	
Interval between appl. (d)	3 days	M1691; EPA Reg. No. 524-582	
Application Method	Soybean: Ground	M1691; EPA Reg. No. 524-582	
Scenario modeled (Metfile) - Initial Application Date	MSsoybeanSTD (W03940.dvf) - 16 April		Dates based on the crop profile, date of planting, & precipitation data.
Henry's Law Constant (atm m^3/mol)	1.6×10^{-9}	Estimated (VP x MW)/(760 torr/1 atm * solubility)	
Molecular Weight (g/mol)	221	SANDOZE Safety Data Sheet (Nov, 1989).	
Solubility @ 25°C (mg/L)	6100	SANDOZE Safety Data Sheet (Nov, 1989).	
Vapor Pressure (torr)	3.41×10^{-5}	SANDOZE Safety Data Sheet (Nov, 1989).	

K_{oc} (mL/g)	13.4 (average)	MRID 42774101; Input parameters guidance (10/22/2009).
Aerobic Soil Metabolic Half-life (days)	18	MRID 43245207; (6d x 3) input parameters guidance (10/22/2009).
Is the pesticide wetted-in?	No	EPA Reg. No. 5905-564
Spray Drift Fraction	0.01 ground	Input guidance, 2009
Application Efficiency	0.99 ground	Input guidance, 2009
Aerobic Aquatic Metabolic Half-life (days)	72.9	MRID 43758509; 3x a single half-life value of 24.3 days was used per guidance (Input guidance, 2009).
Anaerobic Aquatic Metabolic Half-life (days)	423	A single half-life value was available (MRID 43245208); 3x the half-life value (141 x 3 = 423) was used per Input Parameter Guidance 2009.
Hydrolysis (pH 7) half-life (days)	0	Stable. MRID 40547902
Aquatic Photolysis Half-life (days)	105	MRID 42774102. Input Parameter Guidance 2009. Adjusted half-life to represent sun intensity and 12 hours of sunlight per day. 38.1 day value represented continuous sun exposure at an intensity of 1.38 times natural sunlight. Degradate not present.

Table 5. PRZM/EXAMS Input Parameters for DCSA.

Model Input Variable	Input Value	Source and Comments
Application rate (kg ai/hectare)	Soybean: 0.18; 0.09; and 0.09	(degradate molecular weight)/(parent molecular weight) x max%formation x application rate = (207/221)x 0.174 x 1.12
Number of appl./season	Soybean: 3	EPA Reg. No. 524-582
Interval between appl. (d)	3 days	EPA Reg. No. 524-582
Scenario modeled (Metfile) -Initial Application Date	MSsoybeanSTD (W03940.dvf) - 16 April	Dates based on the crop profile, date of planting, & precipitation data.
Henry's Law Constant (atm m^3/mol)	1.6×10^{-9}	Estimated for dicamba and used for DCSA (VP x MW)/(760 torr/1 atm * solubility)
Molecular Weight (g/mol)	207	Product Chemistry
Solubility @ 25°C (mg/L)	2112	MRID 43095301
Vapor Pressure (torr)	3.41×10^{-5}	For Dicamba. SANDOZE Safety Data Sheet (Nov, 1989).
K_{oc} (mL/g)	1208 (average)	MRID 43095301; Input parameters guidance (10/22/2009).
Aerobic Soil Metabolic Half-life (days)	24.6	MRID 43245207; (8.2 d x 3) (Input Parameters Guidance; 10/22/2009).
Is the pesticide wetted-in?	No	EPA Reg. No. 524-582
CAM	1	DCSA formed from parent in the top soil layer
Spray Drift Fraction	0	Assumed formed in the soil
Application Efficiency	1.0	Assumed formed in the soil
Aerobic Aquatic	49.2	No acceptable data were available; 2x the half-life corresponding to the PRZM aerobic soil metabolism rate

Metabolic Half-life (days)		input value (2x 24.6d) was used per guidance (Input guidance, 2009).
Anaerobic Aquatic Metabolic Half-life (days)	0	Stable. MRID 43245208. Input Parameter Guidance 2009.
Hydrolysis (pH 7) Half-life (days)	0	Stable. MRID# 43245208
Aquatic Photolysis Half-life (days)	105	No data for DCSA; therefore, used value for dicamba: MRID 42774102. Input Parameter Guidance 2009. Adjusted half-life to represent sun intensity and 12 hours of sunlight per day. 38.1 day value represented continuous sun exposure at an intensity of 1.38 times natural sunlight.

PRZM-EXAMS Modeling Output

Table 6 presents combined PRZM/EXAMS estimated environmental concentrations in surface water for dicamba acid and the DCSA degradate for the proposed use on dicamba-tolerant soybean. These estimated environmental concentrations (EECs) were used to calculate risk to aquatic animals and plants.

The 1-in-10-year peak concentration for dicamba acid for modeled soybean scenario is 38 µg/L, the 21-day average concentration is 36 µg/L, and the 60-day average concentration is 31 µg/L. Table 6 provides combined EECs for dicamba parent and DCSA degradate. The PRZM/EXAMS output files are provided in the **APPENDIX II.**

TABLE 6. Combined PRZM/EXAMS Estimated Environmental Concentrations (EECs) for Dicamba Acid and DCSA Degradate.

Scenario	Estimated Water Concentrations (µg/L)		
	1-in-10-year Peak EEC	1-in-10-year 21-day mean EEC	1-in-10-year 60-day mean EEC
Dicamba and DCSA[1]			
MS Soybean – water column	40.3	37.9	33.1
[1] The EEC presents a combined value for the parent and degradate			

ASSUMPTIONS AND UNCERTAINTIES

The following uncertainties have been identified in the environmental fate properties and aquatic assessment for dicamba and its degradate DCSA:

- The proposed label does not specify the minimum application interval between the consecutive applications, but the approximate growth stage of the plant. Therefore, for this assessment, it was assumed that the minimum application interval between the consecutive applications is 3 days.

- DCSA percent formation used for the modeling "application rate" calculation was based on the amount of degradate formed in the aerobic soil metabolism conducted on silt loam soil. It is possible that DCSA maybe formed in different amounts in different soil types, and result in DCSA EECs being underestimated. The use of 100% conversion from the parent to DCSA, however, was not pursued herein as this approach would be overly conservative.

- The PRZM/EXAMS aerobic aquatic metabolism input parameter is based on a supplemental study, although there are uncertainties associated with the aerobic aquatic metabolism half-life (MRID 43758509), the input parameter is more conservative than the one previously used in the aquatic assessments (US EPA, 2010).

MONITORING DATA

Surface water and groundwater monitoring data from the United States Geological Survey (USGS) NAWQA program was accessed on November 16, 2010 and all filtered water data (.7 micron glass fiber filter) were downloaded. A total of 14163 water samples from 6243 sites were analyzed for dicamba. Of these samples, 268 (3.4%) out of 7822 samples had positive detections of dicamba in surface water, and five out of 6341 samples in groundwater. The maximum concentration detected in filtered water from surface water was 1.76 µg/L in the Rocky Creek at State Hwy 587 at Citrus Park, Hillsborough County, Florida. Dicamba was detected in the Zollner Creek near Mt Angel, Oregon (agricultural area), in 19 samples with concentrations ranging 0.0097 -0.3775 µg/L and in the White Rock Creek at Greenville Ave, Dallas, Texas (urban area), in 16 samples with concentrations ranging from 0.0113 -0.3175 µg/L. The maximum estimated concentration detected in the filter groundwater was 4.03 µg/L in urban area (SH:UR-18) in Shelby, Tennessee. Overall the filtered surface water samples were detected at various areas with concentrations ranging 0.0094 -1.76µg/L, while groundwater filtered samples with concentration ranging 4.03 (estimated value)-0.14 µg/L. No clear pattern in dicamba detections from different use sites is evident because dicamba was detected in a number of different types of watersheds (agricultural, urban, mixed and other) as classified by the USGS land use information. Most of this data is non-targeted (*i.e.*, study was not specifically designed to capture dicamba concentrations in high use areas). Typically, sampling frequencies employed in monitoring studies are insufficient to document peak exposure values. This coupled with the fact that these data are not temporally or spatially correlated with dicamba application times and/or areas limit the utility of these data in estimating exposure concentrations for risk assessment.

Monitoring data are available in the Pesticides in Ground Water Database [Hoheisel *et al.* 1991] for dicamba (3,172 wells sampled) and 5-hydroxy dicamba (87 wells sampled). Out of the wells sampled, there were no reports of residues greater than the stated MCL (200 µg/L lifetime). However, the detection limits are unknown, and it is not known if wells were sampled in areas where dicamba was used. STORET contains records for sampling for dicamba in samples from lakes, ocean, estuary, canal, or reservoir sites. The data have not been extensively evaluated; in addition, it is uncertain what the actual detection limits were for the samples and whether samples were taken from areas where dicamba was not in use.

ENVIRONMENTAL EFFECTS DATA

Assessment of risk is based on the most sensitive species tested for terrestrial and aquatic organisms. The acute and chronic toxicity values for the most sensitive terrestrial and aquatic organisms tested are presented in **Table 7**. These endpoints are based on those presented in the most recent assessment conducted for dicamba, except for the terrestrial plant endpoints (USEPA 2010, D029801). The risks to terrestrial plants were evaluated using new toxicity information from a seedling emergence (MRID 47815101) and vegetative vigor (MRID 47815102) terrestrial plant studies conducted with a typical end-use product (TEP) representative of the product being proposed here for use on dicamba-tolerant soybean. The new vegetative vigor study was determined to be supplemental due to a decrease in plant height in lettuce controls. Quantitative data for the other nine species in the study may be used in risk assessment, but the endpoints for lettuce may not be used in risk assessment. The new data indicates that the DGA salt may be less toxic to monocots, but has an EC_{25} approximately 13 times more toxic to the vegetative vigor of dicots than dicamba acid. It is unclear if the enhanced toxicity to dicots is due to synergistic effects with surfactants and adjuvants in the formulation used (Clarity Herbicide, EPA Reg No. 7969-137, 56.8% DGA salt) or due to the DGA salt itself.

TABLE 7. Toxicity Values Used to Assess Risks from Use of Dicamba.

SPECIES	ACUTE ENDPOINT	NOAEC	MRID
Rainbow trout (*Oncorhynchus mykiss*)	LC_{50} = 28 mg a.e./L	No data available	40098001[1]
Sheepshead minnow (*Cyprinodon variegates*)	LC_{50} > 180 mg a.e./L	No data available	000253901
Water flea (*Daphnia magna*)	EC_{50} > 100 mg a.e./L	No data available	40094602
Grass shrimp (*Palaemonetes purgio*)	EC_{50} > 100 mg a.e./L	No data available	00034702
Duckweed (*Lemna gibba*)	IC_{50} > 3.25 mg a.e./L	NOAEC = 0.20 mg a.e../L	42774111
Blue-green algae (*Anabaena flos-aquae*)	IC_{50} = 0.061 mg a.e./L	NOAEC = 0.005 mg a.e./L	42774109
Bobwhite quail (*Colinus virginianus*) or Mallard duck (*Anas platyrhynchos*)	LD_{50} = 188 mg a.e./kg-bw (quail) LC_{50} > 10,000 mg a.e./kg-diet (quail)	NOAEC = 800 mg a.e./kg-diet (duck) (based on a reduction in hatchability at 1,600 mg a.e./kg-diet)	42918001, 00025391, 43814003
Rat (*Rattus norvegicus*)	LD_{50} = 2,740 mg a.e./kg-bw	NOAEL = 45 mg a.e./kg-bw (based on decreased pup weight at 136 mg a.e./kg-bw)	00078444, 43137101
Honey bee (*Apis mellifera*)	LD_{50} > 91 µg a.e./bee	No data available	00036935
Dicot (Tomato, *Lycopersicon esculentum*) – seedling emergence	EC_{25} = 0.123 lbs ae/A	NOAEC = 0.0673 lbs ae/A	47815101
Monocot (Onion, *Allium cepa*) – Seedling Emergence	EC_{25} = 1.68 lbs ae/A	NOAEC = 0.64 lbs ae/A	47815101
Dicot (Soybean, *Glycine max*) – Vegetative Vigor	EC_{25} = 0.000513 lbs ae/A	EC_{05} = 0.000013 lbs ae/A	47815102[2]
Monocot (Onion, *Allium cepa*) – Vegetative Vigor	EC_{25} = 0.472 lbs ae/A	EC_{05} = 0.137 lbs ae/A	47815102[2]

[1] The raw data from this study (Mayer and Ellersieck, 1986; MRID 40098001) were not available for review. Therefore, per current EFED policy regarding the results from this study, the study was classified as 'supplemental'.
[2] Currently in review.
"a.e." = acid equivalent.

RISK ESTIMATION & CHARACTERIZATION

Aquatic Organisms

The only acute RQ that could be calculated for aquatic animals based on available data is for freshwater fish [specifically rainbow trout (*Oncorhynchus mykiss*) (MRID 40098001)]. The acute RQ for freshwater fish is <0.01 for both dicamba (37.9 µg a.e./L divided by 28,000 µg a.e./L) and DCSA (2.4 µg a.e./L divided by 28,000 µg a.e./L). The results from the remaining acute aquatic animal studies are from limit tests and are non-definitive (*i.e.*, the LC_{50}/EC_{50}'s are 'greater than' values); therefore, acute RQs cannot be calculated using these data.

In order to gain a better understanding of how the EECs for the maximum proposed dicamba application rate for soybeans relate to the toxicity data currently available for aquatic animals, we compared the EECs to the toxicity endpoints using the conservative assumption that the highest concentrations tested in the acute aquatic animal studies represent endpoints (*e.g.*, acute: LC_{50} = 100 mg a.e./L). In this exercise, none of the acute RQs for estuarine/marine fish or aquatic invertebrates (freshwater and estuarine/marine) would exceed an Agency level of concern (LOC) for dicamba or DCSA (they are all <0.01).

Risks to aquatic animals from chronic exposure to dicamba could not be assessed at this time because of a lack of data. Since risk cannot be precluded, it is assumed.

For aquatic plants the only RQ that exceeds an Agency LOC is for listed non-vascular aquatic plants and dicamba (RQ = 7.6) (see **Table 8**). The results from the available vascular aquatic plant study are non-definitive (*i.e.*, the IC_{50}' is a 'greater than' value); therefore, a non-listed species RQ cannot be calculated using these data. In order to gain a better understanding of how the EECs for the maximum proposed dicamba application rate for soybeans relate to the toxicity data currently available for aquatic vascular plants, we compared the EECs to the toxicity endpoints using the conservative assumption that the highest concentration tested in the vascular aquatic plant study represents the endpoint (*i.e.*, IC_{50} = 3.25 mg a.e./L). In this exercise, the RQ would not exceed the Agency's level of concern (LOC) for dicamba or DCSA (they are <0.01).

TABLE 8. RQs for Aquatic Plants and the Use of Dicamba on Soybeans.

TAXON	LISTED/NON-LISTED	ENDPOINT (µg a.e./L)	MS -SOYBEANS			
			DICAMBA		DCSA	
			EEC (µg a.e./L)	RQ	EEC (µg a.e./L)	RQ
Vascular Aquatic Plant	Non-listed species	Non-definitive	37.9 (peak)	N/A	2.4 (peak)	N/A
	Listed species	NOAEC = 200	37.9 (peak)	0.2	2.4 (peak)	0.01
Non-Vascular Aquatic Plant	Non-listed species	IC_{50} = 61	37.9 (peak)	0.6	2.4 (peak)	0.04
	Listed species	NOAEC = 5	37.9 (peak)	**7.6**	2.4 (peak)	0.5

Bolded numbers exceed the Agency LOC of '1'.
"a.e." = acid equivalent.
"N/A" = not applicable

Terrestrial Organisms

In the EFED Reregistration Chapter for Dicamba/Dicamba Salts (USEPA 2005; DP 317696), the maximum single application rate assessed was 2.0 lb a.e./acre. The maximum single application rate for the proposed new use of dicamba on dicamba-tolerant soybeans is 1.0 lb a.e./acre, with a maximum yearly application rate of 2.0 lb a.e./acre. The maximum single application rate of 1.0 lb a.e./acre can only be used once; the maximum application rate for subsequent applications is limited to 0.5 lb a.e./acre. T-REX does not currently model RQs for multiple applications that have different single application rates (*i.e.*, when entering the application rate for multiple applications into the model, the application rates must be the same for the RQs to be automatically calculated).

In the previous assessments conducted by EFED (USEPA, 2005, 2010), there were risks to birds (acute - listed and non-listed) and mammals (acute – listed; chronic – listed and non-listed) identified based on LOC exceedences from RQs calculated in T-REX using the 2.0 lb a.e./acre application rate. We re-ran T-REX using the 1.0 lb a.e./acre application rate. At the 1.0 lb a.e./acre application rate, the Agency's acute LOCs are exceeded for listed and non-listed birds [acute dose-based RQs range from <0.01 (1,000 g bird that eats seeds) to 2.0 (20 g bird that eats short grass)] (see **Table 9** and **APPENDIX IV**). No chronic RQs exceed the Agency's LOC for chronic risk (chronic dietary-based RQs range from 0.02 to 0.30).

TABLE 9. Acute Dose-Based RQs for Birds from T-REX for Dicamba Use on Dicamba-Tolerant Soybeans[1].

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	**2.02**	**0.90**	**0.29**
Tall Grass	**0.92**	**0.41**	**0.13**
Broadleaf plants/sm insects	**1.14**	**0.51**	**0.16**
Fruits/pods/seeds/lg insects	**0.13**	0.06	0.02
Seeds (granivore)	0.03	0.01	0.00

[1] One application at 1.0 lb a.e./acre was modeled
Bolded numbers exceed the Agency's acute risk LOC for non-listed species (RQ > 0.5) and/or the acute risk LOC for listed species (RQ > 0.1).

For mammals, none of the acute RQs exceed any of the Agency's LOCs (acute dose-based RQs range from <0.01 to 0.04). Additionally, none of the dietary-based chronic RQs exceed the Agency's LOCs for chronic risk (chronic dietary-based RQs range from 0.02 to 0.27). Chronic dose-based RQs, however, do exceed the Agency's LOC for chronic risk (chronic dose-based RQs range from 0.01 to 2.3) (see **Table 10** and **APPENDIX IV**).

TABLE 10. Chronic Dose-Based RQs for Mammals from T-REX for Dicamba Use on Dicamba-Tolerant Soybeans[1].

Dose-based RQs (Dose-based NOAEL)	Small mammal 15 grams	Medium mammal 35 grams	Large mammal 1000 grams
Short Grass	**2.31**	**1.98**	**1.06**
Tall Grass	**1.06**	0.91	0.49

Broadleaf plants/sm insects	**1.30**	**1.11**	0.60
Fruits/pods/lg insects	0.14	0.12	0.07
Seeds (granivore)	0.03	0.03	0.01

[1] One application at 1.0 lb a.e./acre was modeled
Bolded numbers exceed the Agency's chronic risk LOC for listed and non-listed species (RQ > 1).

Therefore, there are still risks to birds (acute - listed and non-listed) and mammals (acute – listed; chronic – listed and non-listed) with the single maximum application rate of 1.0 lb a.e./acre.

Based on the available acute toxicity data available for honey bees, dicamba is classified as practically non-toxic to beneficial terrestrial invertebrates.

Terrestrial Plants

Dicamba exposure to terrestrial and semi-aquatic plants is estimated using the TerrPlant (version 1.2.2) model. The model generates EECs for plants residing near a use area that may be exposed via runoff and/or spray drift. The EECs are generated from one application at the maximum rate for a particular use and compound-specific solubility information. Only a single application is considered because it is assumed that for plants, toxic effects are likely to manifest shortly after the initial exposure and that subsequent exposures do not contribute to the response. Hence, the model estimates EECs based on application rate, the solubility factor, and default assumptions of drift. Parameter values for application rate, drift assumption and incorporation depth are based upon the use and related application method and can be found in Appendix V.

The EECs and resulting RQs for terrestrial and semi-aquatic plants for a single application of dicamba DGA at the maximum label rate for the proposed use on dicamba-tolerant soybeans are presented in **Tables 11 and 12.** RQs were exceeded for listed and non-listed dicots due to spray drift or in semi-aquatic areas due to runoff and spray drift.

Table 11. EECs for Terrestrial and Semi-Aquatic Plants Near Dicamba Use on Dicamba-Tolerant Soybeans.

Crop	Single Max. Application Rate (lbs a.e./A)	EECs (lbs a.e./A) Ground Spray		
		Total Loading to Adjacent Dry Areas (sheet runoff + drift)	Total Loading to Semi-Aquatic Areas (Channelzed runoff + drift)	Drift EEC
Dicamba-Tolerant Soybeans	1.0	0.06	0.51	0.01

Table 12. RQ values for plants in dry and semi-aquatic areas exposed to Diglycolamine Salt (DGA) through runoff and/or spray drift.*

Plant Type	Listed Status	Dry	Semi-Aquatic	Spray Drift
Monocot	non-listed	<0.1	0.30	<0.1
Monocot	listed	<0.1	0.80	<0.1

Dicot	non-listed	0.49	**4.15**	**19.49**
Dicot	listed	0.89	**7.58**	**769.23**
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

EFED's current screening tool TerrPlant results in a RQ of 0.89 for listed species and 0.49 for non-listed species of dicots in dry areas, which is less than the LOC for plants of 1.0. However, using AgDrift, with standard default assumptions, the RQ exceeds the listed species LOC at ≤142 feet from the application site. At 100' from the application area, the RQ=1.45 and at 50' from the application area the RQ=2.54. Similarly, using AgDrift, the RQ for non-listed species exceeds the LOC at ≤ 77 feet from the application site. For ground application in dry areas, listed dicot populations must be > 142 feet from the application area to be protected and non-listed dicot populations must be > 77 feet from the application area to be protected. **Table 13** shows the distance from the edge of field (as calculated by AgDrift) where the RQ falls below the risk to terrestrial plant LOCs. Listed plant species that may be similar to tomatoes or soybeans would exceed the LOC even if a 1000' buffer was applied to the application site. These calculations used a default droplet size distribution of fine to medium. Different droplet spectra (e.g. coarser drop size distributions) would yield less spray drift and lower RQs.

The aforementioned RQ values are for the DGA salt of dicamba. For dicamba acid, which DGA salt may dissociate to and which has more sensitive seedling emergence values, RQ values would exceed the LOC of 1.0 for all listed and non-listed monocots and dicots in semi-aquatic areas and for listed monocots and listed and non-listed dicots in dry areas. It is unclear what the differences in observed toxicities of the seedling emergence and vegetative vigor studies between the DGA salt and dicamba acid is due to.

Table 13 Distance (feet) from the edge of field where the RQ falls below the risk to terrestrial plant LOC for seedling emergence and vegetative vigor endpoints for ground application, based on AgDRIFT EECs.

Plant Species	Seedling Emergence		Vegetative vigor	
	Listed	Nonlisted	Listed	Nonlisted
Corn	30	<3.3	<3.3	<3.3
Ryegrass	<3.3	<3.3	<3.3	<3.3
Wheat	<3.3	<3.3	3.3	<3.3
Onion	<3.3	<3.3	7	<3.3
Oilseed rape	233	<3.3	10	<3.3
Soybean	10	3.3	>997	784
Cabbage	<3.3	<3.3	30	<3.3
Carrot	3.3	<3.3	171	13

Plant Species	Seedling Emergence		Vegetative vigor	
	Listed	Nonlisted	Listed	Nonlisted
Lettuce	3.3	<3.3	259	36
Tomato	10	7	>997	538

Incident Data

A preliminary review on February 23, 2011, of the Ecological Incident Information System (EIIS, version 2.1), which is maintained by the Agency's Office of Pesticide Programs, and the Avian Monitoring Information System (AIMS), which is maintained by the American Bird Conservancy, indicates a total of 2 reported ecological incidents associated with the use of DGA salt. This total excludes incidents classified as 'unlikely' or 'unrelated' and only includes those incidents with certainty categories of 'possible', 'probable', and 'highly probable' (for EIIS) and 'possible', 'probable', 'likely', 'highly likely' and 'certain' (for AIMS). Incidents classified as 'unlikely' the result of or 'unrelated' to DGA salt will not be included in this ecological risk assessment.

In 1998, in Lyon County, Minnesota, 120 acres of soybeans were adversely affected after dicamba DGA and clopyralid were applied. The type of injurty was not reported. The incident was classified as probable for both dicamba DGA salt and clopyralid and the incident was considered as an accidental misuse. In 2007, in Imperial County, California, a complaint was received that alfalfa fields were damaged, with dead and stunted plants, and leaves curled and cupped. An application of dicamba DGA salt and 2,4-D DMA salt by air to adjacent fields was conducted, however, samples taken from the affected field were found negative for both dicamba and 2,4-D. This incident was classified possible for Dicamba DGA salt and 2,4-D DMA salt and was considered a registered use.

A review was also briefly conducted on the incident data for dicamba acid. The 2006 RED recorded thirty-five ecological incidents attributed to dicamba acid use having been recorded in the Ecological Incident Information System (EIIS) as of June l, 2005. Since the RED, two additional incidents have been reported. In 2006, in St. Landry County, LA, 1500 acres of soybean were damaged by a combination of glyphosate, dicamba and 2,4-D. The type of injury was not reported. This incident was classified as probable for dicamba and 2,4-D and possible for glyphosate and the incident was considered as an intentional misuse. In 2007, in Lancaster County, PA, 4 rabbits were killed after a homeowner applied product with MCPP, Dicamba, and 2-4 D ingredients to the house lawn. This incident was classified as possible for all three active ingredients and the legality was undetermined. The earlier incidents reported include terrestrial, plant, and aquatic impacts. 19 of the incidents involve 2,4-D in addition to dicamba and sometimes other active ingredients. Although the database lists a terrestrial mammalian incident in Utah where dicamba was applied, the database states that dicamba is "unlikely" to have caused the incident. Impacts to plants included a wide range of crops (soybeans, corn, wheat) as well as non-agricultural applications. The specific impacts varied from browning and plant damage to mortality of all plants within the treated area. Aquatic impacts consist of two fish kill incidents associated with agricultural and residential turf application.

FEDERALLY-LISTED SPECIES

Potential effects to federally-listed endangered and threatened species (listed species) based on LOC exceedances require an in-depth listed species evaluation. Identified potential risks to listed species are summarized in **Table 14.**

TABLE 14. Listed Species Risks Associated with Potential Direct or Indirect Effects Due to the Proposed Applications of Dicamba on Dicamba-Tolerant Soybeans.

LISTED TAXON	DIRECT EFFECTS	INDIRECT EFFECTS
Terrestrial and semi-aquatic plants – monocots	No[1]	Yes[3]
Terrestrial and semi-aquatic plants - dicots	Yes	Yes[3]
Insects	No	Yes[3]
Birds	Yes (Acute)	Yes[3]
Terrestrial phase amphibians	Yes (Acute)	Yes[3]
Reptiles	Yes (Acute)	Yes[3]
Mammals	Yes (Chronic)	Yes[3]
Aquatic plants	Yes (Non-vascular)	Yes[3]
Freshwater fish	Yes (Chronic)[2]	Yes[3]
Aquatic phase amphibians	Yes (Chronic)[2]	Yes[3]
Freshwater crustaceans	Yes (Chronic)[2]	Yes[3]
Mollusks	No	Yes[3]
Marine/estuarine fish	Yes (Chronic)[2]	Yes[3]
Marine/estuarine crustaceans	Yes (Chronic)[2]	Yes[3]

[1]Listed species of monocots RQ values did not indicate risk from DGA salt, but risk was indicated for dicamba acid. DGA salt rapidly disassociates into dicamba acid.
[2] Risks could not be precluded due to a lack of data; therefore, risk is assumed.
[3]The listed chronic LOC was exceeded for fish and mammals. Therefore, the potential for adverse effects to those species that rely on a specific animal species (specifically fish and/or mammals) or multiple animal species (specifically fish and/or mammals) cannot be precluded. Indirect effects may include general habitat modification,

loss of pollinators/seed dispersers, and food supply disruption.

At this time, no federally-listed taxa can be excluded from the potential for direct and/or indirect effects from the proposed new uses of dicamba, since there is a potential for indirect effects to taxa that might rely on plants, birds, aquatic animals, and/or mammals for some stage of their life-cycle. A complete co-occurrence analysis could not be completed for listed species at this time, since the specific use site associated with the proposed new use of dicamba (dicamba-tolerant soybeans). Therefore, without further refinement, no species currently listed as federally threatened or endangered can be excluded from the potential for adverse effects from the proposed new use of dicamba. Details regarding the environmental fate, ecological effects and ecological risks associated with the proposed new uses of dicamba are discussed in the sections that follow.

UNCERTAINTIES

There is a lack of data on the effect of dicamba to green algae as well as a lack of data on chronic effects of dicamba to freshwater and saltwater fish and invertebrates. In the absence of data, risk to these taxa has been assumed.

Based on the usage of other herbicides associated with genetically modified crops that are tolerant to a specific herbicide (*e.g.,* glyphosate-tolerant soybean), the use of dicamba on soybeans [lbs acid equivalent (a.e.)/year] could potentially increase when compared to past usage data from this new use. This is due to a variety of factors including the fact that once a tolerant crop is grown in a particular area, the use of the tolerant crop is often adopted by neighbors (to minimize the potential risk from spray drift). Additionally, dicamba use on tolerant soybeans is predicted to increase given the recent resistance issues identified in glyphosate-tolerant soybean (J. Tooker, D. Mortensen, and F. Egan, pers. comm., Nov. 2010; Mortensen 2010). Although EFED does not typically address specific concerns related to the increased usage of a chemical, the potential for ecological risks likely increases with increased usage. BEAD should be consulted on the potential for increase use.

Additionally, applications during a warmer time (*i.e.*, post-emergence) may increase off-site transport (via volatility) during a time when many plants have leafed out (J. Tooker, D. Mortensen, and F. Egan, pers. comm., Nov. 2010; Mortensen 2010). Therefore, a post-emergence application may increase the likelihood of effects to non-target plants through habitat loss. This could indirectly affect those organisms which rely on those plants, including pollinators, through this is uncertain and requires additional evaluation.

It is also possible that the proposed new use of dicamba on dicamba-tolerant soybeans may increase the occurrence of weeds that are resistant to dicamba. The occurrence of weed resistance to glyphosate has increased significantly since the adoption of transgenic glyphosate-resistant crops (Powles, 2008). Prior to development of glyphosate-resistant crops, there were no known cases of evolved glyphosate-resistant weeds (Dyer, 1994). There exists potential that a similar pattern of rapidly evolving weed resistance to dicamba could occur where transgenic dicamba-resistant crops are used.

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APPENDIX I

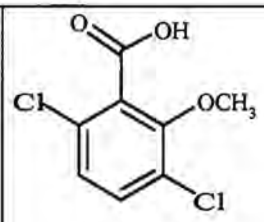
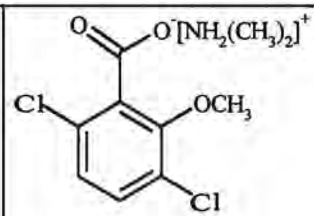
Table 1: Chemical Structures for Dicamba and its Salts	
PC Code 029801	
Chemical structure	
Common name	Dicamba acid
Molecular Formula	$C_8H_6Cl_2O_3$
Molecular Weight	221.04
IUPAC name	3,6-dichloro-*o*-anisic acid
CAS name	3,6-dichloro-2-methoxybenzoic acid or 2-methoxy-3,6-dichlorobenzoic acid
CAS #	1918-00-9
PC Code 029802	
Chemical structure	
Common name	Dicamba dimethylamine salt (DMA salt)
Molecular Formula	$C_{10}H_{13}Cl_2NO_3$
Molecular Weight	266.1
CAS #	2300-66-5
PC Code 029806	
Chemical structure	
Common name	Dicamba sodium salt (Na salt)
Molecular Formula	$C_8H_5Cl_2NaO_3$
Molecular Weight	243.0
CAS #	1982-69-0
PC Code 128931	

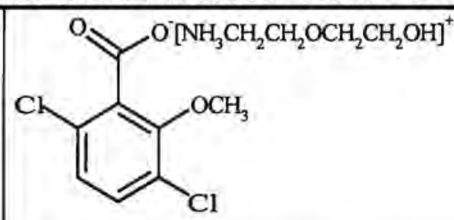
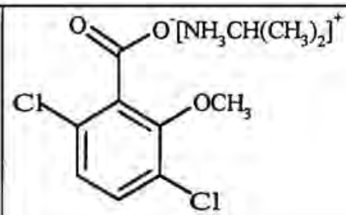
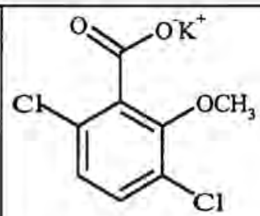
Table 1: Chemical Structures for Dicamba and its Salts	
Chemical structure	
Common name	Dicamba diglycolamine salt (DGA salt)
Molecular Formula	$C_{12}H_{17}Cl_2NO_5$
Molecular Weight	326.18
CAS #	104040-79-1
PC Code 128944	
Chemical structure	
Common name	Dicamba isopropylamine salt (IPA salt)
Molecular Formula	$C_{11}H_{15}Cl_2NO_3$
Molecular Weight	280.15
CAS #	55871-02-8
PC Code 129043	
Chemical structure	
Common name	Dicamba potassium salt (K salt)
Molecular Formula	$C_8H_5Cl_2KO_3$
Molecular Weight	259.1
CAS #	10007-85-9

Table 2. Maximum Percent Formation of Dicamba Degradates Observed in the Laboratory and Field Studies

Degradate	*Max Degradate Concentration (% of applied)*						
	Hydrolysis	*Aqueous Photolysis*	*Soil Photolysis*	*Aerobic Soil Metabolism*	*Anaerobic Aquatic Degradation*	*Aerobic Aquatic Degradation*	*TFD*
DCSA				17.4% (7 days) (MRID 43245207)	61.6% in soil/water system (MRID 43245208)	8.6% (30 days) water 26% (41 days) soil (MRID 43758509)	present
DCGA					3.64% in soil/water system		not detected
5-OH-Dicamba				0.8%	1.9%in soil/water system		not detected
2,5-DiOH-Dicamba				2.7%			not detected

APPENDIX II

Modeling Dicamba applied aerially on MS Soybean

stored as DicamMSsoybeanPDgr.out
Chemical: Dicamba
PRZM environment: MSsoybeanSTD.txt modified Tueday, 26 August 2008 at 06:16:40
EXAMS environment: pond298.exv modified Tueday, 26 August 2008 at 06:14:08
Metfile: w03940.dvf modified Tueday, 26 August 2008 at 06:14:14
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	3.195	3.145	2.943	2.516	2.225	0.9442
1962	5.396	5.332	5.01	4.23	3.702	1.587
1963	12.08	11.87	11.58	10.37	9.189	3.823
1964	5.363	5.289	4.962	4.226	3.711	1.944
1965	1.591	1.57	1.474	1.29	1.159	0.66
1966	12.54	12.38	11.79	10.4	9.286	3.859
1967	16.2	15.97	15.01	13.07	11.6	5.425
1968	7.467	7.396	6.957	5.96	5.242	2.977
1969	48.76	48.28	45.97	39.81	35.09	14.15
1970	11.28	11.1	10.43	9.477	8.454	5.163
1971	38.87	38.42	36.97	32.31	28.59	11.79
1972	6.122	6.027	5.675	5.185	4.781	3.216
1973	51.33	50.79	49.22	43.39	38.3	15.18
1974	21.51	21.25	20.05	17.24	15.32	7.924
1975	7.27	7.187	6.761	5.757	5.074	2.986
1976	4.089	4.033	3.884	3.537	3.171	1.621
1977	15.79	15.62	14.78	12.57	11.01	4.514
1978	8.735	8.624	8.323	7.436	6.6	3.148
1979	9.771	9.625	9.314	8.364	7.481	3.405
1980	28.71	28.38	26.91	22.96	20.02	8.069
1981	3.741	3.725	3.654	3.479	3.32	2.006
1982	16.96	16.75	16.25	14.06	12.41	5.057
1983	3.7	3.645	3.438	2.989	2.802	1.812
1984	8.018	7.894	7.713	6.93	6.174	2.653
1985	6.5	6.417	6.104	5.255	4.64	2.184
1986	1.813	1.783	1.682	1.591	1.459	0.8394
1987	3.864	3.806	3.625	3.072	2.692	1.175
1988	24.89	24.58	23.15	19.85	17.43	6.966
1989	14.08	13.9	13.02	11.09	9.77	4.864
1990	19.66	19.43	18.39	15.9	13.94	6.067

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	51.33	50.79	49.22	43.39	38.3	15.18
0.0645161290322581	48.76	48.28	45.97	39.81	35.09	14.15
0.0967741935483871	38.87	38.42	36.97	32.31	28.59	11.79
0.129032258064516	28.71	28.38	26.91	22.96	20.02	8.069
0.161290322580645	24.89	24.58	23.15	19.85	17.43	7.924
0.193548387096774	21.51	21.25	20.05	17.24	15.32	6.966
0.225806451612903	19.66	19.43	18.39	15.9	13.94	6.067
0.258064516129032	16.96	16.75	16.25	14.06	12.41	5.425
0.290322580645161	16.2	15.97	15.01	13.07	11.6	5.163
0.32258064516129	15.79	15.62	14.78	12.57	11.01	5.057
0.354838709677419	14.08	13.9	13.02	11.09	9.77	4.864
0.387096774193548	12.54	12.38	11.79	10.4	9.286	4.514
0.419354838709677	12.08	11.87	11.58	10.37	9.189	3.859
0.451612903225806	11.28	11.1	10.43	9.477	8.454	3.823
0.483870967741936	9.771	9.625	9.314	8.364	7.481	3.405
0.516129032258065	8.735	8.624	8.323	7.436	6.6	3.216
0.548387096774194	8.018	7.894	7.713	6.93	6.174	3.148
0.580645161290323	7.467	7.396	6.957	5.96	5.242	2.986
0.612903225806452	7.27	7.187	6.761	5.757	5.074	2.977
0.645161290322581	6.5	6.417	6.104	5.255	4.781	2.653
0.67741935483871	6.122	6.027	5.675	5.185	4.64	2.184
0.709677419354839	5.396	5.332	5.01	4.23	3.711	2.006
0.741935483870968	5.363	5.289	4.962	4.226	3.702	1.944
0.774193548387097	4.089	4.033	3.884	3.537	3.32	1.812

0.806451612903226	3.864	3.806	3.654	3.479	3.171	1.621	
0.838709677419355	3.741	3.725	3.625	3.072	2.802	1.587	
0.870967741935484	3.7	3.645	3.438	2.989	2.692	1.175	
0.903225806451613	3.195	3.145	2.943	2.516	2.225	0.9442	
0.935483870967742	1.813	1.783	1.682	1.591	1.459	0.8394	
0.967741935483871	1.591	1.57	1.474	1.29	1.159	0.66	
0.1		37.854	37.416	35.964	31.375	27.733	11.4179
				Average of yearly averages:			4.53362

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:
Output File: DicamMSsoybeanPDgr
Metfile: w03940.dvf
PRZM scenario: MSsoybeanSTD.txt
EXAMS environment file: pond298.exv
Chemical Name: Dicamba

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	221	g/mol	
Henry's Law Const.	henry	1.6E-9	atm-m^3/mol	
Vapor Pressure	vapr	3.41E-5	torr	
Solubility	sol	6100	mg/L	
Kd	Kd		mg/L	
Koc	Koc	13.4	mg/L	
Photolysis half-life	kdp	105	days	Half-life
Aerobic Aquatic Metabolism	kbacw	72.9	days	Halfife
Anaerobic Aquatic Metabolism	kbacs	423	days	Halfife
Aerobic Soil Metabolism	asm	18	days	Halfife
Hydrolysis:	pH 5	0	days	Half-life
Hydrolysis:	pH 7	0	days	Half-life
Hydrolysis:	pH 9	0	days	Half-life
Method:	CAM	2	integer	See PRZM manual
Incorporation Depth:	DEPI		cm	
Application Rate:	TAPP	1.12	kg/ha	
Application Efficiency:	APPEFF	0.99	fraction	
Spray Drift	DRFT	0.01	fraction of application rate applied to pond	
Application Date	Date	16-04	dd/mm or dd/mmm or dd-mm or dd-mmm	
Interval 1	interval	3	days	Set to 0 or delete line for single app.
app. rate 1	apprate	0.56	kg/ha	
Interval 2	interval	3	days	Set to 0 or delete line for single app.
app. rate 2	apprate	0.56	kg/ha	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0.5		
Flag for Index Res. Run	IR		EPA Pond	
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)	

Modeling DCSA from Dicamba applied via ground on MS Soybean

stored as DCSAMSsoybeanPD.out
Chemical: DCSA
PRZM environment: MSsoybeanSTD.txt modified Tueday, 26 August 2008 at 06:16:40
EXAMS environment: pond298.exv modified Tueday, 26 August 2008 at 06:14:08
Metfile: w03940.dvf modified Tueday, 26 August 2008 at 06:14:14
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.4857	0.456	0.3607	0.2974	0.2768	0.1214
1962	0.4204	0.3977	0.3476	0.26	0.2205	0.1292
1963	0.4554	0.4319	0.3631	0.3058	0.2959	0.1733
1964	1.794	1.691	1.339	0.9315	0.7746	0.3625
1965	0.2641	0.2637	0.2613	0.2549	0.2493	0.1673
1966	1.569	1.516	1.312	1.104	0.9609	0.4516
1967	2.399	2.281	1.973	1.573	1.345	0.6988
1968	1.263	1.218	1.119	0.9311	0.811	0.5318
1969	2.197	2.086	1.722	1.258	1.057	0.5596

1970	0.7601	0.728	0.6233	0.5022	0.451	0.3258
1971	2.736	2.601	2.353	1.972	1.657	0.7538
1972	1.099	1.052	1	0.7875	0.6824	0.4672
1973	2.711	2.611	2.242	1.775	1.486	0.7053
1974	0.9504	0.915	0.7939	0.69	0.6292	0.4341
1975	1.589	1.503	1.298	1.012	0.8664	0.4646
1976	1.438	1.367	1.228	0.9746	0.8417	0.4763
1977	1.088	1.039	0.8804	0.6684	0.5829	0.3699
1978	1.36	1.291	1.196	0.9029	0.7588	0.4023
1979	1.502	1.423	1.288	1.046	0.9341	0.5168
1980	1.899	1.81	1.648	1.408	1.19	0.619
1981	1.072	1.024	0.9449	0.7578	0.6585	0.4295
1982	2.189	2.075	1.823	1.319	1.159	0.5977
1983	2.088	1.993	1.646	1.207	1.01	0.5655
1984	1.153	1.099	0.9339	0.7359	0.6511	0.4228
1985	0.3574	0.3475	0.317	0.27	0.2617	0.2047
1986	1.158	1.089	0.8878	0.6305	0.5289	0.2581
1987	0.5557	0.5283	0.4466	0.3983	0.3662	0.2322
1988	1.379	1.307	1.064	0.7544	0.6282	0.3171
1989	1.823	1.729	1.541	1.297	1.111	0.5428
1990	1.513	1.439	1.221	1.001	0.8629	0.5036

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	2.736	2.611	2.353	1.972	1.657	0.7538
0.0645161290322581	2.711	2.601	2.242	1.775	1.486	0.7053
0.0967741935483871	2.399	2.281	1.973	1.573	1.345	0.6988
0.129032258064516	2.197	2.086	1.823	1.408	1.19	0.619
0.161290322580645	2.189	2.075	1.722	1.319	1.159	0.5977
0.193548387096774	2.088	1.993	1.648	1.297	1.111	0.5655
0.225806451612903	1.899	1.81	1.646	1.258	1.057	0.5596
0.258064516129032	1.823	1.729	1.541	1.207	1.01	0.5428
0.290322580645161	1.794	1.691	1.339	1.104	0.9609	0.5318
0.32258064516129	1.589	1.516	1.312	1.046	0.9341	0.5168
0.354838709677419	1.569	1.503	1.298	1.012	0.8664	0.5036
0.387096774193548	1.513	1.439	1.288	1.001	0.8629	0.4763
0.419354838709677	1.502	1.423	1.228	0.9746	0.8417	0.4672
0.451612903225806	1.438	1.367	1.221	0.9315	0.811	0.4646
0.483870967741936	1.379	1.307	1.196	0.9311	0.7746	0.4516
0.516129032258065	1.36	1.291	1.119	0.9029	0.7588	0.4341
0.548387096774194	1.263	1.218	1.064	0.7875	0.6824	0.4295
0.580645161290323	1.158	1.099	1	0.7578	0.6585	0.4228
0.612903225806452	1.153	1.089	0.9449	0.7544	0.6511	0.4023
0.645161290322581	1.099	1.052	0.9339	0.7359	0.6292	0.3699
0.67741935483871	1.088	1.039	0.8878	0.69	0.6282	0.3625
0.709677419354839	1.072	1.024	0.8804	0.6684	0.5829	0.3258
0.741935483870968	0.9504	0.915	0.7939	0.6305	0.5289	0.3171
0.774193548387097	0.7601	0.728	0.6233	0.5022	0.451	0.2581
0.806451612903226	0.5557	0.5283	0.4466	0.3983	0.3662	0.2322
0.838709677419355	0.4857	0.456	0.3631	0.3058	0.2959	0.2047
0.870967741935484	0.4554	0.4319	0.3607	0.2974	0.2768	0.1733
0.903225806451613	0.4204	0.3977	0.3476	0.27	0.2617	0.1673
0.935483870967742	0.3574	0.3475	0.317	0.26	0.2493	0.1292
0.967741935483871	0.2641	0.2637	0.2613	0.2549	0.2205	0.1214
0.1	2.3788	2.2615	1.958	1.5565	1.3295	0.69082

Average of yearly averages: 0.42682

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:
Output File: DCSAMSsoybeanPD
Metfile: w03940.dvf
PRZM scenario: MSsoybeanSTD.txt
EXAMS environment file: pond298.exv
Chemical Name: DCSA

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	207	g/mol	
Henry's Law Const.	henry	1.6E-9	atm-m^3/mol	
Vapor Pressure	vapr	3.41E-5	torr	

Solubility	sol	2112	mg/L		
Kd	Kd		mg/L		
Koc	Koc	1208	mg/L		
Photolysis half-life		kdp	105	days	Half-life
Aerobic Aquatic Metabolism		kbacw	49.2	days	Halfife
Anaerobic Aquatic Metabolism		kbacs	0	days	Halfife
Aerobic Soil Metabolism		asm	24.6	days	Halfife
Hydrolysis:	pH 5	0	days	Half-life	
Hydrolysis:	pH 7	0	days	Half-life	
Hydrolysis:	pH 9	0	days	Half-life	
Method: CAM	1	integer	See PRZM manual		
Incorporation Depth:	DEPI		cm		
Application Rate:	TAPP	0.18	kg/ha		
Application Efficiency:		APPEFF	1.0	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond		
Application Date	Date	16-04	dd/mm or dd/mmm or dd-mm or dd-mmm		
Interval 1	interval	3	days	Set to 0 or delete line for single app.	
app. rate 1	apprate	0.09	kg/ha		
Interval 2	interval	3	days	Set to 0 or delete line for single app.	
app. rate 2	apprate	0.09	kg/ha		
Record 17:	FILTRA				
	IPSCND	1			
	UPTKF				
Record 18:	PLVKRT				
	PLDKRT				
	FEXTRC	0.5			
Flag for Index Res. Run		IR	EPA Pond		
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)		

APPENDIX III: Environmental Fate and Transport Database Dicamba Acid (and its Salts):

GUIDELINE NUMBER	DESCRIPTION	ACTIVE INGREDIENT	CITATION	CLASSIFICATION
835.2120	Hydrolysis	Dicamba acid	40335501	Acceptable
835.2240	Photodegradation in Water	Dicamba acid	42774102	Acceptable
835.2410	Photodegradation on Soil	Dicamba acid	42774103	Acceptable
835.2370	Photodegradation in Air	No data available	N/A	N/A
835.4100	Aerobic Soil Metabolism	Dicamba aicd	43245207	Acceptable
835.4200	Anaerobic Soil Metabolism	Dicamba acid	43245208	Acceptable
835.4400	Anaerobic Aquatic Metabolism	Dicamba acid	43245208	Acceptable
835.4300	Aerobic Aquatic Metabolism	Dicamba acid	43758509	Supplemental
835.1230	Leaching Adsorption/Desorption	Dicamba acid Dicamba acid	42774101 43095301	Acceptable Supplemental
835.1410	Laboratory Volatility	K and DMA salts	41966602	Acceptable
835.8100	Field Volatility	No data available	N/A	N/A
835.6100	Terrestrial Field Dissipation	Sodium and Diglycoamine salts Diglycoamine salt Dimethylamine salt Diglycoamine salt Sodium salt Potassium salt Potassium salt	43361506 43361507 43651405 43651407 43651408 42754101 42754102	Supplemental Supplemental Supplemental Supplemental Supplemental Supplemental Supplemental
835.6200	Aquatic Field Dissipation	No data available	N/A	N/A
835.6300	Forestry Dissipation	No data available	N/A	N/A
850.1730	Accumulation in Fish	Study waived	N/A	N/A
850.1950	Accumulation Aquatic non-target organisms	No data available	N/A	N/A
835.7100	Ground Water- small prospective	No data available	N/A	N/A
166-2	Groundwater-small retrospective	No data available	N/A	N/A
201-1	Droplet Size Spectrum	No data available	N/A	N/A
202-1	Drift Field Evaluation	No data available	N/A	N/A

APPENDIX IV: T-REX Inputs and Outputs for Dicamba Use on Dicamba-Tolerant Soybeans.

Upper Bound Kenaga Residues For RQ Calculation

Chemical Name:	0	
Use	0	
Formulation	0	
Application Rate	1	lbs a.i./acre
Half-life	35	days
Application Interval	0	days
Maximum # Apps./Year	1	
Length of Simulation	1	year

Endpoints			
Avian	**Bobwhite quail**	**LD50 (mg/kg-bw)**	**188.00**
	Bobwhite quail	**LC50 (mg/kg-diet)**	**0.00**
	Mallard duck	**NOAEL(mg/kg-bw)**	**0.00**
	Mallard duck	**NOAEC (mg/kg-diet)**	**800.00**
Mammals		**LD50 (mg/kg-bw)**	**2740.00**
		LC50 (mg/kg-diet)	**0.00**
		NOAEL (mg/kg-bw)	**45.00**
		NOAEC (mg/kg-diet)	**900.00**

Dietary-based EECs (ppm)	**Kenaga Values**
Short Grass	**240.00**
Tall Grass	**110.00**
Broadleaf plants/sm Insects	**135.00**
Fruits/pods/seeds/lg insects	**15.00**

Summary of Risk Quotient Calculations Based on Upper Bound Kenaga EECs

Upper Bound Kenaga, Acute Avian Dose-Based Risk Quotients											
		EECs and RQs									
Size Class (grams)	**Adjusted LD50**	**Short Grass**		**Tall Grass**		**Broadleaf Plants/ Small Insects**		**Fruits/Pods/ Seeds/ Large Insects**		**Granivore**	
		EEC	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**
20	135.44	273.34	2.02	125.28	0.92	153.75	1.14	17.08	0.13	3.80	0.03
100	172.42	155.87	0.90	71.44	0.41	87.68	0.51	9.74	0.06	2.16	0.01
1000	243.55	69.78	0.29	31.98	0.13	39.25	0.16	4.36	0.02	0.97	0.00

Upper Bound Kenaga, Chronic Avian Dietary Based Risk Quotients

NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
800	240.00	0.30	110.00	0.14	135.00	0.17	15.00	0.02

Size class not used for dietary risk quotients

Upper Bound Kenaga, Acute Mammalian Dose-Based Risk Quotients												
Size Class (grams)	Adjusted LD50	EECs and RQs										
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	6022.06	228.82	0.04	104.88	0.02	128.71	0.02	14.30	0.00	3.18	0.00
35	4872.49	158.15	0.03	72.48	0.01	88.96	0.02	9.88	0.00	2.20	0.00
1000	2107.50	36.67	0.02	16.81	0.01	20.63	0.01	2.29	0.00	0.51	0.00

Upper Bound Kenaga, Chronic Mammalian Dietary Based Risk Quotients								
NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
900	240.00	0.27	110.00	0.12	135.00	0.15	15.00	0.02

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dose-Based Risk Quotients											
Size Class (grams)	Adjusted NOAEL	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	98.90	228.82	2.31	104.88	1.06	128.71	1.30	14.30	0.14	3.18	0.03
35	80.02	158.15	1.98	72.48	0.91	88.96	1.11	9.88	0.12	2.20	0.03
1000	34.61	36.67	1.06	16.81	0.49	20.63	0.60	2.29	0.07	0.51	0.01

APPENDIX V: TerrPlant Inputs and Outputs for Dicamba Use on Dicamba-Tolerant Soybeans.

Table 1. Chemical Identity.	
Chemical Name	Diglycolamine salt (DGA) of Dicamba
PC code	128931
Use	Dicamba-Tolerant Soybeans
Application Method	Foliar
Application Form	Liquid
Solubility in Water (ppm)	6100

Table 2. Input parameters used to derive EECs.

Input Parameter	Symbol	Value	Units
Application Rate	A	1	
Incorporation	I	1	none
Runoff Fraction	R	0.05	none
Drift Fraction	D	0.01	none

Table 3. EECs for Diglycolamine salt (DGA) of Dicamba. Units in .

Description	Equation	EEC
Runoff to dry areas	(A/I)*R	0.05
Runoff to semi-aquatic areas	(A/I)*R*10	0.5
Spray drift	**A*D**	**0.01**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.06**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.51**

Table 4. Plant survival and growth data used for RQ derivation. Units are in .

Plant type	Seedling Emergence		Vegetative Vigor	
	EC_{25}	NOAEC	EC_{25}	NOAEC
Monocot	1.68	0.64	0.472	0.137
Dicot	0.123	0.0673	0.000513	0.000013

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Diglycolamine salt (DGA) of Dicamba through runoff and/or spray drift.*

Plant Type	Listed Status	Dry	Semi-Aquatic	Spray Drift
Monocot	non-listed	<0.1	0.30	<0.1
Monocot	listed	<0.1	0.80	<0.1
Dicot	non-listed	0.49	4.15	19.49
Dicot	listed	0.89	7.58	769.23

*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.

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September 17, 2010

Environmental Protection Agency
Office of Pesticide Programs
Regulatory Public Docket (7502P)
1200 Pennsylvania Ave., NW
Washington, DC 20460

RE: Docket No.: EPA-HQ-OPP-2010-0496

Monsanto's petition seeking registration of the use of dicamba on dicamba-resistant soybeans raises a number of important issues, some specific to dicamba and dicamba-resistant crops, and others pertaining to the use of herbicide-resistant (HR) crop systems in general, and how they are regulated by USDA and EPA. We will first address the more general concerns with HR crop systems, followed by a discussion of issues specific to dicamba and dicamba-resistant soybeans.

I. Need for coordinated regulation of herbicide-resistant crop systems

Herbicide-resistant crops (when developed via genetic engineering) are the purview of the USDA, while the application to them of the crop-associated herbicide(s) is the purview of the EPA. The fundamental problem with this regulatory framework is that it fails to address significant issues and problems that arise from the combination.

Below, we argue that herbicide-resistant crops and their associated herbicides must be understood as ***herbicide-resistant crop systems (HRCSs)***, and that the Coordinated Framework must be adapted to regulate them as such. As things now stand, unregulated use of HRCSs have triggered and will continue to cause huge and costly agronomic problems for U.S. agriculture.

a) Distinctive features of HRCSs:

Herbicide-resistant crop systems have dramatically altered the way American farmers control weeds, and it is important to understand why this is so. We discern four distinctive features. With respect to the HR crop-associated herbicide(s), HRSCs facilitate:

1) A great expansion in treated acreage;

2) A dramatic widening of the temporal "application window" or period of the crop's life when the herbicide(s) can be applied;
3) Increased rate of application; and
4) Increased reliance, to the exclusion of other methods of weed control.

The discussion below relies heavily on empirical evidence from glyphosate-resistant, Roundup Ready crop systems, which at present represent nearly the entire universe of HRCSs. Lessons learned from analysis of glyphosate-resistant crop systems should be applied to better anticipate and manage problems created by future HRCSs, including dicamba-resistant soybeans.

Expanded acreage
Herbicide-resistance by definition permits direct application of the associated (usually broad-spectrum) herbicide(s) to a crop that was previously susceptible (or only slightly tolerant) to it. Widespread adoption of the HR crop thus triggers greatly expanded use. Glyphosate-resistant (GR), Roundup Ready crops are instructive in this regard. Prior to GR crop introduction, glyphosate was little used in field crops because it is extremely toxic to both cereal and broadleaf crops. Since their introduction in 1996, GR crops have been grown on roughly 1 billion acres. In 2008, GR soybeans, corn and cotton were planted on at least 130 million acres in the U.S. – over 90% of soybean and cotton acreage, roughly 60% of corn acreage. Thus, it is not surprising to learn that glyphosate use on soybeans, cotton and corn has increased by 15-fold in the U.S. from 1994, shortly before their introduction, to 2005. Thus far, biotech-pesticide firms have targeted HR crop development to the nation's highest acreage crops – corn, soybeans, wheat, alfalfa[1] and cotton – maximizing the expansion in acreage treated with HR crop-associated herbicides.

Widened application window
HR crops are designed to facilitate complete or primary reliance on post-emergence weed control. This means that a broad-spectrum herbicide whose use was previously limited to the beginning (burndown, pre-plant, pre-emergence) or end (burndown) of a crop season may now be applied one or more times through much or all of the crop's growing season. The widespread adoption of GR crops has greatly expanded the post-emergence use of glyphosate. In 1996, glyphosate was applied to soybean and cotton fields on average 1.1 and 1.0 times per season, reflecting the one-time burndown usage of glyphosate by some growers prior to GR crop introduction. In 2006 and 2007, glyphosate was used on average 1.7 and 2.4 times per season on soybeans and cotton, respectively, reflecting a shift to one or more post-emergent applications to GR versions of these crops. This greatly expanded temporal scope of application has many important impacts that will be discussed below.

Increased intensity

[1] Glyphosate-resistant, Roundup Ready wheat was developed by Monsanto, though never introduced due to market rejection. USDA's decision to approve Roundup Ready alfalfa for commercial use was reversed by a U.S. district court due to inadequate environmental assessment by USDA.

HR traits eliminate the obstacles that previously attached to use of HR crop-associated herbicides. Yield-robbing crop injury is no longer a concern. The herbicide can be used through much or all of the crop's growing season. Thus, it is not surprising to find these herbicides used at greater annual rates. From 1996 to 2006 (soybeans) and 2007 (cotton), average one-time glyphosate application rates rose by approximately 25% for both crops, while ***annual per acre use*** of glyphosate approximately doubled for soybeans and tripled for cotton. These dramatically increased herbicide intensities reflect GR crop adoption rates that rose from 0% to over 90% for both soybeans and cotton over this period, as well as increased use to control glyphosate-resistant and glyphosate-tolerant weeds.

Increased reliance

Growers appreciate the flexibility and convenience of the post-emergence weed control regimes associated with HR crops. Effective pre-emergence weed control can be dependent on timely rainfall to activate a residual herbicide. Pre-emergence weed control is also of more limited effectiveness for slow-growing crops, and does not control weeds sprouting later in the season. In contrast, HR crops permit flexible post-emergence timing of herbicide application to more efficiently kill weeds. Thus, it is not surprising that HR crop systems foster exclusive or near-exclusive reliance on the associated herbicide(s). This same overreliance, however, is also a major downside of HRCSs, in that it leads to adverse consequences such as accelerated evolution of HR weeds. As discussed further below, unregulated use of GR crop systems has triggered massive emergence of GR weeds, which are imposing huge and growing costs on U.S. agriculture.

b) Adverse impacts of HRCSs

The distinctive features of HRCSs – including many of their real and perceived advantages – generate adverse consequences both for the growers of these crops, as well as farmers who choose not to grow them. In some cases, HRCSs impair common agricultural resources that are shared by all farmers. In some cases, these adverse impacts are novel. In others, HRCSs exacerbate negative impacts that have long been problems in farm country. Our focus below is on those negative impacts of HRCSs that affect growers of other crops.

Collateral damage

HR crops are usually high-acreage crops engineered for resistance to powerful, broad-spectrum herbicides, the premier example being GR crops and glyphosate. As HR crop adoption and use of the associated herbicide grows, so does the potential for injury to crops that don't carry the herbicide-resistance trait. Collateral damage of this sort is fostered by the large acreage treated with HR crop-associated herbicides, and even more by the expanded application window of the herbicide. Herbicides that were formerly restricted to use at the beginning or end of the agricultural season, when the potential for collateral damage was minimal, are now used throughout the season, with correspondingly greater opportunity to inadvertently harm other (non-HR) crops through drift, misapplication, or volatilization.

Spray drift is a problem that pre-dates, but has been greatly exacerbated by, HR crop adoption. The large acreage planted to GR crops mean that non-GR crop growers are often within "drift range" of a neighboring GR crop grower. Aerial application of glyphosate to GR crops in Arkansas has led to many episodes of injury to non-GR crops like rice. Simulated drift studies show that doses of glyphosate as low as 6.25% of the normal application rate can cause visible injury to conventional cotton, while 12.5% of the same reduces yield (Thomas et al 2005). Since drift incidents often go unreported, it is difficult to estimate the extent of crop injury they cause, but it is likely substantial.

Misapplication is another problem exacerbated by HR crops, as well as the growing trend for farmers to use contract pesticide applicators. These commercial operators, unfamiliar with an HR crop grower's fields, sometimes mistakenly apply an herbicide to an adjoining neighbor's field, causing severe crop injury if the crop is not HR.

Volatilization is another avenue for collateral damage, and is a particular problem in the case of highly volatile dicamba. Behrens and Lueschen (1979) report that post-emergence dicamba sprays used on 250,000 ha of corn in Minnesota in 1974 resulted in 68 reports of dicamba drift effects on soybeans. In contrast, post-emergence use of 2,4-D on 800,000 ha hectares of corn yielded just seven reports. In a series of field and glasshouse experiments, Behrens and Lueschen established that dicamba, volatilizing after application to corn, caused symptoms on soybean plants placed up to 60 meters downwind of the treated corn; that dicamba volatilizing from treated corn could be detected via effects on soybeans for three days after the application; and that dicamba volatilization was enhanced by higher temperatures and lower humidity, and extinguished by rainfall.

Interestingly, this team determined that dicamba acid and various salt forms had widely varying volatilization rates from glass surfaces, and that the vapors of more volatile salts (after application to corn) caused much greater damage to nearby soybeans in closed jars than did the less volatile salts. However, in field experiments, these differences largely disappeared. That is, less volatile salts applied to corn vaporized to damage downwind soybeans almost as much as the highly volatile (e.g. dimethylamine) salts. The diglycolamine salt is apparently less volatile than the widely used dimethylamine salt. However, this may not translate into lesser injury to crops from volatilization.

In tests involving the diglycolamine salt of dicamba, Andersen et al (2004) simulated dicamba drift injury by directly treating soybeans with 5.6 to 56 g a.e./ha dicamba (1% to 10% of the label rate for corn). These treatments reduced soybean yields by 14% to 93%. Andersen et al found greater soybean injury in the drier of the two years of their experiment, in line with the findings of Behren and Lueschen that rainfall extinguished dicamba's volatilization, and that lower humidity enhanced volatilization. Finally, it was found that dicamba applied in a mixture with crop oil concentrate, which enhances absorption of the active ingredient by crop tissues, resulted in slightly higher levels of injury. This highlights the importance of considering dicamba's activity in the forms in which it is actually used by farmers.

Kelly et al (2005) examined the impact of low-level dicamba in combination with other post-emergent herbicides on soybeans, to simulate the effect of dicamba vapor drift in a realistic soybean production setting. Similar to Andersen et al, this team found yield reductions from application of 5.6 g a.e./ha dicamba (1% the label rate for corn) either alone or in combination with each of several post-emergent soybean herbicides (glyphosate, imazethapyr, imazamox, or fomesafen) of from 7% to 41%, with the dicamba/fomesafen combination lowering soybean yield more than any of the other combinations. This study is important in establishing yield losses from soybean exposure to realistic volatilization drift rates (e.g. 1%) under field conditions where such exposure is accompanied by application of common post-emergent soybean herbicides.

Pesticide mixing tanks that harbor residues of dicamba also pose a substantial risk of crop injury to non-dicamba resistant crops that are sprayed from them, in particular soybeans, given their extreme sensitivity to damage from this herbicide. Other crops that are very sensitive to dicamba damage are tomatoes and grapes.

At present, dicamba is applied primarily to corn, which as a monocot (cereal) is naturally tolerant of the herbicide. But at present, the many farmers who utilize the common corn-soybean rotation are less likely to use dicamba on their corn if they are also growing soybeans, from fear of dicamba vapors harming their soybeans. This constitutes a substantial barrier to wider use of this herbicide, which is quite effective and cheap, and helps explain why it was applied to only 12% of U.S. corn acres in 2005, the last year for which USDA NASS data are available. Introduction of dicamba-resistant soybeans would increase dicamba use in two ways. First, it would facilitate dicamba use on tens of millions of acres of soybeans that had previously not been treated at all with this herbicide. Second, it would expand dicamba use on corn, since adoption of dicamba-resistant (DR) soybeans would eliminate the fear of vapor damage in those (many) cases where corn would be grown near DR soybeans.

Pennsylvania State University weed scientist Dave Mortensen estimates that dicamba-resistant soybeans and 2,4-D resistant soybeans will increase herbicide use on soybeans by approximately 70% within a few years of their introduction (Mortensen 2010).

Defensive adoption and its costs

Clearly, the highly volatile nature of dicamba; its ability to injure broadleaf crops like soybeans, tomatoes and grapes at extremely low levels; and the substantial increase in usage expected in consequence of DR soybean adoption, all add up to a significant threat to any farmer growing a non-cereal crop that does not carry a dicamba-resistance trait.

A substantial but undetermined proportion of Roundup Ready corn adoption is attributable to defense – that is, protection from the hazards of spray drift and misapplication in a Roundup Ready world. According to Ford L. Baldwin, of Arkansas-based Practical Weed Consultants, Inc.:

> "A lot of growers planted Roundup Ready corn in the beginning out of self defense. I looked at enough glyphosate drift on conventional corn to understand why."[2]

With the still greater hazards of dicamba volatility, any substantial adoption of DR soybeans would certainly drive many other soybean growers to purchase DR seeds for purposes of "self-defense." Thus, there would likely be a stampede from Roundup Ready soybeans to those conferring resistance to dicamba (perhaps stacked with glyphosate), even by those growers who had no interest in using the DR trait through post-emergence application of dicamba. This would mean, first of all, that farmers would take an economic hit by purchasing a costly DR trait that they do not want to use, and wouldn't need to purchase in a world without that DR trait. Second, it would encourage these very same involuntary adopter farmers to make use of the DR trait that they had purchased initially only for "self-defense." Paying a royalty for a biotech trait constitutes an inducement to make use of it, especially since dicamba is off-patent and cheap, and glyphosate-resistant weeds are legion (note that Baldwin, quoted above, states that growers purchased Roundup Ready corn seed out of self defense ***in the beginning***, implying that they later made use of the trait through reliance on glyphosate).

This additional spur to usage of dicamba (beyond that from growers who actually do want to use the DR trait) would of course redouble selection pressure for evolution of dicamba-resistant weeds. At present, www.weedscience.com lists eight reports of weeds resistant to dicamba, four of them in the U.S.: dicamba-resistant kochia in North Dakota, Idaho and Montana (all 1990s); and dicamba-resistant prickly lettuce in Washington State (2007). While this might be interpreted as indicating a low propensity for weed evolution of resistance to dicamba, it must be recalled that glyphosate-resistant weeds were practically unknown prior to the advent of GR crops. It was only 3-4 years after the introduction of GR soybeans that the decade-long epidemic of GR weeds began. In that short time, GR weeds have expanded from a few thousand acres to infest over 10 million acres in the U.S. alone, a larger acreage than that infested by weeds resistant to any other class of herbicides (ALS inhibitor-resistant weeds come in second). Clearly, a substantial increase in the use of, and reliance on, dicamba, could drive a similar dramatic increase in weeds resistant to this herbicide.

Dicamba-resistant soybeans will likely be introduced in versions stacked with glyphosate resistance. The conventional wisdom holds that dicamba will eliminate GR weeds, while glyphosate will prevent the emergence of any DR weeds. This facile theorizing ignores a basic fact – namely, that over ten million acres are ***already*** infested with weeds that are resistant to glyphosate. Use of dicamba on even a portion (that planted to DR/GR crops) of this huge expanse of land, harboring enormous populations of GR biotypes, will certainly select for the dicamba-resistant biotypes that exist among the innumerable glyphosate-resistant weeds. The result will be biotypes that are resistant to both glyphosate and dicamba. Multiple herbicide-

[2] Baldwin, F.L. (2010). "Herbicide drift damaging rice," Delta Farm Press, June 7, 2010. Baldwin is drawing an analogy between defensive adoption of Clearfield rice and Roundup Ready corn.

resistant weeds, already expanding rapidly, will be spurred on to propagate still more by the adoption of multiple-herbicide-resistant crops such as dicamba/glyphosate-resistant soybeans.

Conclusion

Monsanto has only recently submitted its petition for deregulation of DR soybeans to the USDA, which will not take action for a year or more. EPA is urged to postpone consideration of Monsanto's request to register the diglycolamine salt of glyphosate for use on soybeans until a thorough and coordinated analysis of the ***dicamba-resistant soybean system*** has been carried out jointly by EPA together with USDA. Without such coordinated assessment and regulation of HR crop systems, American agriculture will be pushed willy nilly, without forethought or consideration, into a new age of agriculture that is still more pesticide-intensive, environmentally damaging, and unsustainable as the current one.

Bill Freese, Science Policy Analyst
Center for Food Safety

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JUNE 4, 2010

Superweed Outbreak Triggers Arms Race

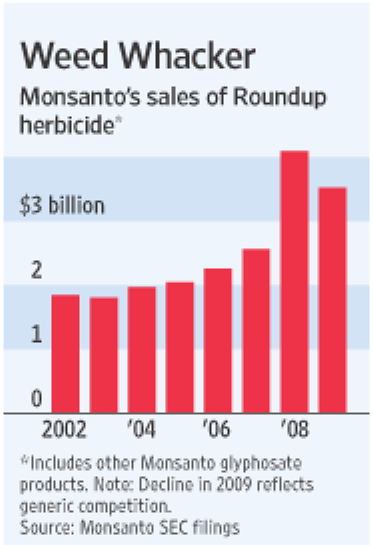
By SCOTT KILMAN

Associated Press

Hardy superweeds immune to the Farm Belt's most effective weedkiller are invading fields, prompting a counterattack from agribusiness that could leave farmers using greater amounts of harsh old-line herbicides.

The flagging weedkiller is Roundup. Its developer, Monsanto Co., also sells seeds for corn, soybean and cotton plants unaffected by the chemical, enabling farmers to spray it on freely without fear of harming their crops. Farmers now do so en masse, using "Roundup Ready" crop varieties for 90% of the soybeans and 80% of the corn grown across the U.S.

The rise of Roundup, more than a decade ago, sent older herbicides that damage both weeds and crops into deep eclipse. But now, as nasty invaders with names like pigweed, horseweed and Johnsongrass develop immunity to the mighty Roundup, chemical companies are dusting off the potent herbicides of old for an attack on the new superweeds.



And big chemical companies—taking a page from Monsanto's book—are engineering crop varieties that will enable farmers to spray on the tough old weedkillers freely, instead of having to apply them surgically in order to spare crops.

Dow Chemical Co., DuPont Co., Bayer AG, BASF SE and Syngenta AG are together spending hundreds of millions of dollars to develop genetically modified soybean, corn and cotton seeds that can survive a dousing by their herbicides, many decades old.

"It will be a very significant opportunity" for chemical companies, says John Jachetta, a scientist at Dow Chemical's Dow AgroSciences and president of the Weed Science Society of America. "It is a new era."

The bioengineering push is causing controversy, though. Some of the old pesticides—in particular, those called 2,4-D and dicamba—have a history of posing more risks for the environment than the chemical in Roundup. That's partly because they have more of a tendency to drift on the wind onto neighboring farms or wild vegetation. Roundup tends to adhere better to the ground.

The chemical companies are betting their biotech investments will pay off in two ways: Farmers will buy more of their herbicides, and will pay big premiums for the new seeds.

Some 40% of U.S. land planted to corn and soybeans is likely to harbor at least some Roundup-resistant superweeds by the middle of this decade, executives at DuPont estimate. That could create big demand for the herbicides that can kill the evolved weeds—and for the seeds of crops that permit free use of those herbicides.

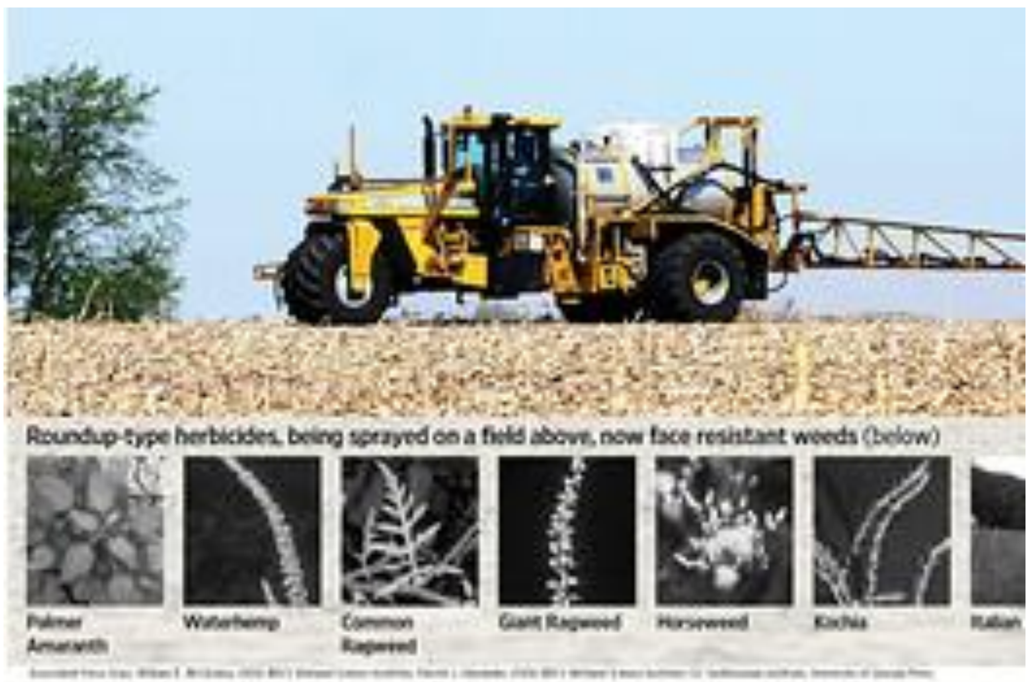
The new herbicide-tolerant seeds "would make controlling weeds very easy for farmers," says David Mortensen, a weed scientist at Pennsylvania State University. As a result, he says, the amount of herbicide sprayed on just one major crop, soybeans, could climb roughly 70%.

The burst of efforts by rivals isn't necessarily bad for Monsanto's crop-biotech business, at least in the short term. The chemical in Roundup remains able to kill hundreds of kinds of weeds and will remain a central part of the farmer's arsenal. Most companies developing crops tolerant of other herbicides want to build them on a Roundup Ready platform, so to speak—putting their new herbicide-tolerant genes into crops that already carry tolerance for Roundup.

Yet the developments portend further turmoil in the $12 billion U.S. pesticide industry. Monsanto already is cutting prices for Roundup to compete with a flood of cheap Chinese-made generics. The patent for Roundup expired years ago. The St. Louis company has cut its earnings outlook recently to reflect both generic competition and a backlash by farmers against the steep prices it charges for genetically modified seeds. Its stock has dropped 39% this year.

Monsanto also is facing the 2014 expiration of the patent on the key gene in seeds for soybeans tolerant of the weedkiller.

Round-type herbicides, being sprayed on a field above, now face resistant weeds.

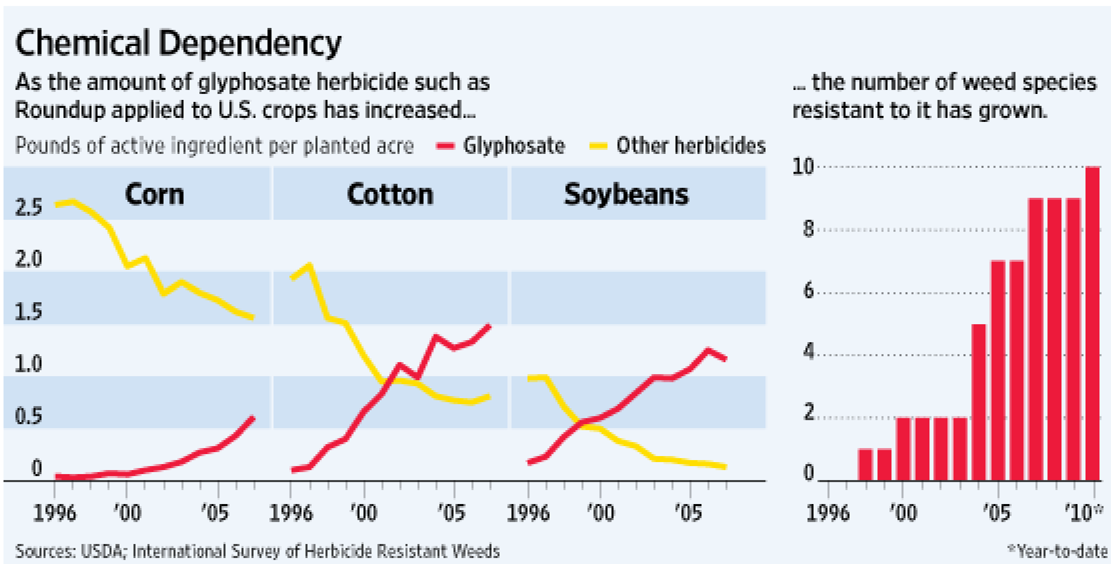


It was back in the 1990s that Monsanto upended the herbicide industry and farming practices by offering its first genetically modified product—soybean seeds into which scientists had transplanted genetic material from microorganisms and petunias. The seeds sprouted soybean plants that could survive exposure to Roundup. Chemically known as glyphosate, Roundup was known for its ability to kill almost anything green yet leave a relatively small environmental footprint, being less toxic to wildlife and people than most weedkillers. "If glyphosate isn't the safest herbicide, it is damn close," says Charles Benbrook, chief scientist of the Organic Center, a nonprofit organic advocacy group.

The new seeds meant farmers could leave behind the risk and guesswork of choosing the right herbicides to spray, at exactly the right time, on the right weeds. Weed control became so easy that many farmers sold off their weed-tilling implements and stopped buying other pesticides.

The chemical weed control even had some environmental pluses because it left the soil undisturbed, reducing erosion. Farmers burned less fuel, no longer needing to crisscross fields with implements that root out weeds. The Roundup revolution, as some called it, freed up time for growers to plant more land, helping spur bigger farms.

Monsanto's sales and profits soared while other herbicide makers suffered. DuPont's leading herbicide for soybean farmers, called Classic, lost about 90% of its business. Some industry players were swept into mergers, and research spending wilted. Today, Roundup and its generic competitors are used on nearly four times as many U.S. acres as any other herbicide.



But weeds are adapting. At least nine species have developed immunity to it. They've spread to millions of acres in more than 20 states in the Midwest and South.

Ron Holthouse, a farmer who grows cotton and soybeans on 8,600 acres near Osceola, Ark., says he spends hundreds of thousands of dollars annually on the herbicide. But after 10 years of use on his land, Roundup no longer controls pigweed, which ran rampant in his fields last year.

The weed, which can grow six feet high on a stalk like a baseball bat, is tough enough to damage delicate parts of his cotton-picking equipment. Mr. Holthouse had to hire a crew of 20 laborers to attack the weeds with hoes, resorting to a practice from his father's generation. For the first time in years, Mr. Holthouse used some of an older, highly poisonous weedkiller called paraquat.

Many Southern farmers are spending twice as much on killing weeds as it typically cost them just a few years ago. "It is getting a lot harder and expensive to run a big farm," says Mr. Holthouse. "This is nerve-racking."

Farmers have no wish to return to labor-intensive methods. The success of expensive seeds that are Roundup-tolerant shows growers will pay a steep premium to control weeds chemically.

Chemical companies are tight-lipped about their development of crops that can tolerate the spraying of herbicides other than Roundup. BASF and Bayer filed petitions last year with biotech regulators at the U.S. Department of Agriculture, seeking permission to market new herbicide-tolerant seeds. The USDA hasn't yet released its environmental assessments. Several of the genetically modified plants are still in field trials or in the laboratory.

Dow AgroSciences manufactures 2,4-D, a powerful herbicide introduced nearly 65 years ago. The company hopes by 2013 to be selling seeds for corn crops that will be unaffected if farmers splash 2,4-D on their fields. The company hopes to have seeds for soybeans tolerant of the herbicide a year later, and is also working on a herbicide-tolerant cotton variety.

It won't predict how the new seeds might help its sales of 2,4-D, but it's optimistic enough that it's developing a new form of the herbicide.

Some winery owners are concerned that such efforts will renew farmer demand for 2,4-D, to which grapes are highly sensitive if the herbicide drifts from a farm sprayer onto vines. "I couldn't survive in this business if 2,4-D resistant seed catches on in cotton country," says Neal Newsom, whose 100-acre vineyard in Plains, Texas, is surrounded by cotton fields. "A neighbor could take me out in one night."

The Natural Resources Defense Council petitioned the Environmental Protection Agency in 2008 to ban 2,4-D, citing research that suggests it disrupts hormones in trout, rodents and sheep. Dow says it is providing rebuttal data to the agency. A spokesman for the EPA said it anticipates responding to the petition this fall.

Both 2,4-D and dicamba, another older herbicide, are common ingredients in weedkillers at lawn-and-garden stores, which homeowners are careful to keep away from flowers and vegetables. Chemical companies say both are safe in larger amounts if farmers follow usage instructions cleared years ago by the EPA.

Allthough dicamba could kill superweeds such as Mr. Holthouse's pigweed, soybean farmers haven't sprayed it because it kills soybeans, too. A dicamba-tolerant soybean variety would change that. Monsanto itself is developing one.

Bayer is developing soybeans that can survive exposure to a herbicide that disables weeds' defense to ultraviolet rays, setting them up for a fatal sunburn. Bayer hopes to have those soybean seeds on the market in 2015 and later give corn and cotton plants immunity to the same herbicide, called isoxaflutole.

As for Monsanto, its chairman and chief executive, Hugh Grant, hinted in a call with analysts last week that the company is considering whether to begin selling farmers cheap, off-patent weedkillers that can kill Roundup-tolerant weeds. On Thursday a Monsanto spokeswoman, Kelli Powers, said, "We remain committed to working with farmers to manage weed resistance," adding, "We have a shared interest with farmers in continuing to deliver environmental and production benefits on the farm with glyphosate."

Monsanto, in fact, is launching a second generation of Roundup Ready seeds. Competitors continue to try to develop their own plant varieties tolerant of the chemical in Roundup. DuPont's big Pioneer Hi-Bred seed business, for example, plans to begin selling seed for soybean and corn plants that can tolerate exposure to both the Roundup chemical and other herbicides.

Swiss-based Syngenta, meanwhile, is field-testing soybeans genetically engineered to tolerate exposure to a relatively new herbicide Syngenta makes called Callisto.

"The herbicide business used to be good before Roundup nearly wiped it out," says Dan Dyer, head of soybean research and development at Syngenta. "Now it is getting fun again."

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

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

PC Codes: 029801, 029802, 029806, 128931,
128944, 129043
DP Barcode: 317696

August 31, 2005

MEMORANDUM

Subject: EFED Reregistration Chapter For Dicamba/Dicamba Salts

To: Susan Lewis, Branch Chief
Reregistration Branch 1
Special Review and Reregistration Division

From: William Erickson, Biologist
Ibrahim Abdel-Saheb, Environmental Scientist
Shannon Borges, Biologist
Environmental Risk Branch 2, Environmental Fate and Effects Division

Through: Thomas Bailey, Branch Chief,
Environmental Risk Branch 2, Environmental Fate and Effects Division

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EFED has completed a screening-level ecological risk assessment for the proposed reregistration of dicamba and its salts. Dicamba is a benzoic acid herbicide formulated for use in agricultural and residential settings. Its major use is weed control in corn, with other major use sites including wheat, barley, pastures, and lawn and turf. The risk assessment is based on toxicity and environmental fate studies submitted to support the registration of dicamba and its salts and on ecological modeling to estimate environmental concentrations. EFED's risk conclusions are summarized below.

- listed and non-listed terrestrial plants are at risk from runoff and drift from all use sites
- risk exists to non-vascular aquatic plants but is minimal for listed and non-listed vascular aquatic plants
- acute risk exists to listed and non-listed birds
- acute risk exists to small, listed mammals exposed to maximum residues from application to sugarcane
- chronic risk exists for listed and non-listed mammals
- minimal risk is expected to listed and non-listed vascular aquatic plants

- no adverse effects are expected for listed and non-listed freshwater and estuarine fish and aquatic invertebrates

The following data gaps have been identified (see Appendix E for further details):

- seedling emergence and vegetative vigor studies (123-1a,b); dicamba acid, TEP
- seedling emergence and vegetative vigor studies (123-1a,b); dimethylamine salt, TEP
- seedling emergence and vegetative vigor studies (123-1a,b); diglycoamine salt, TEP
- seedling emergence and vegetative vigor studies (123-1a,b); isopropylamine salt, TEP
- seedling emergence and vegetative vigor studies (123-1a,b); sodium salt, TEP
- seedling emergence and vegetative vigor studies (123-1a,b); potassium salt, TEP

Note: These seedling emergence and vegetative vigor tests can each be limited to the five most sensitive species determined in previous testing with the technical grade of dicamba acid (MRID no. 42846301). Those species are soybean, onion, turnip, tomato, and lettuce.

EFED plans on conducting further refinements to this assessment after registrant comments have been received. These refinements include the following:

- An AgDrift analysis will be completed.
- An assessment of exposure and risk from granular formulations will be conducted.
- RQs for listed terrestrial plants will be recalculated.
- Available incident data will be more fully evaluated.
- ECOTOX literature references will be examined for relevant information.

Environmental Fate and Ecological Risk Assessment for the Reregistration of Dicamba and Dicamba Sodium, Potassium, Diglycoamine, Dimethylamine and Isopropylamine Salts

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I. EXECUTIVE SUMMARY

A. Nature of Chemical Stressor

Dicamba was first registered in the United States in 1967 and is widely used in agricultural, industrial and residential settings. Dicamba is used as an ingredient in agricultural and home use products, as a sole active ingredient and in conjunction with other active ingredients. Dicamba is a benzoic acid herbicide similar in structure and mode of action to phenoxy herbicides. Typical terrestrial application methods consist of ground and aerial spray to the leaves or to the soil. Dicamba controls annual, biennial and perennial broadleaf weeds in crops and grasslands, and it is used to control brush and bracken in pastures. In combination with a phenoxyalkanoic acid or other herbicide, dicamba is used in pastures, rangeland, and non-crop areas such as fence-rows and roadways to control weeds. Dicamba is absorbed by leaves and roots, and moves throughout the plant acting at multiple sites to disrupt hormone (auxin) balance and protein synthesis, resulting in plant growth abnormalities. Dicamba is formulated primarily as a salt in an aqueous solution. Supported forms are; dicamba acid (29801), dicamba dimethylamine salt - DMA (29802), dicamba sodium salt (29806), dicamba diglycoamine salt - DGA (128931), dicamba isopropylamine salt (128944) and dicamba potassium salt (129043).

B. Potential Risks to Non-target Organisms

For this screening risk assessment, the potential exposure of dicamba and its salts to aquatic and terrestrial endpoints was modeled. The Tier II PRZM(3.12)/EXAMS(2.98) models were used to estimate exposure concentrations for aquatic animals and plants in surface water. The potential levels of dicamba residues on various food items for birds and terrestrial mammals was modeled using the T-REX 1.2.3. Likewise, the TerrPlant 1.0 model estimated exposure to nontarget plants. The risk assessment indicates risk to non-target terrestrial plants and freshwater non-vascular plants; acute sublethal risk to birds; chronic (developmental/reproductive) risk to mammals; and potential risks to listed species (birds, small mammals, terrestrial and semi-aquatic monocots and dicots) from dicamba use based on the maximum application rates of 2.8 lbs ae/acre for sugarcane, 2.0 lbs ae/acre for hay, pasture/rangeland, soybean and turf, 1.0 lbs ae/acre for wheat and 0.75 lbs ae/acre for corn.

The results of this screening risk assessment indicate that dicamba applied at the maximum rates according to label directions as a liquid spray for ground or aerial applications will impact non-target plants for some distance from the application site. Results of Tier I and II toxicity studies with monocots and dicots indicate that seed germination, seedling emergence, and vegetative vigor are impacted by exposure to dicamba. For the modeled scenarios at the label maximum application rates of 2.8, 2.0, 1.0 and 0.75 lbs ae/acre, Acute Risk LOCs for non-listed monocots and dicots located adjacent to treated areas, in semi-aquatic areas, and as a result of spray drift were exceeded. Spray drift from coarse sprays would be expected to damage non-target plants that are closer to the target site; whereas, finer sprays have the potential to travel greater distances. Exposure will depend on droplet size, wind speed, and other factors. Highly active herbicides, such as the growth regulators, present the greatest drift hazard because small amounts can cause severe problems. Even if only a small surface area of the plant is exposed to dicamba, or a seedling is exposed to dicamba as it breaks through the soil surface, there is a possibility that the plant may be severely damaged or die as a result. The resulting damage, even if only minor, may be sufficient to prevent the plant from competing successfully with other plants for resources and water. Currently, some labels for the registered dicamba herbicides place restrictions on droplet size, wind speed or ambient temperatures during application. These specific requirements are intended to reduce the potential exposure of spray drift to susceptible non-target plants.

The results of this screening risk assessment indicate that dicamba applied at the maximum rates according to label directions as a liquid spray for ground or aerial applications will impact freshwater non-vascular plants. The non-listed Acute Risk LOC for the non-vascular aquatic plant (blue green algae) was exceeded; consequently, direct effects to growth, development, and reproduction of aquatic non-vascular plants inhabiting surface waters adjacent to a treated field may occur when exposed to dicamba as the result of the labeled use of the herbicide.

The results of this screening risk assessment indicate that dicamba applied at the maximum rates according to label directions as a liquid spray for ground or aerial applications will impact avian species. The Acute Use and Acute Restricted Use LOCs were exceeded for all weight-classes of birds (20, 100, 1000 g) consuming short grasses, tall grasses and broadleaf forage/small insects and for small birds (20 g) consuming fruit, pods, seeds, and large insects at the higher application rates (2.8 and 2.0 lbs ae/acre) and maximum predicted residues. In addition, the Acute Use and Acute Restricted Use LOCs were exceeded for 20 and 100 g birds consuming short grasses, tall grasses and broadleaf forage/small insects and for large birds (1000 g) consuming short grasses at the lower application rates (1.0 and 0.75 lbs ae/acre) and maximum predicted residues. For mean predicted residues, the Acute Use and Acute Restricted Use LOCs were exceeded for small birds (20 and 100 g) consuming short grasses, tall grasses and broadleaf forage/small insects and for large birds (1000 g) consuming short grasses at the higher application rates (2.8 and 2.0 lbs ae/acre). In addition for mean predicted residues, the Acute Use and/or Acute Restricted Use LOCs were exceeded for 20 g birds consuming short grasses, tall grasses and broadleaf forage/small insects and for100 g birds consuming short grasses at the lower application rates (1.0 and 0.75 lbs ae/acre). Consequently, there may be a concern for potential indirect effects to listed species dependent upon birds for food, pollination or seed dispersal, or habitat. Consequently, based on these results, birds may be subject to sublethal effects and indirect effects on foraging behavior when acutely exposed to dicamba as a result of the labeled use of the herbicide.

Assuming maximum residue levels at the maximum application rates of 2.8, 2.0, 1.0 and 0.75 lbs ae/acre, Chronic Risk LOCs were exceeded for mammals consuming short grass, tall grass and broadleaf forage/small insects. There were no exceedances of Chronic Risk LOC for mammals consuming fruit, seeds, pods and large insects. The risk assessment and calculated RQs assume 100% of the diet is relegated to single food types foraged only from treated fields. These assumptions may overestimate risk, especially considering that contaminated food items might be avoided for more preferred items and diets would likely be more variable over longer periods of time. Other exposure routes are possible for animals residing in or moving through treated areas. Consumption of drinking water would appear to be inconsequential if water concentrations were equivalent to the concentrations from PRZM/EXAMS; however, concentrations in puddled water sources on treated fields may be higher than concentrations in modeled ponds. Preening and grooming exposures, involving the oral ingestion of material from the feathers or fur remains an unquantified, but potentially important, exposure route. Consequently; based on these results, mammals may be subject to developmental/ reproductive effects and direct effects on foraging behavior when chronically exposed to dicamba as a result of the labeled use of the herbicide.

Exposure to dicamba results in direct effects to plant species that could result in indirect effects at the higher levels of organization (i.e. population, trophic level, community, ecosystem). The guideline terrestrial plant studies indicate direct adverse effects to seedling emergence and vegetative vigor, as well as non-lethal effects including brown leaf tips, necrosis, chlorosis, stem tumors, leaf curl, and decrease in size. In terrestrial and shallow-water aquatic communities, plants are the primary producers upon which the succeeding trophic levels depend. If the available plant material is impacted due to the effects of dicamba, this may have negative effects not only on the herbivores, but throughout the food chain. Also, depending on the severity of impacts to the plant communities (edge and riparian vegetation), community assemblages and ecosystem stability may be altered (i.e. reduced bird populations in edge habitats; reduced riparian vegetation resulting in increased light penetration and temperature in aquatic habitats). In addition, allochthonous input from riparian vegetation is not only a significant component of the food supply for aquatic herbivores and detritivores but also provides habitat (i.e. leaf packs, materials for case-building for invertebrates).

The screening risk assessment for listed species indicates potential risk to the following taxonomic groups for the dicamba use scenarios as specified below:

- small birds (20g) feeding on short grasses, tall grasses, broadleaf forage/small insects, and fruit/pods/seeds/large insects at all application rates
- small birds (100 g) feeding on short grasses, tall grasses, and broadleaf forage/small insects at 0.75 and 1.0 lbs ae/acre
- small birds (100 g) feeding on short grasses, tall grasses, broadleaf forage/small insects, and fruit/pods/seeds/large insects at 2.8 and 2.0 lbs ae/acre
- large birds (1000 g) feeding on short grasses, tall grasses, and broadleaf forage/small insects at all application rates
- small (15 g) mammals feeding on short grasses at 2.8 lbs ae/acre
- non-target terrestrial plants - monocots and dicots adjacent to treated areas and in semi-aquatic areas at all application rates (all uses modeled) by ground and aerial spray application.

Although exceedances occurred with comparisons of RQs calculated from mean Kenaga EECs to listed species LOCs, screening level risk assessments rely on maximum residues. Mean Kenaga EECs may be considered more closely in future refined risk assessments.

Since the Listed Species LOCs for birds, small mammals, and terrestrial monocots and dicots are exceeded for the use of dicamba, the LOCATES was run for all taxonomic groups. For terrestrial monocots and dicots, both the Acute Risk LOCs for non-listed species and the Listed Species LOCs were exceeded; consequently a potential concern arises for species with both narrow (i.e., species that are obligates or have very specific habitat or feeding requirements) and general dependencies (i.e., cover type requirements). Information from LOCATES indicates that for the corn, wheat, sugarcane and pasture/grazing uses, several potentially affected species of birds, mammals, reptiles and plants appear to be co-located with pesticide use areas. Consequently, there may be a concern for potential indirect effects to listed species dependent upon birds that consume feed items (short and tall grasses; broadleaf plants; small and/or large insects; and fruits, seeds, and pods) contaminated with dicamba residues; such as predatory birds and mammals. In addition, there may be a potential concern for indirect effects related to plants that require birds and/or mammals for pollination or seed dispersal and for animals that use burrows for shelter or breeding habitat.

This screening risk assessment indicates that there are no acute risks to fish, aquatic invertebrates, aquatic vascular plants and mammals at maximum application rates of 2.8, 2.0, 1.0 and 0.75 lbs ae/acre. In addition, there are no chronic risks to birds at the maximum application rates. Consequently, fish, aquatic invertebrates and aquatic vascular plants inhabiting surface waters adjacent to a dicamba treated field would not be at risk for adverse acute effects on reproduction, growth and survival when exposed to residues in surface runoff and spray drift as a result of ground and/or aerial spray application. Likewise, acute risks to mammals and chronic risks to birds consuming food types containing dicamba residues are not expected from the labeled uses of the herbicide. EFED currently does not quantify risks to terrestrial non-target insects.

C. Conclusions - Exposure Characterization

EFED established a strategy for bridging the environmental fate data requirements for the dicamba sodium and potassium salts, dimethylamine salt (DMA), isopropylamine salt and diglycoamine salt (DGA) to the dicamba acid. Bridging data were submitted indicating that the dicamba salts will be rapidly converted to the free acid of dicamba. A laboratory dissociation study showed that each dicamba salt (tested at >99% purity) completely dissociated to dicamba acid within 75 seconds in pure water. EFED determined that fate studies conducted with dicamba acid provide “surrogate data" for the dicamba salts. However, there is uncertainty regarding the fate of formulated typical end use products (TEPs) containing the dicamba salts in the environment. The influence of inert ingredients and additives, in formulated TEPs, on the degradation potential are unknown.

Based on the physical and chemical properties as well as the laboratory fate studies, dicamba acid is very soluble (6100 mg/L) and very mobile in laboratory soil studies thus it is expected to mobile in environmental settings. Aerobic soil metabolism is the main degradative process for dicamba acid. A single observed half-life for dicamba acid was six days, with formation of the intermediate non-persistent degradate 3,6-dichlorosalicylic acid (DCSA). DCSA degraded at approximately the same rate as dicamba with the final metabolites being carbon dioxide and microbial biomass. Dicamba is stable to abiotic hydrolysis at all pH's and photodegrades slowly in water and on soil. Dicamba is more persistent under anaerobic soil:water systems in the laboratory, with a half-life of 141 days. The major degradate under anaerobic conditions was DCSA, which was persistent, comprising > 60% of the applied after 365 days of anaerobic incubation. There are no acceptable data for the aerobic aquatic metabolism of dicamba; supplemental information indicates that dicamba degrades more rapidly in aquatic systems when sediment is present. Dicamba is not expected to bioaccumulate in aquatic organisms because it is an anion at environmental pHs (pKa = 1.9).

Routes of exposure evaluated in this screening risk assessment focused on deposition, runoff and spray drift from ground and aerial spray applications of dicamba. The dicamba exposure characterization combined the environmental fate data with Tier II exposure models to estimate environmental exposure concentrations (EECs). EECs for aquatic endpoints were developed using the Tier II surface water models PRZM/EXAMS. These models are more comprehensive and determine EECs based on geographic areas nationwide and product use sites in close proximity to water bodies. Likewise, EECs for birds and terrestrial mammals were estimated using the T-REX 1.2.3 model and EECs for non-target terrestrial plants are estimated by the TerrPlant 1.0 model. A review of ground water and surface water monitoring data indicate historical detections of dicamba at low concentrations (<1.14 µg/L). Approximately, 100 incidents have been reported associated with dicamba usage. Incidents reported include impacts to terrestrial and aquatic non-target plants and animals. The majority of reported incidents are damage to plants including a wide range of crops (corn, sorghum, soybeans, sugar beets and wheat) as well as impacts to non-crop plants. The specific impacts varied from browning and plant damage to mortality of all plants within the treated area. Aquatic impacts reported consist of three fish kill incidents associated with pasture and residential turf application.

D. Conclusions - Effects Characterization

Spray drift and runoff to adjacent bodies of water are the most likely sources of dicamba and dicamba salts exposure to nontarget aquatic organisms. Available acute toxicity data indicate that dicamba acid appears to be slightly toxic to freshwater fishes (rainbow trout and bluegill sunfish) and the sodium salt of dicamba is slightly toxic to daphnids. No toxicity studies have been conducted to determine potential chronic effects to fish and aquatic invertebrates. Toxicity studies with non-vascular aquatic plants exposed to dicamba acid indicate that cell densities were significantly reduced in blue-green algae. However, aquatic vascular plant species were not sensitive to dicamba acid. Data are currently unavailable to determine potential impacts to sediment-dwelling benthic organisms and to riparian habitats.

Ground deposition and spray drift with resulting residues on foliage and on insects and seeds are the most likely sources of dicamba exposure to nontarget terrestrial birds and mammals, including listed species. In addition, uptake in plant roots could occur through ground spray application. Available acute toxicity data indicate that the s dicamba salts are practically non-toxic to bobwhite quail and mallard ducklings in the diet; however, oral gavage studies indicate that dicamba acid was moderately toxic to bobwhite quail and slightly toxic to mallard ducks. In chronic studies with dicamba acid, a reduction in hatchability was observed in mallard ducks. No treatment-related mortality, signs of toxicity, or effects on reproduction were observed in bobwhite quail. Dicamba acid is classified as practically non-toxic to small mammals on an acute oral basis. In a 2-generation rat reproduction study, maternal neurotoxicity was observed as well as decreased pup growth. Developmental studies with rabbits reported irregular ossification of internasal bones and maternal toxicity. Mortality, clinical signs of toxicity, body weight changes, and decreased food consumption, was also observed in rats. In addition, sublethal effects were reported in subchronic feeding studies. The reproductive and developmental effects observed in these studies may lead to a potential concern for impacts to populations of mammals consuming feed items contaminated with dicamba and to the predators that feed on them. Since, dicamba is classified as practically non-toxic to bees on a contact exposure basis (LD_{50} > 90.65 µg/bee); the potential for dicamba to have adverse effects on pollinators and other beneficial insects is low. Therefore, the label does not need a warning for honey bees.

Terrestrial plant toxicity studies indicate that dicamba acid negatively impacts seed germination (radicle length; soybean EC_{25} = 0.036 lb ai/A), seedling emergence (shoot length;

soybean EC_{25} = 0.0027 lb ai/A), and vegetative vigor (shoot length; soybean EC_{25} = 0.0068 lb ai/A) in monocots and dicots. The most sensitive monocot tested was onion (EC_{25} = 0.071 lb ai/A - seed germination; EC_{25} = 0.0044 lb ai/A - seedling emergence; and EC_{25} = 0.1507 lb ai/A - vegetative vigor). Non-lethal effects included brown leaf tips, necrosis, decrease in size, leaf curling, chlorosis, and stem tumors. Consequently, spray drift presents a potential risk to non-target plants inhabiting edge habitats adjacent to target fields and riparian vegetation along streams and/or ponds in close proximity to sprayed fields.

E. Uncertainties and Data Gaps

There are a number of areas of uncertainty in the terrestrial and the aquatic organism risk assessments that could potentially cause an underestimation of risk. First, this assessment accounts only for exposure of non-target organisms to dicamba, but not to its degradates. The risks presented in this assessment could be underestimated if degradates also exhibit toxicity under the conditions of use proposed on the label. Data are not available concerning the fate and toxicity of the degradation products of dicamba. Second, the risk assessment only considers the most sensitive species tested and only considers a subset of possible use scenarios. For the aquatic organism risk assessment, there are uncertainties associated with the PRZM/EXAMS model, input values, and scenarios including the use of surrogate scenarios, however these uncertainties cannot be quantified. The potential impacts of these uncertainties are outlined in the Aquatic Exposure and Risk Assessment and the Terrestrial Exposure and Risk Assessment sections of this document.

There is uncertainty in the environmental fate of the typical end use products (TEPs) which contain the sodium, DMA or DGA salts. Dissociation rates, adsorption/desorption rates and field dissipation information are needed for TEPs to determine the persistence and mobility of the salts and their associated inert ingredients found in the TEPs.

Additional uncertainty results from lack of information in components of this ecological risk assessment. For example, actual residue levels in foliage, insects, and seeds are not available to accurately predict risks to terrestrial organisms (birds, mammals, pollinators) which may contact dicamba residues after application. Therefore, model estimates are used in risk quotient calculations. Additionally, little field information is not available to help characterize risks. An AgDrift analysis also will be completed in further refinements to the chapter.

II. PROBLEM FORMULATION

The purpose of the ecological risk assessment (ERA) is to assist the Agency in evaluating the actions needed, if any, to address ecological risks associated with the reregistration of the herbicide dicamba (3,6-Dichloro-o-anisic acid). Dicamba is formulated in aqueous solutions as a salt and has herbicidal activity against annual, biennial and perennial broadleaf weed species and other plants in terrestrial settings.

A. Stressor Source and Distribution

1. **Source and Intensity:** Dicamba is a benzoic acid herbicide similar in structure and mode of action to phenoxy herbicides. Typical terrestrial application methods consist of ground and aerial spray to the leaves or to the soil. Dicamba controls annual, biennial and perennial broadleaf weeds in grain crops and grasslands, and it is used to control brush and bracken in

2. **Physical/Chemical/Fate and Transport Properties:** A summary of selected physical and chemical properties for dicamba acid are presented in Table II.b.

EFED established a strategy for bridging the environmental fate data requirements for the dicamba sodium and potassium salts, dimethylamine salt (DMA), isopropylamine salt and diglycoamine salt (DGA) to the dicamba acid. Bridging data were submitted indicating that the dicamba salts will be rapidly converted to the free acid of dicamba. A laboratory dissociation study showed that each dicamba salt (tested at >99% purity) completely dissociated to dicamba acid within 75 seconds in pure water (MRID 43288001). EFED determined that fate studies conducted with dicamba acid provide “surrogate data" for the dicamba salts.

Dicamba acid is very soluble (6100 mg/L) and very mobile in laboratory soil studies. In batch equilibrium experiments, dicamba acid was determined to be very mobile in loam, clay loam, silt loam, and sandy loam soils and a loam sediment, with Freundlich K_d values of 0.16, 0.10, 0.53. 0.07 and 0.21, respectively. Corresponding K_{oc} values were 7.27, 3.45, 21.1, 17.5 and 17.5, respectively.

Aerobic soil metabolism is the main degradative process for dicamba acid. A single observed half-life for dicamba acid was six days, with formation of the intermediate non-persistent degradate 3,6-dichlorosalicylic acid (DCSA). DCSA degraded at approximately the same rate as dicamba with the final metabolites being carbon dioxide and microbial biomass. Aerobic degradation of dicamba is slower at lower temperatures and low soil moisture and rainfall. Dicamba is stable to abiotic hydrolysis at all pH's and photodegrades slowly in water and on soil. Dicamba is more persistent under anaerobic soil:water systems in the laboratory, with a half-life of 141 days. The major degradate under anaerobic conditions was DCSA, which was persistent, comprising > 60% of the applied after 365 days of anaerobic incubation. No other anaerobic degradates were present at > 10% during the incubation. There are no acceptable data for the aerobic aquatic metabolism of dicamba; supplemental information indicates that dicamba degrades more rapidly in aquatic systems when sediment is present.

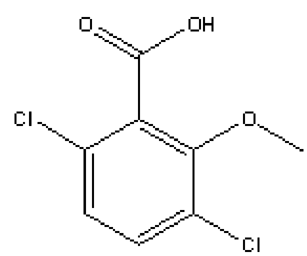
Provided retention times of dicamba in aerobic soils are sufficient and conditions are amenable to allow degradation, dicamba can be biodegraded thus reducing the potential to leach to groundwater. Biodegradation in aerobic soils is reduced at lower temperatures and dry conditions. If dicamba did reach anaerobic soil or anaerobic groundwater zones, it would be somewhat persistent (due to its anaerobic half-life of 141 days); any DCSA that reached groundwater would also be expected to persist.

Results from field dissipation studies conducted with the dimethylamine salt of dicamba, indicated that dicamba dissipated with reviewer calculated half-lifes ranging from 4.4 to 19.8 days with DCSA was the major degradate. Both, dicamba and its primary degradate were found at low concentrations (<20 ppb) in soil segments deeper than 10 cm. Supplementary data in other field dissipation studies indicate that the sodium and diglycoamine salts of dicamba dissipated similar to the dimethylamine salt with half-lifes ranging from 3 to 12.9 days.

Based on the vapor pressure of $3.4e^{-5}$ torr, when released in the atmosphere dicamba will exist in both the vapor phase as well as the adsorbed to particulate phase. Soil volatilization rates for potassium salt and DMA ranged from 2.91 to 4.97 x 10^{-4} µg/cm^2/hr when dicamba was applied at rate of 0.5 lb a.i./A (MRID 41966602). There are numerous label restrictions for ground and aerial spray applications. Spraying is not recommended if wind is gusty or in excess of 5 mph and moving in the direction of adjacent sensitive crops. Recommendations on spray systems for coarse spray application are included on the labels as well as directions for keeping the spray pressure at or below 20 psi and spray volume at or above 20 gpa. Finally, dicamba should not be applied adjacent to sensitive crops when temperature on the day of application is expected to exceed 85°C as drift is more likely to occur.

Dicamba is not expected to bioaccumulate in aquatic organisms because it is an anion at environmental pHs (pKa = 1.9).

Figure II.a. Chemical Structure of 3,6-Dichloro-o-anisic acid (Dicamba)
(CAS No. 1918-00-9)



Form	Molecular Weight	ae Conversion Factor
dicamba acid	221.0	----
dimethylamine salt of dicamba	226.1	0.977
sodium salt of dicamba	243.0	0.909
potassium salt of dicamba	259.1	0.853

The emphasis of this preliminary screening risk assessment is to address risk to non-target aquatic and terrestrial species that may be exposed to dicamba and its salts. The labeled uses of dicamba (Table II.c.) could result in exposure to aquatic and terrestrial organisms inhabiting flowing, non-flowing or transient freshwater waterbodies and wildlands (forests, wetlands and ecotones, such as edge and riparian habitats).

a. Aquatic Effects

Spray drift and surface runoff/leaching to adjacent bodies of water are the most likely sources of dicamba exposure to nontarget aquatic organisms, including listed species. Available acute toxicity data indicates that the toxicity of dicamba varies with the salt forms tested. Study results show that the salt forms appeared to be practically non-toxic to freshwater fishes (LC_{50} >100 mg/L); however, dicamba acid (LC_{50} = 28 mg a.e./L; 88% a.i.) was slightly toxic to rainbow trout. Toxicity to bluegill was similar. The sodium salt of dicamba (26.5% a.i.) was slightly toxic to daphnids with an EC_{50} of 34.6 mg a.e./L. Dicamba acid and the other salts were not toxic to daphnids, with EC_{50}'s >100 mg/L. Results of acute aquatic toxicity studies with the potassium salt of dicamba are questionable due to the precipitation of the test material during testing. Toxicity test results with marine/estuarine species indicate that dicamba acid is practically non-toxic to fish (96-hr LC_{50} >180 mg a.i./L - sheepshead minnow) and invertebrates (96-hr LC_{50} >100 mg a.i./L - grass shrimp; 96-hr LC_{50} >180 mg a.i./L - fiddler crab). No toxicity studies have been conducted to determine potential chronic effects to freshwater and marine/estuarine fish and aquatic invertebrates. Toxicity studies with algae exposed to dicamba acid indicate that cell densities were significantly reduced in blue-green algae at test concentrations as low as 0.061 mg a.i./L. Aquatic vascular plant species were not as sensitive to dicamba acid with 14-day EC_{50} values of >3.25 mg a.i./L, which is greater than the equivalency of the maximum application rate [2.9 mg a.i./L (4 lb ai/ac)]. However, duckweed frond chlorosis occurred at mean measured concentrations as low as 0.39 mg a.i./L. Laboratory studies indicate that dicamba should not bioaccumulate in aquatic organisms; however, it may persist in sediments with an estimated half-life of 141 days (MRID 43245208). Data are currently unavailable to determine potential impacts to sediment-dwelling benthic organisms and to semi-aquatic/transitional habitats (wetlands, riparian habitats).

b. Terrestrial Effects

Ground deposition, spray drift, and wind erosion of soil particles with resulting residues on foliage and on insects and seeds are the most likely sources of dicamba exposure to nontarget terrestrial organisms, including listed species. In addition, uptake in plant roots and foliage would be expected to occur. Current data were not provided to determine the potential exposure to birds, mammals, and pollinators from residues on foliage, insects, and seeds. Available acute toxicity data indicate that the salt forms of dicamba are practically non-toxic to bobwhite quail and mallard ducklings in the diet; however, oral gavage studies indicate that dicamba acid (86.9% a.i.) was moderately toxic (LD_{50} = 188 mg ai/kg) to bobwhite quail and slightly toxic to mallard ducks (NOEL could not be determined due to signs of toxicity at all test levels). In chronic studies with dicamba acid (86.9% a.i.), a reduction in hatchability was observed in mallard ducks at 1390 ppm a.e. (NOEC = 695 ppm a.e.). No treatment-related mortality, signs of toxicity, or effects on reproduction were observed in bobwhite quail. Dicamba acid is classified as practically non-toxic to small mammals on an acute oral basis. A 13-week subchronic oral study in Charles River CD rats reported body weight changes and liver effects at 1000 mg a.i./kg/day. Developmental studies with New Zealand white rabbits reported irregular ossification of internasal bones at 300 mg a.i./kg/day (dicamba acid, 90.5% a.i.) and maternal toxicity (abortion and clinical signs of toxicity, including ataxia, rales, and decreased motor activity) was reported at 150 mg a.i./kg/day. Maternal toxicity; including mortality, clinical signs of toxicity, body weight changes, and decreased food consumption, was also observed in Charles River CD rats at 400 mg a.i./kg/day (dicamba acid, 85.8% a.i.). In a 2-generation reproduction study with Sprague-Dawley rats (dicamba acid, 86.5% a.i.), maternal neurotoxicity was observed at doses of 419 mg a.i./kg/day in males and at 450 mg a.i./kg/day in females and developmental effects, decreased pup growth, were observed in rats at a dose of 136 mg a.i./kg/day. No toxicity studies have been conducted to determine the potential effect of residues to pollinators. An additional source of exposure to dicamba could be in puddled water on treated fields through preening and grooming, involving the oral ingestion of material from the feathers or fur.

Terrestrial plant toxicity studies indicate that dicamba acid negatively impacts seed germination (radicle length; soybean EC_{25} = 0.036 lb ai/A), seedling emergence (shoot length; soybean EC_{25} = 0.0027 lb ai/A), and vegetative vigor (shoot length; soybean EC_{25} = 0.0068 lb ai/A) in monocots and dicots. The most sensitive monocot tested was onion (EC_{25} = 0.071 lb ai/A - seed germination; EC_{25} = 0.0044 lb ai/A - seedling emergence; and EC_{25} = 0.1507 lb ai/A - vegetative vigor). Consequently, spray drift presents a potential risk to non-target plants inhabiting edge habitats adjacent to target fields and riparian vegetation along streams and/or ponds in close proximity to sprayed fields.

Dicamba is readily absorbed through the foliage and roots of plants; consequently, it could be injurious to non-target plant species by drift, runoff, or leaching to roots. Dicamba may accumulate in the soil with frequent or extensive use which may result in damage to trees, shrubs, or other ornamentals. Residuals of dicamba in soil have been shown to reduce emergence in sugarbeet and cause petiole epinasty, severe stunting of seedlings, and trumpeting (Dexter et al, 1994). Dicamba applied according to label directions as a liquid spray for ground or aerial applications may impact non-target plants for some distance from the application site depending on droplet size, wind speed, and other factors. Numerous cases of soybean injury are reported yearly from the use of dicamba on corn that results in the exposure of adjacent fields of soybean to dicamba through spray drift and volatilization (Proost and Boerboom 2004; Hartzler 2003). Injury includes leaf malformations, terminal bud kill, and delayed maturity. Yield loss can occur if soybeans are exposed to dicamba after they bloom (in the reproductive stage).

Since the dicamba salts rapidly dissociate to dicamba acid and it rapidly degrades under aerobic conditions, it would not be expected to persist in surface soils. Thus, risks from exposure to birds, small mammals, and soil invertebrates through dermal contact or ingestion of soils should be minimal.

2. Ecosystems at Risk

In terrestrial and shallow-water aquatic communities, plants are the primary producers upon which the succeeding trophic levels depend. If the available plant material is impacted due to the effects of dicamba, this may have negative effects not only on the herbivores, but throughout the food chain. Also, depending on the severity of impacts to the plant communities [i.e., forests, wetlands, ecotones (edge and riparian habitats)], community assemblages and ecosystem stability may be altered (i.e. reduced bird and mammal populations in edge habitats; reduced riparian vegetation resulting in increased light penetration and temperature in aquatic habitats; reductions in algal biomass). In addition, allochthonous input from riparian vegetation is not only a significant component of the food supply for aquatic herbivores and detritivores but also provides habitat (i.e. leaf packs, materials for case-building for invertebrates).

C. Assessment Endpoints

The portion of the problem formulation which is an explicit statement of the characteristic of the environment to be protected is encompassed in a delineation of endpoints. These endpoints can include a particular species, a functional group of species, a community, or an ecosystem.

Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs, U.S. Environmental Protection Agency

Endangered and Threatened Species Effects Determinations

Office of Prevention, Pesticides and Toxic Substances
Office of Pesticide Programs
Washington, D.C.

January 23, 2004

In situations where available toxicity data indicate that a pesticide formulation for registration in the United States may be more toxic to terrestrial wildlife than indicated by active ingredient effects testing, it may be necessary to consider exposure to the formulation. Exposure modeling in these instances is limited to dietary exposure to residues for a time period immediately following pesticide product application.

The limitation on the quantitative exposure modeling for formulations is based on the expectation that the varying physical-chemical properties of individual components of pesticide formulations will result in progressively different formulation constituents in environmental media over time. Because the proportions of formulation components in environmental media differ from the proportions in the tested formulation, the assumption that environmental residues are toxicologically equivalent to tested formulations cannot be supported beyond the time period immediately following product application.

The Agency's methods for considering formulated product exposure in the screening-level terrestrial organism risk assessment follows approaches developed by the European Union for evaluating pesticide formulation risks (see Support Document #80 - EU Council Directive 91/414/EEC).

d. Non-Target Plant Exposure Modeling

As discussed previously in the aquatic organism exposure section, exposure for non-target aquatic plants is assessed in a manner consistent with exposure for other aquatic organisms.

Terrestrial and semi-aquatic plant exposure characterization employs runoff and spray drift scenarios contained in OPP's Terrplant model (Support Document #18). Exposure calculations are based on a pesticide's water solubility and the amount of pesticide present on the soil surface within the first inch of depth. For dry areas, the loading of pesticide active ingredient from runoff to an adjacent non-target area is assumed to occur from one acre of treatment to one acre of non-target area; for semi-aquatic (wetland) areas, runoff is considered to occur from a larger source area with active ingredient loading originating from 10 acres of treated area to a single acre of non-target wetland. Default spray drift assumptions are 1% for ground applications and 5% for aerial, airblast, forced air, and chemigation applications. Drift is not considered for formulations of herbicides that are not spray-applied (e.g., granules); however, runoff is still considered and expressed on a percent of applied mass basis. A discussion of the uncertainties associated with the drift assumptions is included in section VI.C.6 .b.10 and are included in the risk characterizations for screening-level risk assessments.

2. Effects Characterization

In screening-level ecological risk assessments, effects characterization describes the types of effects a pesticide can produce in an organism and how those effects change with varying pesticide exposure levels. This characterization is based on an effects profile that describes the available effects (toxicity) information for various plants and animals and an interpretation of available incidents information and effects monitoring data. Environmental fate data, monitoring data, and computer models are used to estimate the exposure of non-target animals and plants to pesticide residues in the environment.

40 *CFR* Parts 158.490, 158.540, and 158.590 specify the types and amounts of data that the Agency needs to determine the risks of a pesticide to wildlife, aquatic organisms, and plants. The types of data needed can vary depending on how and where the pesticide is used. A list of the studies that the Agency may require in support of the registration or approval of certain pesticides is provided in Support Document #29.

In these tests, organisms are exposed to different amounts of pesticide active ingredient (and under certain conditions formulated product and degradates) and their responses to these varying concentrations are measured. Study endpoints are used to estimate the toxicity or hazard of a pesticide. (See Support Documents #45, #47-49, #52-53, #57, and #63 for toxicity categories.) The toxicity testing scheme is tiered, such that results from a lower level study are used to determine potential harmful effects to non-target organisms and whether further testing is required. Testing can progress from basic laboratory tests at the lowest level to applied field tests at the highest level.

For screening risk assessments, the following toxicity endpoints are used as inputs to the Risk Quotient (RQ) method for expressing risk (see Section V. C.1) :

Aquatic Animals	
Acute assessment	Lowest tested EC_{50} or LC_{50} for freshwater fish and invertebrates and estuarine/marine fish and invertebrates acute toxicity tests.
Chronic assessment	Lowest NOEC for freshwater fish and invertebrates and estuarine/marine fish and invertebrates early life-stage or full life-cycle tests.
Terrestrial Animals	
Acute avian assessment	Lowest LD_{50} (single oral dose) and LC_{50} (subacute dietary).
Chronic avian assessment	Lowest NOEC for 21-week avian reproduction test.
Acute mammalian assessment	Lowest LD_{50} from single oral dose test.
Chronic mammalian assessment	Lowest NOEC for two-generation reproduction test.
Plants	
Terrestrial non-endangered	Lowest EC_{25} values from both seedling emergence and vegetative vigor for both monocots and dicots.
Aquatic vascular and algae	Lowest EC_{50} for both vascular and algae.
Terrestrial endangered	Lowest EC_5 or NOEC for both seedling emergence and vegetative vigor for both monocots and dicots.

While the above toxicity endpoints are routinely used to calculate screening-level risk assessment RQs, they do not represent a limitation on the types of toxicity endpoints that may be considered in the risk assessment. Over the course of evaluation of available toxicity data (see Section V.B.2 for a discussion of OPP's use of ECOTOX database for effects data searches), the risk assessment team may encounter other effects data that provide: (1) additional information on existing toxicity endpoints commonly used in the screening risk assessment, (2) insight on endpoints not routinely considered for RQ calculation, and/or (3) effects data on specific additional taxonomic groups (e.g., amphibian and freshwater mussel tests). Professional judgment is used and documented by the risk assessment team to determine whether and how available data on other toxicological endpoints are included in the risk assessment. This evaluation may include (1) reference to data quality objectives for specific types of studies, (2) the degree to which adequate documentation is available to evaluate the technical merit of the data, and (3) whether the data are applicable to the assessment endpoints established for the risk assessment. To decide if data are applicable to assessment endpoints, the risk assessment team uses professional judgment and available lines of evidence to determine if the toxicological endpoints can be linked to assessment endpoints in a reasonable and plausible manner.

As stated earlier in this section, the Agency routinely conducts screening-level risk assessments on an active ingredient basis. The only routine exception to this is for terrestrial plant effects analysis, where toxicity studies are conducted on the formulated product. Consequently, the majority of toxicity data received by the Agency relates to the active ingredient. However, Agency regulations have provisions for the request of additional data on formulated products. 40 *CFR* 158.75 allows the Agency to request additional data if routinely required data are not sufficient to evaluate the potential of a pesticide product to cause unreasonable adverse effects on man or the environment. In addition., 40 *CFR* 158.202 indicates that acute aquatic animal toxicity testing may be required if any of the following conditions are met:

- The end-use product is applied directly to water when used as directed;
- Active ingredient LC_{50}/EC_{50} values are equal to or less than the maximum expected environmental concentration or the estimated environmental concentration in aquatic systems when the product is used as directed; or
- An ingredient in the end-use product is expected to enhance the toxicity of the active ingredient or is toxic itself to aquatic organisms.

Support Document #78 presents the Agency's process for the identification of degradates of potential toxicological concern. This information, in conjunction with any available toxicity data and data regarding the extent to which degradates are produced in laboratory and field environmental fate studies, will be considered by the Agency to determine the need for incorporating active ingredient degradates in a risk assessment. This evaluation, which is conducted by the Metabolism Assessment Review Committee, may be based upon information relating to (1) biologically reactive chemical moieties on both the active and degradates, (2) past experience with close chemical analogues, (3) consultation with Agency human health toxicologists, and (4) publically available literature. If degradates are considered by the Agency to be of toxicological significance as determined by the process outlined in Support Document # 78, the Agency evaluates the available information to determine if quantitative or qualitative consideration of degradate risks is warranted. The rationale supporting such decisions are documented in the risk assessment document. To be consistent with Agency risk assessment guidance, risk assessors must clearly and concisely describe this evaluation in the risk assessment.

Formulated product effects data are evaluated and included in the risk assessment when available. (See Section V.A.2 for sources of such information). Acute mammalian effects testing for formulated products is commonly submitted to the Agency. In addition, effects testing for formulations is required for registrations in other nations (EU Directive 91/414/EEC). The Agency provisions for submission of effects data under 40 *CFR* 159.165(b) suggest that formulation effects information conducted for other nations would be submitted to the Agency when it indicates that the formulation may be more toxic than the active ingredient. In addition, searches of the publicly available literature may identify additional effects data for formulations.

Before formulated product effects data can be considered quantitatively in the risk assessment, it must be evaluated for its applicability to formulations under consideration for registration. This evaluation includes a comparison of the confidential statement of formulation for the product proposed for registration with any available information on the constituents of the tested formulation. If the comparison suggests that the tested and proposed registration formulations are similar, the test data are used quantitatively in the risk assessment process. However, if a similarity is not supported by the available formulation information, the toxicity data on formulated products is documented, and the risk characterization qualitatively discusses the potential implications the formulated toxicity may have on the confidence of the risk assessment conclusions.

a. Registrant-Submitted Studies for Direct Effects of Pesticides

Support Documents #45 - #57 and #63 list the universe of toxicity studies commonly submitted by pesticide registrants in support of registration proposals. 40 *CFR* Section 158 describes the criteria that serve as the basis for the requirements for each type of study. The Agency has determined, that under most situations, these effects data are sufficient for risk assessment purposes.

b. Open Literature Studies for Direct Effects of Pesticides

In addition to registrant-submitted data, the Agency also consults publicly available literature for additional toxicity information to be used in screening risk assessments, such as studies on additional taxa, toxicity endpoints, routes of exposure, or test materials. (See Section V.B.2.)

To ensure consistent consideration and use of information in the open literature for ecological risk assessments, OPP has developed guidance for its scientists (Support Document #71) and steps to implement the guidance have been initiated.

(1). ECOTOX

OPP uses the ECOTOX (ECOTOXicology) database as a search engine to identify open literature studies that may potentially be used in ecological risk assessments (http://www.epa.gov/ecotox). The ECOTOX database was selected because it is a user-friendly, publicly-available, quality-assured, comprehensive tool for locating open literature chemical toxicity data for aquatic life, terrestrial plants, and wildlife. Relevant literature for ECOTOX is retrieved using a comprehensive search strategy designed to locate worldwide aquatic and terrestrial ecological effects literature. This strategy is expected to capture the data from research that evaluates species and/or toxic effects, which fall outside the standard battery of required ecotoxicity tests.

The ECOTOX database is developed and maintained by EPA's National Health and Environmental Effects Research Laboratory, Mid-Continent Ecology Division (MED) in Duluth, Minnesota. ECOTOX includes unique toxicity data for aquatic life, terrestrial plants, and terrestrial wildlife and contains information on lethal, sublethal and residue effects. With regard to terrestrial animals, ECOTOX's primary focus is wildlife species, but the database does include some information on domestic species. Sources routinely used for ECOTOX searches are AGRICOLA, Cambridge Scientific Abstracts (CSA), BIOSIS and CAB Abstracts, Current Contents, ScienceDirect, and MED library journal holdings. Relevant sources are also identified from benchmark documents and review papers, and online ecotoxicology databases such as the U.S. Geological Survey's "Wildlife and Contaminants Online" website http://www.pwrc.usgs.gov/contaminants-online/ and the Canadian Wildlife Service's "Reptile and Amphibian Toxicology Literature" website http://www.cws-scf.ec.gc.ca/nwrc-cnrf/ratl/index_e.cfm.

The ECOTOX database can issue two types of reports. The aquatic organism report includes toxic effects data on all aquatic species including plants and animals and freshwater and saltwater species, while the terrestrial organism report contains toxicity data for terrestrial animals and terrestrial plants.

The high level of quality assurance of the ECOTOX database makes it an important primary source for consistently searching open literature data. Extensive documentation for this database, ranging from Standard Operating Procedures, Coding Guidelines, Chemical Verification, and various procedures, are described in Support Documents #72 - #77.

Quality assurance procedures begin with literature acquisition and cataloging and continue through the chemical and species verification, the literature review process, data entry, and data retrieval. The ECOTOX literature is encoded by trained document abstractors. An intensive training period, a well-documented manual, and close interaction with the data coordinator help to ensure a high level of accuracy and consistency in the review process. Ten percent of the publications are independently reviewed by two different reviewers. These reviews are compared, and differences (if any) are documented, discussed, and resolved by the data coordinator.

This procedure provides a consistent attempt at finding data. Since there is a lag time of three months between literature acquisition and data availability in ECOTOX, OPP may request MED to search their reference files for any unreviewed studies on a chemical of concern. In addition, OPP will work with MED to identify citations and papers in their holdings that were not encoded in ECOTOX, including studies conducted on chemical mixtures, formulations, inert ingredients and surfactants, and survey and incident data.

(2). OPP Strategy for Conducting Literature Searches

OPP is refining a search strategy that it will follow for finding and filtering pesticide data in ECOTOX and is establishing guidance that describes how to evaluate the data output from ECOTOX. After identifying pesticide toxicity data in ECOTOX that may be useful in a pesticide risk assessment, copies of the journal articles and study reports will be retrieved so that the risk assessor may more closely critique the study. MED holds paper copies of all studies cited in the ECOTOX database and copies of applicable papers can be provided to OPP upon request.

This guidance, which will help maintain consistency concerning when and how data from open literature can be used, will help the risk assessor determine if an open literature study can be used in a pesticide risk assessment. Development of this guidance is being coordinated with other OPP quality assurance guidance. In addition, EPA science policy documents will be used as a base in developing the guidance (http://www.epa.gov/osp/spc/2polprog.htm and http://www.epa.gov/oei/qualityguidelines), and the guidance will be similar to previous work by OPP (U.S. Environmental Protection Agency, 2003), Superfund (http://www.epa.gov/ecotox/ecossl/), Office of Water (U.S. Environmental Protection Agency, 2002a), and EVISTRA (U.S. Environmental Protection Agency, 2002b).

In accordance with established risk assessment guidance, the Agency will identify in the risk assessment (1) the effects data from the literature that were considered in the risk assessment, (2) the basis for decisions on the manner in which such data were incorporated in the risk assessment, and (3) the rationale for not including data obtained from the literature.

c. Open Literature Studies for Indirect Effects of Pesticides

To obtain best available information for interpreting the potential for indirect effects at the screening level, the Agency will utilize "species profiles", when available, prepared by the Services for other Federal action agencies (e.g., EPA's Office of Water). These summaries, or profiles, are considered current best available information concerning species' life history, ecology, population demographics, etc., and will be provided to the Agency by the Services. The Agency anticipates that the Services will provide the Agency with similar summary information for listed species not covered by existing "species profiles."

d. Open Literature Studies for Critical Habitat Evaluations

To obtain best available information for interpreting the potential for critical habitat evaluations at the screening level the Agency may utilize "critical habitat profiles", when available, prepared by the Services. These summaries, or profiles, are considered current best available information concerning principle constituent elements for specific species and will be provided to the Agency by the Services. Critical habitat profiles provide the Agency with an identification of the principle constituent elements or equivalent (e.g., lists of biological resource requirements for the listed species associated with the critical habitat).

C. Risk Characterization

Risk characterization is the integration of effects and exposure characterization to determine the ecological risk from the use of the pesticide and the likelihood of effects on aquatic life, wildlife, and plants based on varying pesticide-use scenarios. The Agency's policy and guidance (Support Document #28) requires that risk characterizations be prepared in a manner that is clear, transparent, reasonable, and consistent with other risk characterizations of similar scope.

1. Integration of Exposure and Effects Data - The Risk Quotient for Direct Effects

Risk characterization integrates the results of exposure and toxicity data to evaluate the likelihood of adverse ecological effects on non-target species. For most chemicals, the effects characterization is based on a deterministic approach using one point on a concentration-response curve (e.g., LC50). In this approach, OPP uses the risk quotient (RQ) method to compare exposure over toxicity. Estimated environmental concentrations (EECs) based on maximum application rates are divided by acute and chronic toxicity values. (Equations are provided in Support Document #8.)

2. Levels of Concern for Direct Effects - The Policy Tool for Interpreting Risk Quotients for Direct Effects

After risk quotients are calculated, they are compared to the Agency's LOCs. These LOCs are the Agency's interpretative policy and are used to analyze potential risk to non-target organisms and the need to consider regulatory action. These criteria are used to indicate when a pesticide use as directed on the label has the potential to cause adverse effects on non-target organisms. A discussion of the developmental history is provided in support document # 70. LOCs currently address the following risk presumption categories:

- Acute - Potential for acute risk to non-target organisms which may warrant regulatory action in addition to restricted use classification (acute RQ > 0.5 for aquatic animals, mammals, birds);
- Acute Restricted Use - Potential for acute risk to non-target organisms, but may be mitigated through restricted use classification (acute RQ > 0.1 for aquatic animals or 0.2 for mammals and birds);
- Acute Endangered Species - Endangered species may be potentially affected by use (acute RQ > 0.05 for aquatic animals or 0.1 for mammals and birds);

- Chronic Risk - Potential for chronic risk may warrant regulatory action, endangered species may potentially be affected through chronic exposure (chronic RQ > 1 for all animals);

- Non-endangered Plant Risk - RQ >1; and

- Endangered Plant Risk - Potential for effects in endangered plants (RQ>1).

It should be noted that both acute endangered species and chronic risk LOCs are considered in the screening-level risk assessment of pesticide risks to listed species. Endangered species acute LOCs are a fraction of the non-endangered species LOCs or, in the case of endangered plants, RQs are derived using lower toxicity endpoints than non-endangered plants. Therefore, concerns regarding listed species within a taxonomic group are triggered in exposure situations where restricted use or acute risk LOCs are triggered for the same taxonomic group. The Agency risk assessment also includes, both in the risk characterization and the endangered species sections, an evaluation of the potential probability of individual effects for exposures that may occur at the established endangered species LOC. This probability is calculated using the established dose/response relationship and the median lethal dose estimate for the study used to establish the toxicity endpoint for the endangered taxa.

As discussed earlier in this document, the Agency is not limited to a base set of surrogate toxicity information in establishing risk assessment conclusions. The Agency also considers toxicity data on non-standard test species (e.g., amphibian data) when available. (See Section V.B.2.b.on searches for publically available effects information.) To the extent that such data meet data quality requirements, it is used to interpret the relevance of risk assessment LOCs in the context of other tested taxa.

3. Comparison of Field and Laboratory Data for Direct Effects

Given the general widespread nature of pesticide uses and the variability in the physical, chemical, and biological conditions associated with pesticide use sites, validation of the results of the existing screening risk assessment process would be impractical. However, OPP does consider data on exposure and effects collected under field conditions to make determinations on the predictive utility of the screening assessment.

After the 1992 Ecological, Fate, and Effects Task Force review of the testing requirements for environmental fate and ecological effects, the Agency decided to not require avian and aquatic guidelines field testing, except in unusual circumstances (Support Document #25). However, when field studies along with incident data reports and compliance monitoring studies are available, they are used to help elucidate the potential sources and magnitude of uncertainties when extrapolating from effects predictions based on laboratory toxicity data to effects occurrence in the field. As pointed out in the Agency's Guidelines for Ecological Risk Assessment (Support Document #7), developing solid relationships between cause and observed field effects adds to the certainty of the assessment. The criteria presented in these guidelines adopted from Fox (1991) and similar to other criteria reviewed by Fox (U.S. Department of Health, Education, and Welfare, 1964; Hill, 1965; and Susser, 1986a and 1986b) stressed the importance of the strength of association between the causative agent and the observed effect.

OPP routinely receives information on the field dissipation of pesticides under actual use conditions. These data provide the Agency with information on the persistence of the parent compound and the rate of production of degradates. Incorporation of the results of field dissipation data into the quantitative exposure modeling is problematic because of the nature of the model input requirements. However, overall rates and routes of pesticide decline as predicted by the fate models can be examined and compared with the results of the field dissipation models to determine the degree to which the risk assessment fate modeling may overstate exposure.

In addition to field dissipation measurements, scientists often consider available data on environmental media monitoring for pesticides. For example, the results of the screening environmental models are compared with monitoring data for surface waters. As previously mentioned, though, there are practical limitations to surface water monitoring efforts. For example, non-targeted routine monitoring programs, such as the U.S. Geological Survey's National Water-Quality Assessment Program, are more useful for tracking trends than they are for establishing true peak concentrations. However, comparison of the Agency modeling results with such monitoring programs can provide some insight into the degree to which modeling results reflect realistic conditions in the field.

As discussed for surface water monitoring, field effects data are limited in the ability to account for the myriad combinations of physical, chemical, and biological variables that may affect organism response to pesticides in the environment. Consequently, field studies or incident reports cannot conclusively validate screening risk assessment predictions, but they can allow inferences on the reasonableness of the assessment predictions.

Incident information can add lines of evidence to provide context to the risk predictions from the screening level assessment. Sometimes this reporting provides limited information for an ecological assessment because most incidents are not reported, and those that are reported, often do not have enough information to assess cause and effect. Generally, it is assumed that the application was from normal use and was applied within the rates allowed on the labeling, unless otherwise indicated. On occasion, the use rates are reported in incident investigations, but actual documentation with scientific rigor is rare. Therefore, incident reports often provide limited information about the correlation between use rates and effect levels. However, consistent with components of the criteria described by Fox (1991), the greater the number of wildlife mortality incidents following application of a specific pesticide for a specific use, and the greater the number of individuals involved, the higher the confidence in the strength of the association. The more confidence in the association between incident and pesticide exposure, the more useful the information when evaluating risk conclusions derived from laboratory-based screening assessment methods. The Agency maintains a database, which is described in Section IV.C.2.c, of incident information to support risk assessment.

4. Indirect Effects Characterization for Listed Species

The Agency acknowledges that pesticides have the potential to exert indirect effects upon the listed organisms by, for example, perturbing forage or prey availability, altering the extent and nature of nesting habitat, etc.

In conducting a screen for indirect effects, the Agency uses the direct effects LOCs for each taxonomic group to make inferences concerning the potential for indirect effects upon listed species that rely upon non-endangered organisms in these taxonomic groups as resources critical to their life cycle. The Agency considers pesticide-use scenarios, resulting in RQs that are below all direct effect endangered species LOCs for all taxonomic groups assessed to be of no concern for risks to listed species either by direct or indirect effects.