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MEMORANDUM

SUBJECT: **DICAMBA:** Occupational and Residential Exposure and Risk Assessment for the Reregistration Eligibility Decision (RED) Document
[PC Code 029801, DP Barcode D317701]

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Attached is the Occupational and Residential Exposure and Risk Assessment document for the Dicamba RED Chapter.

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Table of Contents

Executive Summary		**3**
1.01	**Background Information**	**6**
1.1	Purpose and Criteria for Conducting Exposure Assessments	6
1.2	Toxicological Endpoints	6
1.3	Incident Reports	8
1.4	Summary of Use Patterns, Formulations and Application Methods	8
2.0	**Occupational and Residential Exposures and Risks**	**13**
2.1	**Occupational Handler/Applicator Exposures & Risks**	**13**
2.1.1	Exposure Scenarios	13
2.1.2	Exposure Assumptions and Data Sources	13
2.1.3	Exposure and Risk Estimates	16
2.1.4	Risk Characterization	16
2.2	**Occupational Post Application Exposures & Risks**	**18**
2.2.1	Exposure Scenarios	18
2.2.2	Exposure Data Sources, Assumptions and Transfer Coefficients	18
2.2.3	Exposure and Risk Estimates	20
2.2.4	Risk Characterization	20
2.3	**Residential Applicator Exposure and Risks**	**21**
2.3.1	Exposure Scenarios, Data Sources and Assumptions	21
2.3.2	Exposure and Risk Estimates	22
2.3.3	Risk Characterization	22
2.4	**Residential Turf Post Application Exposure and Risks**	**22**
2.4.1	Exposure Scenarios, Data Sources and Assumptions	22
2.4.2	Exposure and Risk Estimates	28
2.4.3	Risk Characterization	29
2.5	**Resdential Turf Granular Ingestion Exposure and Risks**	31
3.0	**References**	**32**
4.0	**Glossary of Terms**	**33**

Appendices

A - Standard Formulas Used for Calculating Dicamba Occupational and Residential Exposures
B - Occupational Handler Exposure Data and Risk Calculations for Dicamba
C - Occupational Post-Application Risks of Dicamba
D - Residential Handler Exposure Data and Risk Calculations for Dicamba
E - Dicamba Turf Transferable Residue Data
F - Residential Turf Post Application Risk Assessment for Dicamba

Executive Summary

Dicamba Use Description

Based upon the Dicamba Use Closure Memo, there are registered products of dicamba intended for both occupational and residential uses. The registered occupational uses include small grains, corn, sorghum, sugarcane, sod farms, pastures, rangeland and rights of way areas. Residential uses include broadcast and spot treatment on golf courses and lawns.

Toxicology Endpoints:

Dicamba is of low to moderate acute toxicity (i.e. Tox Category III or IV) via the oral, inhalation or dermal routes of exposure. Dicamba is an eye and skin irritant (Tox Category II); however, it is not a skin sensitizer.

The following endpoints were used for assessing dicamba occupational and residential risks:

- An oral LOAEL of 300 mg/kg/day from an acute neurotoxicity study in rats in which clinical signs of neurotoxicity were observed at the lowest dose tested of 300 mg/kg/day. This LOAEL is applicable for acute dermal and incidental oral exposures for children and acute dermal exposures for adults.

- An oral NOAEL of 45 mg/kg/day from a multigeneration reproduction study in rats in which decreased pup growth was observed at the LOAEL of 136 mg/kg/day. This NOAEL is applicable to short-, intermediate-, and long-term incidental oral, dermal and inhalation exposures for the general population and workers.

- A dermal absorption factor of 15 percent was estimated for converting dermal exposures to oral equivalent doses.

The target MOE for occupational exposures is 100, which includes the standard safety factors of 10X for intraspecies variability (i.e. differences among humans) and 10X for interspecies variability (differences between humans and animals). The target MOE for acute residential exposures is 300 because it includes an additional factor of 3 to account for the lack of a NOAEL in the acute neurotoxicity study. The target MOE for short term residential exposures is 100.

Occupational Handler/Applicator Exposure and Risk Estimates:

The MOEs for occupational exposures were calculated for short/intermediate term dermal and inhalation exposures using standard assumptions and unit exposure data. The unit exposure data were generally taken from the Pesticide Handlers Exposure Database (PHED) and the Outdoor Residential Exposure Task Force (ORETF) studies for professional lawn care operators. All of the mixer/loader MOEs exceed the target of 100 with single layer PPE (i.e. baseline clothing with gloves) and are not of concern. The MOEs for applicators are above 100 with baseline or single layer PPE . The MOEs for the mixer/loader/applicators are acceptable with

single layer PPE and the MOEs for the flaggers are acceptable with baseline PPE. The labels typically require baseline clothing with water proof gloves.

Data Used for Turf Post Application Exposure Assessment

There are three turf transferable residue studies that were submitted by the Broadleaf Turf Herbicide TFR Task Force and there was an additional study that was submitted by Novartis Crop Protection. All of the studies were reviewed by HED and were found to meet most of the series 875 guidelines for postapplication exposure monitoring. The day 0 TTR values ranged from 0.8 to 1.5 percent of the application rate with an average of 1.1 percent (n =9) and maximum TTR values ranged from 1.1 to 2.6 with an average of 1.6 (n=9). In many cases the maximum TTR values occurred a few hours after application. The half lives ranged from 0.33 days at sites with rain to 1.8 days at dry sites.

A maximum TTR value of 2.6 percent of the application rate was derived from the Vanquish Study (MRID 449590-01) and was used for assessing acute exposures. A 7 day average TTR of 0.55 percent of the application rate was derived from the California site of MRID 450331-01 which had a half life of 1.8 days. The seven day average TTR was used for assessing short term exposures.

Post-Application Occupational Exposure and Risk Estimates:

Post application exposure to re-entry workers may occur because dicamba can be applied over the top to some of the labeled crops. The exposures include irrigation and scouting of small grains and harvesting of sod farm turf. The exposures were assessed using standard assumptions and maximum label rates. The TTR data was used to assess exposures on sod farm turf and default assumptions were used for the other crops that did not have residue data. All of the post application MOEs are above the target MOE of 100 on Day 0.

Residential Applicator Exposure and Risk Estimates:

The residential products are typically formulated as dry weed and feed products or as liquids in concentrates or ready to use sprays. Spot and broadcast treatments are both included on the labels. The MOEs for residential handlers exposures were calculated using standard assumptions, maximum label rates and PHED and ORETF unit exposure data. The MOEs exceed the target MOE of 100 which means the risks are not of concern.

Residential Turf Post Application Exposure and Risk Estimates

The MOEs for residential turf exposures were calculated using the TTR data, maximum label rates and the Residential SOPs. MOEs were calculated for acute exposures using the maximum TTR value of 2.6 percent of the application rate along with the appropriate acute endpoint. MOEs for short term exposures were calculated using the seven day average TTR because the short term NOAEL was based upon effects observed during the multi-generation reproduction study (decreased pup weight gain) which did not occur until after several days of exposure.

The acute MOEs exceed the target MOE of 300 and the short term MOEs exceed the target MOE of 100. This means that the acute and short term risks are not of concern.

Residential Turf Granule Ingestion Exposure and Risk Estimates

The risks for toddlers ingesting granules that have been applied to residential turf were assessed using a standard method as outlined in the Residential SOPs. The percent ai in granular products was assumed to be in the range of 0.1 to 1.0 percent based upon the labels listed in OPPIN. The MOEs were calculated using the NOAEL of 300 mg/kg/day and ranged from 1,500 to 15,000 which exceeds the target MOE of 300. This means that the risks for toddler exposures from granular ingestion are not of concern.

Risk Characterization

The calculation of acute MOEs using a maximum TTR value for toddler turf post application exposure represents a policy change, because the maximum TTR values were previously only used to calculate short term MOEs. The dicamba risk assessment team decided that the previous approach would greatly overestimate the short term risks, because the short term incidental oral and dermal endpoints were based upon effects that would only occur after several days of exposure. The team also decided that the single day exposures as represented by the maximum TTR values would be more appropriately assessed using the acute dietary endpoint. The short term exposures were assessed using the seven day average TTR values because the endpoints occurred after several days of exposure and because the TTR data were collected during a seven day time period.

The actual use rates of dicamba are typically less than the maximum label rates because dicamba is usually mixed with other herbicides (e.g. 2,4-D) to improve weed control.

Only a few dicamba products are formulated as wettable powders and most of these products are packaged in water soluble bags for turf use.

Some of the end use product labels require waterproof gloves instead of chemical resistant gloves. It is not known if these gloves provide adequate protection for dicamba.

1.0 Background Information

1.1 Purpose and Criteria for Conducting Exposure Assessments

Occupational and residential exposure and risk assessments are required for an active ingredient if: (1) certain toxicological criteria are triggered **and** (2) there is potential exposure to handlers during use, or to field workers entering treated areas after application is completed. Dicamba (4-chloro-2-methylphenoxy acetic acid; CAS # 94-74-6) meets both criteria. There is potential exposure to handlers and field workers from agricultural site applications of dicamba. In addition, the general public may be exposed to dicamba during or after application to turf.

Many of the dicamba products also contain other registered active ingredient herbicides including other phenoxy herbicides such as 2,4-D. These ingredients are not addressed in this risk assessment.

1.2 Toxicological Endpoints

A summary of the acute toxicity data is included in Table 1. This data indicates that dicamba is of low to moderate toxicity (i.e. Tox Category III or IV) via the oral, inhalation or dermal routes of exposure. Dicamba is an eye and skin irritant (Tox Category II), however, it is not a skin sensitizer.

Table 1 - Acute Toxicity of Dicamba

Guideline No.	Study Type	MRID NO.	Results	Toxicity Category
870.1100	Acute Oral	00078444	LD_{50} = 2740 mg/kg	III
870.1200	Acute Dermal	00241584	LD_{50} > 2000 mg/kg	III
870.1300	Acute Inhalation	00263861	LC_{50} = >5.3 mg/L	IV
870.2400	Primary Eye Irritation	00241584	Irritant	II
870.2500	Primary Skin Irritation	00237955	Irritant	II
870.2600	Dermal sensitization	00263861	Non sensitizer	N/A

The toxicological endpoints used to complete occupational and residential exposure assessments are summarized in Table 2. A 21 day dermal toxicity study was available but it was not used to assess dermal exposures because it did not evaluate reproductive effects. A dermal absorption factor of 15 percent was derived from a comparison of the NOAEL of 1000 mg/kg/day from the 21 day dermal toxicity study in rabbits with the NOAEL of 150 mg/kg/day from the rat oral developmental study.

Table 2 - Dicamba Toxicological Endpoints Used for Occupational and Residential Risk Assessment

Exposure Scenario	Dose or Factor Used in Risk Assessment	Study and Toxicological Effects
Acute Dietary (all populations)	Oral LOAEL = 300 mg/kg/day	Acute Neurotoxicity Study in Rats LOAEL = 300 mg/kg/day (LDT) based on clinical signs of neurotoxicity.
Incidental Oral Short/Intermediate/ Long Term	NOAEL= 45 mg/kg/day	Multi-generation Reproduction Study in Rats. LOAEL = 136 mg/kg/day based on impaired pup growth.
Dermal Short/Intermediate/ Long Term	Same as above	Same as above
Inhalation Short/ Intermediate/ Long Term	Same as above	Same as above
Cancer	Classification: Not likely to be carcinogenic to humans	
Dermal Absorption Factor	15 percent of the oral dose	Comparison of NOAEL of 1000 mg/kg/day from the 21 day dermal toxicity study in rabbits with the NOAEL of 150 mg/kg/day from the rat oral developmental study.
Target MOE for Occupational Exposures	100 Dermal 100 Inhalation	Includes standard uncertainty factors of 10 and 10 for intraspecies variability and interspecies extrapolation.
Target MOE for Acute Residential Exposures	300 All routes	Includes additional factors of 3 to account for the lack of a NOAEL.
Target MOE for Short Term Residential Exposures	100 All routes	

* Since an oral NOAEL was selected, a dermal absorption factor should be used in route to route extrapolation.
* Inhalation absorption is assumed to be equivalent to oral absorption (100 percent default value).

1.3 Incident Report

The incident report was prepared under a separate memo by Monica Spann, M.P.H. and Jerome Blondell, PhD. of the Office of Pesticide Programs. The incident report was complicated by the fact that dicamba is rarely used as a herbicide by itself and is usually mixed with other chlorophenoxy herbicides, like 2,4-D. Only those incidents involving products with dicamba as the sole active ingredient in a product were considered. There was only a single report in the Incident Data System which occurred when a contractor at the formulating plant was treated for minor eye irritation resulting from dicamba flaked dust falling into his eye. The flake operation was started while the contractor was installing a pipe bracket under a line below the operating equipment.

Poison Control Center Data for the years 1993 through 2003 indicate that there were only 24 occupational exposures to dicamba that is too few to warrant a detailed analysis. Of these 24 cases, 3 had a moderate medical outcome and 1 was considered a major medical outcome. The one major outcome case was a 15 year old who was exposed in the eye and experienced blurred vision, irritation, non-reactive pupils, and visual defect. This case should not have been classified as major unless the poison specialist anticipated the effect would be permanent and the duration of effect for this case was listed as unknown. The poison control data indicated that there were 146 non-occupational (i.e. residential) exposure cases and 13 of these cases were classified as a moderate medical outcome with primary symptoms of eye irritation, corneal abrasion, coughing, and difficulty breathing. One case with major medical outcome was a 16 year-old with chest pain, dysrhythmia, tachycardia (fast pulse), multiple seizures, and coma after inhalation. However, there were no other cases with such serious symptoms among the 146 exposures.

No reports of dicamba poisoning were reported in California from 1982 through 2003. It was not possible to search the National Pesticide Information Center for calls associated with products containing only dicamba. Out of 5,899 reported cases in the NIOSH SENSOR program from 1998-2003, none involved dicamba as a sole active ingredient.

The incident report concluded that "There were too few reports of ill effects from exposure to dicamba in the available data bases to draw conclusions about likely effects. Reigart and Roberts (1999) state that dicamba can be moderately irritating to skin and respiratory tract. This is consistent with reported symptoms from Poison Control Centers. No recommendations are made based on the limited information available."

1.4 Summary of Use Patterns, Formulations and Application Methods

Uses

Based upon the Dicamba Use Closure Memo, there are registered products of dicamba intended for both occupational and residential site applications. The registered agricultural uses include small grains (i.e. barley, oats, rye and wheat), corn, sorghum, sugarcane, pastures, rangeland and sod farm turf. Residential uses include broadcast and spot treatment on turf.

Based upon available pesticide survey usage information for the years 1998-2003, the Biological and Economic Effects Division (BEAD) of EPA estimates that total annual domestic usage of dicamba is approximately 5.65 million pounds active ingredient (ai). A listing of the use sites ranked by the amount used is given in Table 3.

Table 3 - Screening Level Estimates of Agricultural Uses of Dicamba

Use Site	Amount Used (pounds)	Percent of Total Used
Corn	3,500,000	61.9%
Wheat	1,300,000	23.0%
Pasture and Rangeland	600,000	10.6%
Sorghum	100,000	1.8%
Hay	50,000	0.9%
Sugarcane	30,000	0.5%
Barley	30,000	0.5%
Oats	20,000	0.4%
Cotton	10,000	0.2%
Soybeans	10,000	0.2%
Total of Above	5,650,000	100%

Source: SLUA Report for Dicamba, EPA BEAD, 6/20/01.

Mode of Action and Targets Controlled

Dicamba is a highly selective herbicide mainly used for post emergent control of certain broadleaf weeds and woody plants. It is an auxin agonist that is readily translocated symplastically and apoplastically with accumulation in meristemic regions of the plant. Sensitive plants exhibit rapid uncontrolled growth characterized by twisting and curling of stems and petioles, stem elongation and swelling and leaf cupping. Weed control is generally achieved in 5 to 7 days.

Formulation Types and Percent Active Ingredient

According to the EPA OPPIN tracking system, as of 01/24/05, there were approximately 434 active dicamba products formulated from 6 different forms. A listing of these forms is included in Table 4. The acid, dimethylamine and sodium salt ester forms of dicamba have the most products. The commercial and agricultural products are generally formulated as liquids, standard granules and water dispersible granules. One dimethylamine product (228-283) is a wettable powder and is labeled for professional applicator use on turf. One sodium salt product (241-359) is a wettable powder that is packaged in water soluble bags and it is labeled for use on clearfield corn seed hybrids. The residential products are typically formulated as granular weed and feed formulations or as liquids in concentrates or ready to use sprays. Two dimethylamine residential products are listed as dusts in OPPIN, however, the labels indicate that they are weed and feed formulations applied with broadcast spreaders which suggests that they are actually granular formulations.

Table 4 - Dicamba Forms and Number of Labels				
Dicamba Form	**PC CODE**	**Number of Labels**	**Predominant Formulations**	**Other Formulations (Registration Number)**
Acid	029801	143	Liquids and granules	None
Dimethylamine salt(DMA)	029802	251	Liquids and granules	Dusts (228-343, 228-229) Wettable Powder (228-283)
Sodium salt	029806	21	Liquids and Water Dispersible Granules	Wettable Powder in Water Soluble Bags (241-359)
Potassium salt	129043	10	Liquids	None
DGA salt	128931	5	Liquids	None
Isopropyl amine	128944	4	Liquid	None

Application Rates, Timing and Frequency of Applications

Typically one application is made per growing season. The label required spray volumes for ground applications range from 20 gallons for most crops to 100 gallons per acre for vine and brush control. Dicamba can be applied over the top to the labeled crops.

The application rates are included in Table 5 and are given in terms of acid equivalent (ae). The average application rates are typically lower than the label application rates because dicamba is typically tank mixed with other herbicides.

Table 5 - Dicamba Application Rates

Crop or Site	Acid Equivalent Application Rates Per Application (lb ae/acre)				
	Application Rates per Smart Meeting[1]	Application Rates per All Registrant Labels[2]	Average Rate[3]	Percent Crop Treated[4]	Outlier Labels
Asparagus	0.5	0.5	0.33	5	
Barley	N/A	0.25 foliar 0.5 Preplant	0.08	5	
Corn	0.5	0.5	0.19	20	
Cotton	0.25	0.25	0.25	<1	
Fallow Land	2.0	2.0	0.12	ND	
Grass for Seed	2.0	1.0	ND	ND	
Hay	1.0	2.0	ND	ND	
Right of Way (ROW) Areas	2.0	2.0 Most Labels 8.7 Outlier Labels	ND	NA	Veteran 10G SAN 845H*
Oat	0.125	0.125 foliar 0.5 preplant	ND	5	
Millet	0.125	0.125	ND	ND	
Pasture and Rangeland	1.0	2.0 Most Labels 8.7 Outlier Labels	0.25	<1	Veteran 10G SAN 845H
Rye	N/A	0.5	ND	ND	
Sod Farms	1.0	1.0	ND	ND	
Sorghum	0.25	0.275 foliar 0.5 pre-emergent	0.16	5	
Soybean	2.0	2.0	0.21	<1	
Sugar Cane	2.0	2.0 Most Labels 2.8 Outlier Label	0.18	15	7969-140
Turf, Golf Courses		1.0	ND	NA	
Turf, Lawns		2.0	ND	NA	
Wheat	0.25		0.10	10	

Notes
1. As listed in the Dicamba Smart Meeting of 11/04/2004.
2. Based upon the master label spreadsheets produced by BEAD.
3. Usage Report in Support of the Dicamba (029801) Reregistration. BEAD. 7/29/05
4. Screening Level Estimates of Agricultural Uses of Dicamba. BEAD. 7/14/04

* The master label spreadsheet has this rate listed as 0.877 lb ae/acre which is an apparent typographical error.

Application Methods

The dicamba labels allow ground and aerial application, but do not allow chemigation. Most of the dicamba applications (97%) are made by ground and only a small percentage (3%) are made by air. Most of the ground applications are made by the grower. A listing of application methods and amounts of acreage treated per 8 hour day is included in Table 6.

Table 6 - Dicamba Application Methods

Application Method	Typical Crops Treated	Treated Acreage[a]
Groundboom	Small Grains, Corn, Sugarcane Golf Course Turf	200 40
Fixed Wing Aircraft	Small Grains, Corn, Sugarcane	1200
Right of Way (ROW) Sprayer	Broadcast Weed Control - 20 gallons per acre Spot Treatment Brush Control - 10 gallons/acre	50[b] 10[c]
Turfgun (mix/load/apply) Turfgun (mixer/loader for 20 person crew) Turfgun (apply only)	Turf	5 100[d] 5
Backpack Sprayer - Mix/Load/Apply	Spot Treatment	2[e]
Backpack Sprayer (apply only) Backpack Sprayer (mixer/loader for 10 person crew)	Forest Sites	4[f] 40[g]
Tractor Drawn Broadcast Spreader	Turf	40
Push Type Broadcast Spreader	Turf	5

a. Based upon HED Exposac SOP #9 "Standard Values for Daily Acres Treated in Agriculture", Revised July 5, 2000
b. Based upon 1000 gallons of spray applied per day from SOP #9 divided by an estimated spray volume of 20 GPA.
c. Based upon 1000 gallons of spray applied per day from SOP #9 divided by an estimated spray volume of 100 GPA.
d. Based upon a mixer loader at a central location supporting a crew of 20 PCOs.
e. Based upon 40 gallons of spray applied per day from SOP #9 divided by an estimated spray volume of 20 GPA.
f. Based upon the acreage treated in CA DPR HS-1769 normalized to an 8 hour day. The spray volume was 25 GPA.
g. Based upon a mixer/loader supporting a crew of 10 backpack applicators.

2.0 Occupational and Residential Exposures and Risks

As discussed above, dicamba is used both in the agricultural and residential environment. The risks from mixing, loading and applying dicamba in the agricultural environment are discussed in section 2.1. Post application exposures and risks for agriculture are discussed in section 2.2. Exposures and risks for homeowners (i.e. residential) are discussed in sections 2.3 and 2.4.

2.1 Occupational Handler/Applicator Exposures & Risks

2.1.1 Exposure Scenarios

Based upon the application methods listed in Table 6, the following exposure scenarios were assessed.

Mix/Load Wettable Powder
Mix/Load Water Dispersible Granules
Mix/Load Liquid Formulations
Load Granules
Aerial Application
Groundboom Application
Turfgun Application
Backpack application
Right of Way Application
Broadcast Spreader Application
Mix/Load/Apply Liquids with a Backpack Sprayer

Mix/Load/Apply Wettable Powder with a Turfgun
Mix/Load/Apply Wettable Powder with a Water Dispersible Granules
Mix/Load/Apply Liquids with a Turfgun
Load/Apply Granules with a Push Cyclone
Flag Aerial Application

2.1.2 Occupational Handler Exposure Assumptions and Data Sources

Exposure Assumptions

The following assumptions and factors were used in order to complete the exposure and risk assessments for occupational handlers/applicators:

- The average work day was 8 hours.
- The daily acreages treated were taken from EPA Science Advisory Council for Exposure Standard Operating Procedure #9 "Standard Values for Daily Acres Treated in Agriculture," Revised July 5, 2000. These values are listed in Table 6.
- The application rates are the maximum rates as listed in the Dicamba Use Closure Memo.
- A body weight of 70 kg was assumed because the endpoint is not gender specific.
- The inhalation absorption rate is 100%.
- Baseline PPE includes long sleeve shirts, long pants and no gloves or respirator.
- Single Layer PPE includes baseline PPE with chemical resistant gloves.
- Double Layer PPE includes coveralls over single layer PPE.
- PF5 indicates a filtering facepiece respirator (i.e. a dustmask) with a protection factor of 5 when properly fitted.
- PF10 indicates a half mask elastomeric facepiece respirator with a protection factor of 10 when properly fitted and used with appropriate cartridges.
- Only closed cockpit airplanes are used for aerial application.
- Airplane pilots do not wear chemical resistant gloves.

Handler Exposure Data Sources

The handler exposure data were taken from the Pesticide Handler Exposure Database (PHED). the Outdoor Residential Exposure Task Force (ORETF) and the California Department of Pesticide Regulation (CA DPR). The PHED data were used primarily for the large scale agricultural and forestry scenarios and the ORETF data were used for lawn care scenarios. The CA DPR data were used for the backpack applicator forest site preparation scenario where multiple applicators are supplied by a nurse tank. A summary of each data source is provided below.

PHED Data

PHED was designed by a task force of representatives from the US EPA, Health Canada. the California Department of Pesticide Regulation. and member companies of the American Crop Protection Association. PHED is a software system consisting of two parts – a database of measured exposure values for workers involved in the handling of pesticides under actual field conditions and a set of computer algorithms used to subset and statistically summarize the selected data. Currently, the database contains values for over 1,700 monitored individuals (i.e., replicates). The distribution of exposure values for each body part (e.g., chest, upper arm) is categorized as normal, lognormal, or "other" (i.e., neither normal nor lognormal). A central tendency value is then selected from the distribution of the exposure values for each body part. These values are the arithmetic mean for normal distributions. the geometric mean for lognormal distributions, and the median for all "other" distributions. Once selected, the central tendency values for each body part are composited into a "best fit" exposure value representing the entire body.

The unit exposure values calculated by PHED generally range from the geometric mean to the median of the selected data set. To add consistency and quality control to the values produced from this system. the PHED Task Force has evaluated all data within the system and has developed a set of grading criteria to characterize the quality of the original study data. The assessment of data quality is based upon the number of observations and the available quality control data. These evaluation criteria and the caveats specific to each exposure scenario are summarized in Table B2 of Appendix B. While data from PHED provide the best available information on handler exposures, it should be noted that some aspects of the included studies (e.g., duration, acres treated, pounds of active ingredient handled) may not accurately represent labeled uses in all cases. HED has developed a series of tables of standard unit exposures for many occupational scenarios that can be used to ensure consistency in exposure assessments.

Unit exposure values were calculated in PHED using the following protection factors for PPE: second layer of clothing = 50% PF for dermal exposure to the body, chemically resistant gloves 90% PF for dermal exposure to the hands, dust mask 80% PF for inhalation exposure and half face cartridge respirator = 90% PF for inhalation. Engineering controls are assigned a protection factor of 90% to 98% depending upon the type of engineering controls selected.

ORETF Data

Handler exposure data generated by the Outdoor Residential Exposure Task Force (ORETF) were used for assessing the lawn care operator scenarios. These studies are summarized in the HED Memorandum "Summary of HED's Reviews of ORETF Chemical Handler Exposure Studies: MRID 449722-01", DP Barcode D261948 of April 30, 2001. These studies used Dacthal as a surrogate compound with a target application rate of 2.0 lbs/ae acre. These studies were conducted in accordance with current Agency guidelines and the data generated were of high quality. These studies have been reviewed by HED and Health Canada.

California Department of Pesticide Regulation Exposure Data

The study HS-1769 "Exposure of Hand Applicators to Triclopyr in Forest Settings, 1995" was used to assess the exposure of backpack application for forest site preparation. This study was conducted by the California Environmental Protection Agency, Department of Pesticide Regulation, Worker Health and Safety Branch.

Ten applicators were monitored for two days for a total of 20 replicates as they applied Garlon using Solo Backpack Sprayers which were filled from a 300 gallon mixing tank. The workers treated an average of 3.2 acres during each 9 hour day with a spray volume of 25 gallons per acre and an application rate of 1.0 lb triclopyr ae per acre. The actual spraying time was 360 minutes per day with the remainder of time spent placing plastic bags over the seedlings at the start of the workday, removing the bags at the end of the day, pulling hose, lunch/rest breaks and donning monitoring clothing and equipment.

Dermal exposures were monitored using long sleeve t-shirt and knee length socks, hand and face/neck exposures were monitored using Chubbs baby wipes and inhalation exposures were monitored using glass fiber filters. The workers typically wore coveralls over the dosimeters. The results of the socks were extrapolated to rest of the leg by the Agency using a factor of 2.04 to account for the thighs. This factor is based upon the surface area of the thighs, lower legs and feet (7510 cm^2) divided by the surface area of the lower legs and feet (3690 cm^2).

The field recovery was 60 $\pm$ 21% for the air filters at 100 ug/sample, 95.9 $\pm$ 8.7% for the wipes at 100 ug/sample, 85.6 $\pm$ 8.0% for the sock dosimeters at 100 ug/sample and 98.2 $\pm$ 5.1% at 5000 ug/sample for the t-shirt dosimeters. The measured results were above the fortification levels for the dermal media and were approximately one tenth the fortification level for the air filters. The minimum storage stability sample recoveries were 81 $\pm$ 40% for the air filters at week 31, 88% $\pm$ 7.3% for the socks at week 16, 93.2 $\pm$ 2.4% for the t-shirt at week 10 and 93.2 $\pm$ 6.5% for the wipes at week 16. Method validation data were also provided and substantiated the LOQs of 150 ug/sample for the t-shirts, 40.1 ug/sample for the socks, 10 ug/sample for the wipes and 1.5 ug/sample for the air filters. All of the results were above the LOQs.

This study meets Agency guidelines and is acceptable for use in risk assessment. The major limitation is the use of knee length socks to estimate exposures to the thighs. This could be significant because the majority of the exposure (53%) was measured on the legs, while lessor

amounts were measured on the torso (33%), hands (13%) and head/face (2.3%). In a backpack applicator study on grasslands in England, however, 86% of the leg exposure occurred to the lower legs, 11% occurred on the thighs and 3.5% occurred on the feet (Abbot et. al. 1983). This study was conducted with whole body dosimeters. Another limitation is that 4 of the 20 inhalation replicates were not valid because the sampling pump flowrate decreased by more than 25 percent by the end of the sampling period. The data from this study are summarized in Table 7. In accordance with ExpoSAC Policy the geometric mean values will be used as the appropriate measure of central tendency for exposure assessment because the data have a lognormal distribution.

Table 7 - Unit Exposure Values for Backpack Application in Forest Settings (CA DPR HS-1769)

Unit Exposures per lb ae handled	N	Mean	SD	Geo. Mean[1]	Median	90th Percentile	Maximum	W-test Result for Normality
Dermal (mg/lb ae)	20	8.1	7.1	**6.1**	6.9	15.1	30.9	Lognormal
Inhalation (ug/lb ae)	16	56	17	**54**	56	78	91.1	Lognormal

Note 1 - The values in bold font are used for risk assessment in accordance with ExpoSAC Policy.

2.1.3 Occupational Handler Exposure and Risk Estimates

Calculation Methodology and Equations

Daily dermal and inhalation exposures and MOEs were calculated using standard HED methodology as described in Appendix A. A combined MOE was also calculated because dicamba exposures from the dermal and inhalation routes have the same toxicological effects. The target MOE is 100 for short/intermediate/long term exposure. Scenarios with an MOE less than the target MOE indicates a risk of concern for the occupational population.

Results and Comparison to Target MOE

The MOEs for handlers are summarized in Table 8 and a detailed listing is also included in Appendix B. All of the mixer/loader MOEs exceed the target of 100 with the single layer PPE and are not of concern. The MOEs for applicators are above 100 with baseline or single layer PPE . The MOEs for the mixer/loader/applicators are acceptable with single layer PPE and the MOEs for the flaggers are acceptable with baseline PPE.

2.1.4 Occupational Handler Risk Characterization

The actual use rates of dicamba are typically less than the maximum label rates because dicamba is usually mixed with other herbicides such as 2,4-D to increase the spectrum of weeds controlled. Only a few dicamba products are formulated as wettable powders and most of these products are packaged in water soluble bags that are used on turf. Many of the labels require waterproof gloves instead of chemical resistant gloves. It is not known if these gloves provide adequate protection.

Table 8 - Dicamba Handler Combined MOEs

Exposure Scenario	Crop or Site	Application Rate (lb ae/acre)	Acres/ Day	Base-line MOE	Single Layer MOE	Engineering Control MOE
Mixer/Loader (M/L)						
M/L WP for Groundboom	Golf Courses	1	40	130	>1000	>1000
M/L WP for Turfgun Application	Turf	1	100	**53**	>1000	>1000
M/L WDG for Aerial	Fallow Land	2	1200	120	120	NA
M/L WDG for Aerial	Corn	0.5	1200	490	490	NA
M/L WDG for Groundboom	Fallow Land	2	200	740	740	NA
M/L WDG for Groundboom	Corn	0.5	200	>1000	>1000	NA
M/L WDG for Groundboom	Golf Courses	1	40	>1000	>1000	NA
M/L WDG for Turf Gun	Turf	1	100	>1000	>1000	NA
M/L Liquids for Aerial	Sugar Cane	2.8	1200	**2**	200	680
M/L Liquids for Aerial	Soybeans, RPF	2	1200	**3**	280	960
M/L Liquids for Aerial	Small Grains, Corn	0.5	1200	**12**	>1000	>1000
M/L Liquids for Groundboom	Sugar Cane	2.8	200	**13**	>1000	>1000
M/L Liquids for Groundboom	Soybean, RPF	2	200	**18**	>1000	>1000
M/L Liquids for Groundboom	Small Grains, Corn	0.5	200	**72**	>1000	>1000
M/L Liquids for Groundboom	Sod Farms	1	80	**90**	>1000	>1000
M/L Liquids for Groundboom	Golf Courses	1	40	180	>1000	>1000
M/L Liquids for ROW Sprayer	Right of Way Areas	2	50	**72**	>1000	>1000
M/L Liquids for Turf Gun	Turf	1	100	**72**	>1000	>1000
M/L Liquids for Backpack Application	Forest Site Prep	2	40	**90**	>1000	>1000
Load Granulars for Broadcast Spreader	Golf Courses	1	40	>1000	>1000	>1000
Applicator (APP)						
Aerial Application	All crops above	0.5 to 2.8	1200	ND	ND	>1000
Groundboom Application	All crops above	0.5 to 2.8	40 to 200	>1000	>1000	>1000
ROW Application	ROW	2	50	160	500	ND
Back Pack Application	Forest Site Prep	1	4	ND	410	ND
Turfgun Application	Turf	1	5	ND	>1000	ND
Broadcast Spreader Application	Golf Courses	1	40	>1100	>1000	>1000
Mixer/Loader/Applicator (M/L/A)						
M/L/A Wettable Powder with Turfgun	turf	1	5	ND	>1000	>1000
M/L/A WDG with Turfgun	turf	1	5	ND	>1000	ND
M/L/A Liquid Flowables with Turfgun	turf	1	5	ND	>1000	ND
M/L/A Liquids with Backpack Sprayer	ROW, RPF	2	4	ND	970	ND
Load/Apply Granules with a Push Cyclone	turf	1	5	ND	>1000	ND
Flagger						
Flag Aerial Application	All crops above	0.5 to 2.8	1200	>470	>440	>1000

Notes:

RPF = Rangeland, Pastures and Fallow Land
ROW = Rights of Way

MOEs that are less than 100 indicate risks of concern and are highlighted in bold font.

2.2 Occupational Post Application Exposure and Risks

Post application dicamba exposures can occur in the agricultural environment when workers enter fields recently treated with dicamba to conduct tasks such as scouting and irrigation.

2.2.1 Occupational Post Application Exposure Scenarios

Broadcast applications can be made to grass crops, such as cereal grains, which are tolerant of dicamba. Because dicamba is typically applied once per season and the relevant agricultural scenarios occur for only a few weeks per year, it is anticipated that dicamba exposures would be primarily short term and, more rarely, intermediate term.

Potential inhalation exposures are not anticipated for the post-application worker scenarios because of the low vapor pressure of dicamba (3.4e-05 mm Hg at 25° C), and the Agency currently has no policy/method for evaluating non-dietary ingestion by workers due to poor hygiene practices or smoking. As a result, only dermal exposures were evaluated in the post-application worker assessment.

2.2.2 Exposure Data Sources, Assumptions and Transfer Coefficients

Data Sources:

There are three turf transferable residue (TTR) studies that were submitted by the Broadleaf Turf Herbicide TFR Task Force. These studies summarized in Section 2.4 - Residential Turf Post Application Exposures and Risks.

Assumptions

The following assumptions were made regarding occupational post application:

- Risks were assessed using the maximum rates from the Dicamba Use Closure Memo.
- The transfer coefficients as listed in Table 9 are from an interim transfer coefficient policy developed by HED's Science Advisory Council for Exposure using proprietary data from the Agricultural Re-entry Task Force (ARTF) database (US EPA, August 7, 2001). This policy will be periodically updated to incorporate additional information about agricultural practices in crops and new data on transfer coefficients. Much of this information will originate from exposure studies currently being conducted by the ARTF.
- The transfer coefficients for turf harvesting and maintenance are based upon recently conducted ARTF studies that are being reviewed by HED.
- The initial percent of application rate as Dislodgeable Foliar Residue (DFR) was assumed to be 20% for all crops except turf. These are standard values used in the absence of chemical specific data.
- The Maximum TTR value (2.6 percent of the application rate) from the DMA Treatment at the Florida site in the Vanquish Study was used to assess risks of working on turf.

Table 9 - Post Application Exposure Scenarios and Transfer Coefficients for Dicamba

Crop	Label Directions Post Application Exposure Scenarios	Transfer Coefficient (cm^2/hr)
Asparagus	Apply immediately after cutting. If spray contacts emerged spears, crooking may result. Pre Harvest Interval (PHI) = 24 hours	None[1,2]
Small Grains Barley, Oats, proso millet, triticale, wheat	Apply to fall seeded barley prior to the jointing stage. Apply to spring seed barley before it exceeds the 4 leaf stage. Apply to fall seeded oats prior to the jointing stage. Apply to spring seeded oats before the 5 leaf stage is exceeded. Apply to proso millet at the 2 to 5 leaf stage. Apply to fall seeded triticale or wheat prior to the jointing stage. Apply to spring seeded triticale or wheat before the 6 leaf stage. Low Exposure Scenarios - Irrigation, scouting, immature plants Medium Exposure Scenarios - Same as above on mature plants	 100 1500
Corn	Early Post Emergence - Apply from corn emergence through 5 leaf stage or 8 inches tall, whichever comes first. Late Post Emergence - Apply from 8 to 36 inch corn or to 15 days before tassel emergence, whichever comes first. Low Exposure Scenarios - Scouting, weeding immature plants Medium Exposure Scenarios - Scouting, weeding more mature plants High Exposure Scenarios - Scouting, weeding, irrigation mature plants Very High Exposure Scenarios - Detasseling	 100 400 NA NA
Cotton	N/A - Applied as a preplant treatment.	NA
Pasture, Rangeland, Grassland	PHI = 7 days	None[1]
Sorghum	Post Emergence - Apply when sorghum is in the 3 to 5 leaf stage, but before it is 15" tall. If sorghum is taller than 8" use drop nozzles and keep spray off the foliage. Pre-harvest application (TX and OK only) - apply anytime after soft dough stage (PHI = 30 days) Low Exposure Scenarios - Scouting immature plants High Exposure Scenarios - Irrigation and scouting mature plants	 100 1000
Soybeans	Apply after pods have reached mature brown color and at least 75% leaf drop has occurred (PHI = 14 days)	None[1]
Sugarcane	Apply before canes appear for control of emerged weeds. Apply after canes emerge and through canopy closure. When possible direct sprays beneath the canopy to minimize the likelihood of crop damage. Medium Exposure Scenarios - scouting immature plants High Exposure Scenarios - scouting mature plants	 1000 2000
Turf, Sod Farm and Golf Course	Treat when weeds are young and actively growing. Do not apply more than 1.0 lb per season. Low Exposure Scenarios - Mowing High Exposure Scenarios - Transplanting, hand weeding	 3400 6800

1. Post application exposures are expected to be minimal due to application timing or method.
2. Asparagus plants do not have foliage (i.e. ferns) when the spears are harvested.

Calculation Methodology for Post Application Exposures

The calculations used to estimate the exposures for the post-application scenarios are similar to those described previously for the handler/applicator scenarios and are described in Appendix A. Daily dermal exposure is calculated by multiplying the residue level (ug/cm^2 of leaf area) times a transfer coefficient (amount of leaf area contacted per unit time). Inhalation exposures were not calculated for the post-application scenarios because inhalation exposures have been shown to account for a negligible percentage of the overall body burden. This is particularly true for dicamba which has a low vapor pressure of 3.4 x 10^{-5} mm Hg at 25°C..

2.2.3 Occupational Post Application Exposure and Risk Estimates

A summary of the worker risks for short/intermediate term post application exposures is given in Table 10 and the calculations are included in Appendix C. All of the short/intermediate term MOEs are above 100 on Day 0 which indicates that the risks are not of concern at the current REI of 24 hours.

Table 10 - Dicamba Postapplication Worker Risks

Crop	Transfer Coefficient Group	Short/Intermediate Term MOE on Day 0			
		Application Rate (lb ae/acre)	Low Exposure Scenarios*	Medium Exposure Scenarios*	High Exposure Scenarios*
Small Grains (i.e. wheat)	Field/row crop, low/medium	0.50	23000	1600	NA
Corn (Early Post Emergence)	Field/row crop, low/medium	0.50	23000	N/A	NA
Corn (Late Post Emergence)	Field/row crop, low/medium	0.25	N/A	12000	N/A
Sorghum	Field/row crop, low/medium	0.25	47000	12000	4700
Sugarcane	Sugarcane	2.8	N/A	420	210
Turf	Turf	1.0	2600	N/A	1300

*Task descriptions for each crop and exposure scenario are included in Table 9.

2.2.4 Occupational Post Application Risk Characterization

The actual use rates of dicamba are typically less than the maximum label rates because dicamba is usually mixed with other herbicides. In addition, the rate of 2.8 lbs ae/acre for sugarcane is present only one label (7969-140). The rate for the remaining labels is 2.0 lb ae/acre.

2.3 Residential Handler Exposures and Risks

According to the EPA Pesticide Sales and Usage Report for 2000/2001, dicamba is ranked number seven among the ten most commonly used conventional pesticide active ingredients in the home and garden market sector. This list includes 2,4-D and MCPP-p and which rank 1 and 5, respectively.

The residential products are typically formulated as dry weed and feed products or as liquids in concentrates or ready to use sprays. Many of these formulations include other herbicides such as 2,4-D and MCPP-p. Spot and broadcast treatments are both included on the labels. Exposures are expected to be short term in duration for broadcast treatments because the label allows only two broadcast treatments per year. Exposures are also expected to be short term in duration for spot treatments because the labels recommend repeat applications in two to three weeks for hard to kill weeds.

2.3.1 Residential Handler Scenarios, Data Sources and Assumptions

Scenarios

The following scenarios were assessed.

1. Hand Application of Granules
2. Belly Grinder Application
3. Load/Apply Granules with a Broadcast Spreader
4. Mix/Load/Apply with a Hose-end Sprayer (Mix your own)
5. Mix/Load/Apply with a Hose-end Sprayer (Ready to Use)
6. Mix/Load/Apply with Hand Held Pump Sprayer
7. Mix/Load/Apply with Ready to Use Sprayer

Data Sources

Exposure data for scenarios #1 and #2 were taken from PHED. Exposure data for scenarios #3, #4 and #5 were taken from the residential portion of the ORETF Handler Study (this study was discussed in Section 2.1.2.)

Exposure data for scenarios #6 and #7 were taken from MRID 444598-01, which has recently been purchased by the ORETF. This study involved low pressure handwand and RTU trigger sprayer application of carbaryl to home vegetable plants. Details of this study are included in Appendix D.

Assumptions Regarding Residential Applicators

- Clothing would consist of a short-sleeved shirt, short pants and no gloves.
- Broadcast spreaders and hose end sprayers would be used for broadcast treatments and the other application methods would be used for spot treatments only.
- An area of 0.023 acre (1000 square feet) would be treated per application during spot treatments and an area of 0.5 acre would be treated during broadcast applications.

- The application rate is 1.0 lb ae/acre as listed in the Dicamba Use Closure Memo.

2.3.2 Residential Handler Exposure and Risk Estimates

The MOE calculations are included in Appendix D and a summary is included in Table 11. The MOEs exceed the target MOE of 100 and the risks are not of concern.

Table 11 - Dicamba Short Term MOEs for Homeowner Applications to Lawns (Application Rate = 1.0 lb ae/acre)

Scenario	Treated Area (acres/day)	Combined Dose (mg/kg/day)	Combined MOE[A]
1. Hand Application of Granules (spot treatment)	0.023	0.0058	7800
2. Belly Grinder Application (spot treatment)	0.023	0.0054	8300
3. Load/Apply Granules with a Broadcast Spreader	0.5	0.00073	62000
4. Mix/Load/Apply with a Hose-end Sprayer (Mix your own)	0.5	0.012	3800
5. Mix/Load/Apply with a Hose-end Sprayer (Ready to Use)	0.5	0.0029	16000
6. Mix/Load/Apply with Hand Held Pump Sprayer	0.023	0.0019	24000
7. Mix/Load/Apply with Ready to Use Sprayer	0.023	0.0027	17000

A. The target MOE is 100.

2.3.3 Residental Handler Risk Characterization

The residential handler risks were calculated using standard assumptions, the highest quality unit exposure data available and the maximum label application rates.

2.4 Residential Turf Post Application Exposure and Risks

2.4.1 Residential Turf Post Application Exposure Scenarios, Data Sources and Assumptions

Scenarios

The following exposure scenarios are assessed for residential post application risks

Acute and Short Term Exposures of Toddlers Playing on Treated Turf
Acute and Short Term Exposures of Adults Performing Yardwork on Treated Turf
Acute and Short Term Exposures of Adults Playing Golf on Treated Turf
Acute Exposures of Toddlers From Incidental Oral Ingestion of Granules

Data Sources:

There are three turf transferable residue studies (MRID 446557-02, 450331-01 and 446557-03 that were submitted by the Broadleaf Turf Herbicide TFR Task Force. The field portion of the studies were conducted by Grayson Research LLC of Creedmoor, North Carolina, AGSTAT of Verona, Wisconsin, and Research for Hire of Porterville, California. The laboratory analysis for all three studies was conducted by Covance Laboratories of Madison, Wisconsin. These studies measured the dissipation of several phenoxy herbicides, including dicamba, using the ORETF roller technique (also called the modified California Roller).

The was an additional study (MRID 449590-01) that was submitted by Novartis Crop Protection. This field portion of this study was conducted by Research Options, Inc of Winter Garden, Florida, ABC Laboratories California of Madera, California and Crop Management Strategies of Germansville, PA. The laboratory analysis for all three sites was conducted by ABC Laboratories of Columbia, Missouri. This study also used the ORETF roller technique.

All of the studies were reviewed by HED and were found to meet most of the series 875 guidelines for postapplication exposure monitoring. The studies are summarized on the following pages and the data analyses are presented in Appendix E. The abbreviations DAT and HAT refer to Day After Treatment and Hour After Treatment, respectively.

Determination of Transferable Turf Residues on Turf Treated with 2,4-D, 2,4-DP-p, MCPP-p and Dicamba, MRID 446557-02 (Phase 1 - Effect of Form)

The purpose of this study was to assess the effects of different forms upon the day zero turf transferable residues (TTR) and dissipation rates of phenoxy herbicides including dicamba. Dicamba was applied with 2,4-D DMA and MCPP-p DMA to turf plots in North Carolina using a groundboom sprayer. The plots were mowed to a height of two inches prior to the application and were not mowed again until after the seventh day of sampling. No irrigation was performed. Significant rainfall (i.e. greater than 0.05 inches) did not occur until DAT 10 when 0.17 inches occurred prior to the DAT 10 sample.

Sampling was conducted with a ORETF roller using a 27" X 39" percale cotton cloth in accordance with the SOP developed by the ORETF. Samples were collected after the sprays had dried and at 0.5, 1, 2, 3, 4, 5, 6, 7, 10 and 14 DAT. The samples were analyzed using a validated method that had an LOQ of 0.879 ng/cm^2. The concurrent laboratory recoveries were close to 100 percent and were acceptable. The average field recoveries were acceptable with a range of 68.9 to 87.1 percent depending upon the date of fortification and fortification level. The TTRs values were corrected using a field recovery factor of 0.689.

The results of the Phase 1 samples are shown in Table 12. The highest TTR levels occurred on DAT 0.5. The TTR levels declined to the LOQ by DAT 2.

Table 12 - Dissipation of Dicamba Applied to Turf Using Various Forms (Phase 1)					
Dicamba Form	Application Rate (lb ae/acre)	Maximum TTR[2] (ug/cm^2)	Percent Applied as TTR	Correlation Coefficient	Half Life (days)
Dicamba Mixture	0.20	0.055 ± 0.012 (n=3)	2.5	0.89 (n=12)	0.38
1. The DMA mixture contained Dicamba with 2,4-D DMA and MCPP-p DMA					

Determination of Transferable Turf Residues on Turf Treated with 2,4-D DMA + MCPP-p DMA + Dicamba DMA in Various Spray Volumes, - MRID 446557-03
(Phase 2 - Effect of Spray Volume)

The purpose of this study was to assess the effects of different spray volumes upon the day zero TTRs and dissipation rates of phenoxy herbicides. In all cases, dicamba was applied in combination with MCPP-p DMA and 2,4-D DMA All of the applications were made to cool season fescue/blue grass turf plots in North Carolina using a groundboom sprayer. The plots were mowed to a height of two inches prior to the application and were not mowed again until after the seventh day of sampling. No irrigation was performed. No rain occurred on DAT 0 or DAT 1 and 0.17 inches of rain occurred prior to the DAT 2 sample, 0.46 inches occurred prior to the DAT 3 sample and 0.03 inches occurred prior to the DAT 4 and 5 samples.

Sampling was conducted in the same manner as for Phase 1 using an ORETF roller. Samples were collected at 3 and12 hours after treatment (HAT) and at 1, 2, 3, 4, 5, 6, 7, 10 and 14 DAT. The samples were analyzed using Method 2 as described and validated in MRID 446557-04 and the LOQ was 0.879 ng/cm^2. The concurrent laboratory recovery was 86.3 ± 11.6 (n=26) and did not vary significantly with respect to the fortification levels which ranged from 1 to 400X LOQ. Field recovery samples were prepared at DAT 0 and DAT 6 using fortification levels of 0.004 and 0.04 ug/cm^2. The average recoveries for each subset of field spikes (n=6) ranged from 76.4 to 80.2 percent depending upon the fortification level and date of preparation. The raw data were corrected for field recovery by using 0.78 which is overall average (n=12).

A summary of the results are shown in Table 13 and a more detailed listing is included in Appendix E. The half lives ranged from 0.33 to 0.39 days and were calculated based upon the first two days of dissipation because the TTRs reached the LOQ by DAT 2.

Table 13 - Dissipation of Dicamba Applied to Turf at Various Spray Volumes (Phase 2)					
Spray Volume (GA/acre)	Application Rate (lb ae/acre)	Maximum TTR[1] (ug/cm^2)	Percent Applied as TTR	Correlation Coefficient	Half Life (days)
2	0.2	0.035 ± 0.0072 (n=3)	1.4	0.80 (n=12)	0.39
5	0.2	0.036 ± 0.0085 (n=3)	1.5	0.97 (n=12)	0.33
20	0.2	0.028 ± 0.0060 (n=3)	1.1	0.95 (n=12)	0.35
1. The maximum average TTR occurred on DAT 1 0, DAT 0.0 and DAT 0.5 for the 2, 5 and 20 GPA applications, respectively.					

Determination of Transferable Turf Residues on Turf Treated with 2,4-D DMA + MCPP-p DMA + Dicamba DMA MRID 450331-01 (Two Additional Sites)

The purpose of this study was to assess the effects of two additional sites upon the day zero TTRs and dissipation rates of phenoxy herbicides. Dicamba was applied in combination with MCPP-p DMA and 2,4-DP-p DMA (Treatment 4). The applications were made to turf plots in Wisconsin and California using groundboom sprayers with a spray volume of 9.4 to 9.9 gallons per acre. The plots were mowed to a height of two inches prior to the application and were not mowed again until after the seventh day of sampling. No irrigation was performed. No rain occurred at the California site, however, the grass was wet with dew during the DAT 0.5 sampling which occurred at night. The following rainfall occurred at the Wisconsin site: 0.025 inches prior to the HAT 8 sample, 0.145 inches prior to the HAT 12 sample and 0.19 inches prior to the HAT 24 sample.

Sampling was conducted in the same manner as for Phase 1 using the ORETF roller. Samples were collected at 1, 4, 8, 12 and 24 HAT and 2, 3, 4 and 7 DAT. The samples were analyzed using a validated method and the LOQ was 0.879 ng/cm^2. The concurrent laboratory recoveries were acceptable for both sites. Field recovery samples were prepared in the same manner as for Phase 1 with the exception that a different fortification solution was used. In Phase 1, the fortification solution contained only acetone as the solvent, while in this study 0.1 M phosphoric acid was added to the acetone. The recoveries obtained were very low and were not reported. These low recoveries were thought to be the result of interference caused by the acid interaction with the cotton during storage The recoveries from phase 1 were instead used as a surrogate.

The results of this study are shown in Table 14. The TTR values declined to the LOQ by DAT 1 in Wisconsin and to 2X LOQ by DAT 7 in California. The data for DAT 0.5 at the California site are not included because these samples were collected at night when there was dew.

Table 14 - Dissipation of Dicamba Applied to Turf at Sites in California and Wisconsin

Site - Treatment[1]	Application Rate (lb ae/acre)	Maximum TTR[2] (ug/cm^2)	Percent Applied as TTR	Correlation Coefficient	Half Life (days)
CA-4	0.21	0.030 ± 0.0040 (n=3)	1.3	0.91(n=24)	1.8
WI-4	0.21	0.034 ± 0.0040 (n=3)	1.5	0.90(n=15)	0.17

1. Treatment 4 consisted of Dicamba DMA formulated with MCPP-p DMA and 2,4-D DMA
2. The maximum TTR occurred on HAT 1 for the CA site and at HAT 8 for the WI-5 site.

Determination of Transferable Turf Residues on Turf Treated with Dicamba (Vanquish) - MRID 449590-01

In this study, a soluble concentrate formulation of dicamba (Vanquish) was applied by itself, to turf plots in Florida (FL), California (CA) and Pennsylvania (PA) at an application rate of 1.0 lb ae/acre with a spray volume of 50 gallons per acre. The applications were made using CO_2 powered backpack sprayers in FL and PA and a groundboom sprayer in CA. The turf was mowed to a height of one inch two days prior to application at the FL site, three inches seven days prior to application at the CA site and 2 inches one day prior to application at the PA site. The turf was not mowed during the study. One of the two PA sites was irrigated with 0.28 inches of water approximately 30 minutes after application and the FL and CA site were not irrigated. Significant rainfall (0.71" inches on day 2) occurred only at the FL site. No rain occurred at the CA site, and only a small amount of rain (0.06 inches on day 3) occurred at the PA site.

Sampling was conducted using the ORETF roller with cotton cloth with an exposed surface area of 5600 cm^2. Samples were collected at 0, 4, 8, 24, 32-36, 48, 56-60 HAT and 3, 5 and 7 DAT. Four samples were collected at each plot at each sampling intervals. The samples were analyzed using a validated method and the LOQ was 0.000879 ug/cm^2. The concurrent laboratory recoveries were acceptable. Field recovery samples were prepared by spiking blank sampling cloths with 25 or 2000 ug of dicamba to yield fortification levels of 0.0045 or 0.36 ug/cm^2. The average (n=6) field recoveries were 87.1 percent for the FL site, 79.5 percent for the CA site and 86.6 percent for the PA site. The recoveries did not vary significantly between fortification levels.

The raw results were corrected for site specific field recovery and are shown in Table 15. The maximum TTRs at the non-irrigated plots occurred on HAT 8 at the FL site, on HAT 1 at the CA site and on HAT 3 at the PA site. The TTRs declined to the LOQ by DAT 3 in FL, 3X LOQ by DAT 7 in CA and 6X LOQ by DAT 7 in PA. Most of the TTRs at the irrigated plot were close to the LOQ. Only one of the four DAT 0 replicates had detectable residues, which when combined with the other three replicates that were at the LOQ, yielded the maximum TTR of 0.0026 ug/cm^2.

Table 15 - Dissipation of Dicamba Applied as Vanquish

Site	Application Rate (lb ae/acre)	Maximum TTR (ug/cm^2)	Percent Applied as TTR	Correlation Coefficient	Half Life (days)
FL	1.0	0.29 ± 0.072 (n=4)	2.6	0.85 (n=32)	0.44
CA	1.0	0.17 ± 0.017 (n=4)	1.5	0.97 (n=40)	1.1
PA - Dry	1.0	0.13 ±0.0075(n=4)	1.2	0.90 (n=40)	1.5
PA - Irrigated	1.0	0.0026 ± 0.0042 (n=4)	0.023	N/A	N/A

Application of the TTR Data

A summary of the data used for exposure assessment is included in Table 16. A maximum TTR value of 2.6 percent of the application rate was derived from the Vanquish Study (MRID 449590-01) and was used for assessing acute exposures. A 7 day average TTR of 0.55 percent of the application rate was derived from the California site of MRID 450331-01 which had a half life of 1.8 days.

Table 16 - Summary of TTR Data Used for Post Application Exposure Assessment

MRID	**449590-01**	**450331-01**
Location	Florida	California
Precipitation	No Rain	No Rain
Application Rate (lb ae/acre)	1.0	0.21
Maximum TTR (ug/cm^2) Maximum TTR (percent of application rate)	0.29 2.6 - Note 1	0.033 1.3
Day 0 Average TTR (ug/cm^2) Day 0 Average TTR (percent of application rate)	0.10 0.90	0.033 1.3 - Note 2
Semi-log Slope Factor	N/A	-0.38 - Note 2
7 day Average TTR (ug/cm^2) 7 day Average TTR (percent of application rate)	N/A N/A	0.013 0.55 - Note 2

Note 1 - This value was used to derive the TTR for 1day acute exposures.
Note 2 - These values were used to derived the TTR for seven day average short term exposures.

General Assumptions

The following general assumptions are taken from the Standard Operating Procedure (SOPs) of December 18, 1997 and ExpoSAC Policy #12 "Recommended Revisions to the Standard Operating Procedures for Residential Exposure Assessments of February 22, 2001.

- The TTR values were used for calculating dermal exposures on turf because they were greater than 1.0% of the application rate. These values were adjusted for application rates as needed.
- An assumed initial TTR value of 5.0% of the application rate is used for assessing hand to mouth exposures.
- An assumed initial TTR value of 20% of the application is used for assessing object to mouth exposures.
- Soil residues are contained in the top centimeter and soil density is 0.67 mL/gram.
- Three year old toddlers are expected to weigh 15 kg.
- Hand-to-mouth exposures are based on a frequency of 20 events/hour and a surface area per event of 20 cm^2 representing the palmar surfaces of three fingers.

- Saliva extraction efficiency is 50 percent meaning that every time the hand goes in the mouth approximately ½ of the residues on the hand are removed.
- Adults are assessed using a transfer coefficient of 14,500 cm^2/hour.
- Toddlers are assessed using a transfer coefficient of 5200 cm^2/hour.
- Golfers are assessed using a transfer coefficient of 500 cm^2/hour.
- An exposure duration of 2 hours per day is assumed for toddlers playing on turf or adults performing heavy yardwork.
- An exposure duration of 4 hours is assumed for playing golf.

Assumptions Specific to Dicamba

The following assumptions that are specific to dicamba are used for assessing residential post application exposures.

- The application rate of 1.0 lbs ae/acre as stated in the Use Closure Memo was used.

Calculation Methods

The above factors were used in the standard SOP formulas to calculate the exposures. These formulas are described in Appendix A. MOEs were calculated for acute dermal and incidental oral exposures using the maximum TTR value along with the acute dietary NOAEL of 300 mg/kg/day. MOEs for short term exposures were calculated using the seven day average TTR value, because the short term dermal NOAEL of 45 mg/kg/day was based upon decreased pup body weight gain which did not occur until after several days of exposure.

2.4.2 Residential Turf Post Application Exposure and Risk Estimates

The MOEs for acute exposures are summarized in Table 17 and the detailed calculations are included in Appendix F. All of the acute MOEs for both adult and toddler exposures exceed the target MOE of 300. This means that the risks for adults and toddler exposures are not of concern.

Table 17 - Acute Dicamba MOEs for Turf Exposures
(Application Rate = 1.0 lb ae/acre)

Population/ Scenario	TTR (ug/cm^2)	TC (cm^2/hr)	Dermal Dose[B]	Hand-to Mouth Dose	Object to Mouth Dose	Soil Ingestion Dose	Total Dose	Total MOE[C]
Toddlers/Playing	0.29[A]	5,200	0.0030	0.015	0.0037	0.000050	0.049	6,100
Adults/Yardwork Adults/Golfing	0.29[A]	14,500 500	0.018 0.0012	N/A	N/A	N/A	0.018	17,000 240,000

A. This value was derived from the maximum TTR of 2.6 percent from MRID 449590-01.
B. All doses are expressed in mg/kg/day.
C. Total MOE = NOAEL/Total Dose where the NOAEL is 300 mg/kg/day.

The target MOE for adult and toddler exposures is 300.

The MOEs for short term exposures are summarized in Table 18. All of the short term MOEs for both adult and toddler exposures exceed the target MOE of 100.

Table 18 - Short Term Dicamba MOEs for Turf Exposures
(Application Rate = 1.0 lb ae/acre)

Population/ Scenario	TTR (ug/cm^2)	TC (cm^2/hr)	Dermal Dose[B]	Hand-to Mouth Dose	Object to Mouth Dose	Soil Ingestion Dose	Total Dose	Total MOE[C]
Toddlers/Playing	0.060[A]	5,200	0.0062	0.0063	0.0016	0.000021	0.014	3,200
Adults/Yardwork	0.060[A]	14,500	0.0037	N/A	N/A	N/A	0.0037	12,000
Adults/Golfing		500	0.0003				0.0003	170,000

A. Seven day average TTR derived from the California TTR Study MRID 450331-01.
B. All doses are expressed in mg/kg/day.
C. Total MOE = NOAEL/Total Dose where the NOAEL is 45 mg/kg/day.

The target MOE for adult and toddler exposures is 100.

2.4.3 Residential Turf Post Application Risk Characterization

The calculation of acute MOEs using a maximum TTR value for toddler turf post application exposure represents a policy change, because the maximum TTR values were previously only used to calculate short term MOEs. The dicamba risk assessment team decided that the previous approach would greatly overestimate the short term risks, because the short term incidental oral and dermal endpoints were based upon effects that would only occur after several days of exposure. The team also decided that the single day exposures as represented by the maximum TTR values would be more appropriately assessed using the acute dietary endpoint. The short term exposures were assessed using the seven day average TTR values because the endpoint occurred after several days of exposure and because the TTR data were collected during a seven day time period.

The actual use rates of dicamba are typically less than the maximum label rates because dicamba is usually mixed with other herbicides such as 2,4-D and MCPP-p. As shown in Table 19, the application rate of dicamba ranges from 0.03 to 0.20 lb ae/acre when dicamba is formulated with other herbicides.

Table 19 - Dicamba Application Rates in Phenoxy Herbicide Liquid Products					
Product	Reg #	Individual Application Rate(lb ae/acre)			
		2,4-D	MCPP-p	Dicamba	2,4-DP
Trimec 937 PBI Gordon Trimec Plus	2217-758 2217-709	0.80 0.80	---- 0.40	0.20 0.20	0.40 ---
Riverdale Triplet Sensitive	228-288	0.41	0.72	0.18	---
Ortho Weed b Gon Trimec Bentgrass Formula	2217-570 2217-529	0.37 0.40	1.27 0.64	0.16 0.16	--- ---
NuFarm Tri-Power	228-262	1.36	0.26	0.13	---
PBI Gordon Trimec 849	2217-597	0.57	1.06	0.12	---
Riverdale Triplet Selective Herbicide PBI Gordon Trimec 848	228-264 2217-531	1.19 0.99	0.32 0.48	0.11 0.11	--- ---
Millenium Ultra TM Plus	228-382	0.83	---	0.10	---
PBI Gordon Trimec Lawn Weed Killer Lilly Miller Lawn Weed Killer Bonide Lawn Weed Killer Dexol Lawn Weed Killer PBI Gordon Trimec 891	2217-539 802-485 4-400 192-118 2217-517	0.73 0.77 0.73 0.73 0.95	0.18 0.19 0.35 0.35 0.25	0.08 0.08 0.08 0.08 0.08	--- --- --- --- ---
PBI Gordon Speed Zone	2217-864	0.73	0.23	0.07	---
Trimec 932	2217-749	1.49	0.29	0.06	---
EC 1382 Residential	2217-855	0.35	0.14	0.03	---

2.5 Residential Turf Granule Ingestion Exposure and Risks

Scenarios

The following exposure scenario was assessed

Acute Exposures of Toddlers from Incidental Oral Ingestion of Granules

General Assumptions

The following general assumptions are taken from the Standard Operating Procedure (SOPs) of December 18, 1997 and ExpoSAC Policy #12 "Recommended Revisions to the Standard Operating Procedures for Residential Exposure Assessments of February 22, 2001.

- The assumed ingestion rate is 0.3 gram/day. This is based on the assumption that if 150 lbs of product were applied to a ½ acre lawn, the amount of product per square foot would be 3 g/ft^2 and a child would consume one-tenth of the product available in a square foot.
- Three year old toddlers are expected to weigh 15 kg.
- The application rate of 1.0 lbs ae/acre as stated in the Use Closure Memo was used.

- The percent ai in granular formulations used in residential settings was assumed to be in the range of 0.1 to 1.0 percent based upon the product labels listed in OPPIN.

Calculation Methods

The above factors were used to calculate the potential dose rate and the absorbed dose using the standard SOP formula as shown in Table 20 MOEs were then calculated using the acute dietary NOAEL of 300 mg/kg/day and they exceed the target MOE of 300. This means that the risks for toddler exposures from granular ingestion are not of concern.

Table 20 - Granule Ingestion Risks for Dicamba

Percent ai	Potential Dose Rate[1] (mg/day)	Absorbed Dose[2] (mg/kg/day)	Acute MOE[3]
0.1	0.3	0.02	15000
0.5	1.5	0.1	3000
1.0	3.0	0.2	1500

1. Potential Dose Rate (PDR) = 0.3 gram/day * Percent ai* 1000 mg/gram
2. Absorbed Dose = PDR/BW
3. MOE = NOAEL/Dose where the NOAEL = 300 mg/kg/day

3.0 References

Dicamba Smart Meeting, November 4, 2004, BASF.

U.S. EPA, February 10, 1998 Draft Standard Operating Procedures for Residential Exposure Assessments. U.S Environmental Protection Agency, Office of Pesticide Programs.

U.S. EPA, 1998. PHED Surrogate Exposure Guide, V1.1. U.S. Environmental Protection Agency, Office of Pesticide Programs, August 1998.

U.S. EPA SAP, "Exposure Data Requirement for Assessing Risks from Pesticide Exposure of Children", SAP Meeting of March 8, 1999, page 60.

U.S. EPA, 1999, "Use of Values from the PHED Surrogate Table and Chemical-Specific Data." Science Advisory Council for Exposure, Policy.007, U.S. Environmental Protection Agency, Office of Pesticide Programs.

U.S. EPA, August 7, 2000, "Agricultural Default Transfer Coefficients" Science Advisory Council for Exposure, SOP 003.1. .U.S. Environmental Protection Agency, Office of Pesticide Programs.

U.S. EPA, July 5, 2000, "Standard Values for Daily Acres Treated in Agriculture" HED Science Advisory Council for Exposure, Policy.009, U.S. Environmental Protection Agency, Office of Pesticide Programs.

U.S. EPA, 9/14/04, Screening Level Estimates of Agricultural Uses of Dicamba, OPP BEAD

4.0 Glossary of Terms Used in Occupational/Residential Exposure Assessment

TERM	DEFINITION
AE - Acid Equivalent	The weight of dicamba excluding the weight of the ester or salt groups.
Baseline PPE	Includes long pants, long sleeved shirt, shoes, socks and no gloves or respirator
DAT	Day after treatment
Dose	The amount of pesticide that is absorbed into the body.
Double Layer PPE	Includes coveralls over single layer PPE
ExpoSac - Scientific Advisory Committee for Exposure	A committee within the EPA Health Effects Division that reviews pesticide exposure assessments and develops policy.
Exposure	The amount of pesticide that impinges upon the skin or is inhaled.
Handler/Applicator	A worker who mixes, loads and/or applies pesticides
HAT	Hours after treatment
Intermediate Term	31 days to six months
MOE - Margin of Exposure	The ratio of the "safe" dose (usually the NOAEL) divided by the estimated exposure. Formerly called the Margin of Safety.
NOAEL	No Observed Adverse Effect Level
ORETF	Outdoor Residential Exposure Task Force
PF5 Respirator	A filtering facepiece respirator (i.e. dustmask) that has a protection factor of 5 when properly fitted.
PF10 Respirator	A half face respirator with cartridges that has a protection factor of 10 when properly fitted.
PHED	Pesticide Handlers Exposure Database
Re-entry Worker	One who works in fields that have been treated with pesticides
REI - Restricted Entry Interval	The period of time that must pass following pesticide application before workers are re-enter the treated area.
ROW - Right of Way	Areas such as roadsides, powerlines, railway right-of-way and pipelines.
Short Term	One to thirty days
Single Layer PPE	Includes baseline PPE with chemical resistant gloves
Target MOE	The MOE which is equal to the uncertainty factor level of concern. MOEs that are less than the target MOE indicate risks of concern that may require additional evaluation and refinement.

APPENDIX A

STANDARD FORMULAS USED FOR CALCULATING OCCUPATIONAL AND RESIDENTIAL EXPOSURES TO DICAMBA

A. Introduction

This document is a summary of the formulas used to calculate occupational and residential exposures to dicamba. These formulas and a basic description of how they are used were taken from References A through F. These references also contain more detailed information on the rationale behind these formulas. Only those formulas that are pertinent to dicamba exposures are discussed in this document.

B. Occupational Handler/Applicator Exposures

The basic rationale for these formulas is that the daily exposure is the product of the amount of active ingredient (a.i.) handled per day times a unit exposure value. The amount of ai handled per day is the product of the application rate times the area treated. For example, if 2.0 lb/acre of dicamba were applied to 200 acres in one day, the amount of dicamba handled that day would be 400 lbs. The unit exposure value is the amount of exposure that results from handling a given amount of active ingredient by a certain method while using certain PPE. For example, the dermal unit exposure value for open mixing and loading of liquids with only minimal PPE is 2.9 mg per pound of ai handled. In this example, the daily exposure would be 400 lbs ai handled times 2.9 mg unit exposure per pound of ai handled which equals 1160 mg per day. The daily absorbed dose (mg/kg BW) is calculated from the exposure by multiplying the exposures times an absorption factor (0.15) and dividing the result by the body weight (70 kg). In this example the daily dose would be (1160 mg/day *0.15)/70 kg which would equal 2.5 mg/kg/day.

<u>Daily dermal exposure is calculated</u>:

Daily dermal exposure =	Unit exposure x	Application rate x	Area Treated
(mg/day)	(mg/lb ai)	(lb ai/acre)	(acres/day)

Where:

Unit exposure =	normalized exposure value (mg exposure per pound ai handled) derived from chemical specific study data or from the PHED Surrogate Exposure Table in Reference A.
Application rate =	normalized application rate based on a logical unit treatment such as acres, a maximum value is generally used (lb ai/acre); and
Area treated =	normalized application area such as acres/day.

[Note: (lb ai/acre) and (A/day) are replaced, respectively, with (lb ai/gal) and (gal/day) when appropriate]

Daily inhalation unit exposure values were calculated for inclusion into the PHED surrogate exposure tables and presented as (μg/lb ai) based on a human inhalation rate of 29 L/minute and an 8-hour working day.

Daily inhalation exposure is calculated:

Daily inhalation exposure = [Unit exposure x Application rate x Area Treated] / Conversion Factor
(mg/kg/day) (1 mg/1000 ug)

Where:

Unit exposure = normalized exposure value (µg/lb ai handled) derived from study data or PHED;
Application rate = same as for dermal exposure (lb ai/acre); and
Daily treatment = same as for dermal exposure (acres/day).

Absorbed daily dermal and inhalation doses are then calculated by adjusting for dermal and inhalation absorption and normalizing by body weight. A body weight of 70 kg (average body weight) was used because the effects observed in the toxicology study were not gender specific.

Absorbed Daily Dose is calculated:

Absorbed daily dermal or inhalation dose = (Daily dermal or inhalation exposure x absorption factor) / body weight
(mg/kg/day) (mg/day) (unitless) (kg)

[Note: an absorption factor of 0.15 was used for dermal exposures and 1.0 for inhalation exposures.]

Because the dicamba endpoints for dermal and inhalation routes were based upon the same toxicology studies, a combined absorbed daily dose can be calculated. Once the combined absorbed daily doses are calculated, the combined Margins of Exposure (MOEs) can be calculated.

Combined Absorbed Daily Dose is calculated:

Combined Dose (mg/kg/day) = Absorbed dermal dose (mg/kg/day) + Absorbed inhalation dose (mg/kg/day)

Combined Margin of Exposure is calculated:

Combined MOE (unitless) = NOAEL (mg/kg/day) / Combined Dose (mg/kg/day)

The target MOEs are 100 for occupational handlers. Scenarios with MOEs greater than the target MOEs do not exceed the Agency's level of concern for the occupational population.

C. Residential Handler Exposures

Residential handler exposures are calculated in the same manner as described above for occupational handlers. however, there are a few differences in the assumptions used. These differences are described in References B and C and include the following:

*Clothing consists of short sleeved shirt and short pants.
*PPE such as chemical resistant gloves and respirators are not worn.
*The areas treated are much smaller.

D. Post-Application Occupational Exposures

The formulas used to estimate daily dermal dose and the MOE for the dermal post-application scenarios are similar to those described above for the handler/applicator scenarios. The only major difference is that the daily dermal exposure is calculated by multiplying the dislodge-able foliar residue level (ug/cm^2 of leaf area) times a transfer coefficient (amount of leaf area contacted per hour for a given activity). Inhalation exposures are not calculated for the post-application scenarios because inhalation exposures have been shown to account for a negligible percentage of the overall body burden. This is particularly true for dicamba which has a very low vapor pressure.

The following equation taken from Reference D is used to calculate dermal doses for dicamba.

<u>Post-Application Dermal Exposure is calculated</u>**:**

Dermal exposure (mg/day) = (DFR at day t) x CF1 x TC x DA x # hours/day)

Where:

DFR	=	dislodgeable foliar residue (ug/cm^2) at day (t) after application
CF1	=	conversion factor of 0.001 to convert DFR value in ug/cm^2 to mg/cm^2
TC	=	transfer coefficient (cm^2/hour)
DA	=	dermal absorption factor = 0.15 for dicamba
Hours/day	=	standard assumption is 8 hours exposure per day

Once the post-application dermal exposure are calculated, the dermal dose and MOEs are calculated in the similar manner as described for handlers. The single difference is that only the dermal route of exposure is considered. The target MOE is 100 for occupational exposures.

Absorbed Daily Dose is calculated:

Absorbed daily dose (mg/kg/day) = (daily dermal exposure (mg/day) / BW (kg)

Margin of Exposure is calculated:

MOE (unitless) = NOAEL (mg/kg/day) / Absorbed Daily Dose (mg/kg/day)

E. Residential Post Application Exposure on Treated Turf

The *SOPs For Residential Exposure Assessment (Reference B)* define several pathways that apply to post application exposure on treated turf. The SOPs and the associated pathways are presented below:

- ***Dose from dermal exposure on treated turf calculated using SOP 2.2:*** Postapplication dermal dose among toddlers from playing on treated turf, adults working on treated turf and adults playing golf on treated turf;

- ***Dose from hand-to-mouth activity from treated turf calculated using SOP 2.3.2:*** Postapplication dose among toddlers from incidental non-dietary ingestion of pesticide residues on treated turf from hand-to-mouth transfer (i.e., those residues that end up in the mouth from a child touching turf and then putting their hands in their mouth);

- ***Dose from object-to-mouth activity from treated turf calculated using SOP 2.3.3:*** Postapplication dose among toddlers from incidental non-dietary ingestion of pesticide residues on treated turf from object-to-mouth transfer (i.e., those residues that end up in the mouth from a child mouthing a handful of treated turf); and

- ***Dose from soil ingestion activity from treated turf calculated using SOP 2.3.4:*** Postapplication dose among toddlers from incidental non-dietary ingestion of pesticide residues from ingesting soil in a treated turf area (i.e., those soil residues that end up in the mouth from a child touching treated soil and turf then putting their hands in their mouth).

Exposures were calculated by considering the potential sources of exposure (i.e., TTRs on lawns) then calculating dermal exposure, and risks in the same manner as described for the occupational post application risk assessments.

The other aspects of the turf exposure scenario involves calculating dose from non-dietary ingestion that arises from the hand-to-mouth, object-to-mouth and soil ingestion pathways. The algorithms used for each type of calculation are presented below.

Dermal Exposure from Treated Turf

Dermal exposure from treated turf is calculated using the following formula (SOP 2.2):

Dermal exposure (mg/day) = (TTR at day t) x CF1 x TC x conversion factor x # hours/day)

Where:

TTR	=	transferable turf residue (ug/cm^2) at day (t) after application
CF1	=	conversion factor of 0.001 to convert TTR value in ug/cm^2 to mg/cm^2
TC	=	transfer coefficient (cm^2/hour)
Hours/day	=	standard assumption is 2 to 4 hours of exposure per day depending upon the activity

In the case of dicamba the TTR data were taken from submitted studies which used the ORETF roller, therefore, the TTR values could be used directly as discussed in Reference B. The transfer coefficients are 500 cm^2/hour for golfing, 5200 cm^2/hour for toddlers playing on treated turf and 14,500 cm^2/hour for adults performing heavy yardwork. An exposure duration of 2 hours per day is used for toddlers playing on treated turf and for adults performing heavy yardwork. An exposure duration of 4 hours per day is used for golfing.

The formula for calculating the dissipation rate when TTR data are available is as follows:

$$TTR_t = TTR_i * e^{-kt}$$

where:

TTRt	=	TTR at time t after application
TTRi	=	TTR initially after application (i.e. at Day 0)
e	=	2.718
k	=	Slope of the regression of the ln transformed TTR values vs time
t	=	Dissipation time after application (days)

Exposures from Hand to Mouth Behavior on Treated Turf:

The following formula illustrates the approach used to calculate the non-dietary ingestion exposures that are attributable to hand-to-mouth behavior on treated turf (SOP 2.3.2).

PDR = TTR * (SE/100) * SA * Freq * Hours * (1 mg/1000 ug)

where:

PDR	=	potential dose rate from hand-to-mouth activity (mg/day);
TTR	=	Turf Transferable Residue where dissipation is based on TTR study and the 0-day value is based on the 5% initial transferability factor (µg/cm^2);
SE	=	saliva extraction factor (50%);
SA	=	surface area of the hands (20 cm^2);
Freq	=	frequency of hand-to-mouth events (20 events/hour); and
Hours	=	exposure duration (2 hours).

When used for hand to mouth exposures, the TTR value is based upon the default assumption of 5 percent of the application rate and not the TTR study because the TTR studies do not account for "the sticky hand effect" as discussed in Reference C. The TTR study data are used, however, to determine the dissipation rate.

The formula for calculating the TTR value on Day 0 is given below:

TTR = Application Rate * F * CF1 * CF2 * CF3

Where:

Application Rate	=	lbs ai/acre
F	=	fraction of applied ai that is available for hand to mouth exposure (5 percent)
CF1	=	1.0 lb ai/acre equals 2.3×10^{-5} lbs ai per ft^2
CF2	=	4.54×10^8 ug/lb
CF3	=	0.00108 ft^2/cm^2

Note: CF1 * CF2 * CF3 = 11.23

Exposures from Object to Mouth Behaviors on Treated Turf

The following formula illustrates the approach used to calculate exposures that are attributable to object-to-mouth behavior on treated turf that is represented by a child mouthing on a handful of turf (SOP 2.3.3):

PDR = TTR * IGR * (1mg/1000ug)

where:

PDR	=	potential dose rate from mouthing activity (mg/day);
TTR	=	Turf Transferable Residue where dissipation is based on TTR study and the 0-day value is based on the 20% initial transferability factor ($\mu g/cm^2$); and
IgR	=	ingestion rate for mouthing of grass per day (25 cm^2/day).

When used for object to mouth exposures, the TTR value is based upon the default assumption of 20 percent of the application rate and not the TTR study because the TTR studies do not account for "saliva washing effect" as discussed in Reference C. The TTR study is used, however, to determine the dissipation rate.

Exposures from Soil Ingestion on Treated Turf

The following formula illustrates the approach used to calculate exposures that are attributable to soil ingestion (SOP 2.3.4):

PDR = SR * IgR * (0.000001 gm/ 1 ug)

Where:

PDR	=	dose from soil ingestion activity (mg/day)
SR	=	Soil Residue where dissipation is based on TTR study and the 0-day value is based on the application rate, 1 cm depth of surface soil, and the density of soil ($\mu g/cm^3$)
IgR	=	ingestion rate for daily soil ingestion (mg/day)

MOE Calculations for Each Pathway

The MOEs are calculated for each individual pathway using the MOE formula:

MOE (unitless) = NOAEL / (Dose /BW)

where

NOAEL	=	300 mg/kg/day (acute), 45 mg/kg/day (short term)
Dose	=	mg/kg/day
BW	=	15 kg (toddlers) and 70 kg (adult)

MOEs Calculations for All of the Pathways Combined

When assessing adult exposures only the dermal pathway is considered and when assessing toddler exposures all of the pathways are considered. The dicamba endpoints that were selected for acute and short term residential exposure apply to all of the pathways, therefore, it was appropriate to combine the dose from each pathway into a total dose as shown below.

Total Dose = (Dermal Dose + Hand-to Mouth Dose + Object to Mouth Dose + Soil Ingestion Dose)/BW

Where:
Dose = mg/kg/day
BW = 15 kg for toddlers

The total dose is then used to calculate an MOE as shown above. The target MOE for acute exposures is 300 for toddlers and 100 for adults. The target MOE for short term exposure is 100 for both toddler and adults.

References

(A) PHED Surrogate Exposure Guide, V1.1. Health Effects Division, Office of Pesticide Program. August, 1998.

(B) Standard Operating Procedures for Residential Exposure Assessments. U.S. EPA. December 18, 1997.

(C) ExpoSAC SOP #12 "Recommended Revisions to the Standard Operating Procedures (SOPs) for Residential Exposure Assessments. February 22, 2001

(D) Series 875 - Occupational and Residential Exposure Test Guidelines, Group B - Post Application Exposure Monitoring Test Guidelines. U.S. EPA. February 10, 1998.

(E) Overview of Issues Related to the Standard Operating Procedures for Residential Exposure Assessment. Presented to the FIFRA Scientific Advisory Panel on September 1999

Appendix B: Occupational Handler Exposure Data and Risk Calculations for Dicamba

HED Records Center Series 361 Science Reviews - File R115090 - Page 43 of 81

ED_005172C_00001675-00043

Table B1 - Dicamba Formulations Used, Application Methods, Application Rates and Daily Amounts Treated				
Application Method	**Representative Crops**	**Formulations Used** **L = Liquid** **G = Granular** **WP = Wettable Powder** **WDG = Water Dispersible Granule**	**Label Rate[1] (lb ae/acre)**	**Area Treated[2] (Acres/Day)**
Aerial Spray	Sugar Cane Soybeans. Fallow Land. Rangeland. Pastures Corn. Small Grains	Liquid Liquid Liquid, WDG Liquid Liquid Liquid, WDG Liquid	2.8 2.0 2.0 2.0 2.0 0.5 0.5	1200 1200 1200 1200 1200 1200 1200
Groundboom Spray	Sugar Cane Soybeans. Fallow Land. Rangeland. Pastures Sod Farm Turf Golf Courses Corn. Small Grains	Liquid Liquid Liquid, WDG Liquid Liquid Liquid Liquid, WDG, WP Liquid Liquid	2.8 2.0 2.0 2.0 2.0 1.0 1.0 0.5 0.5	200 200 200 200 200 80 40 200 200
Backpack Sprayer (Mix/Load/Apply) Backpack Sprayer (Applicator) Backpack Sprayer (Mixer/Loader)	Christmas Trees Forest Site Prep Forest Site Prep	Liquid Liquid Liquid	2.0 2.0 2.0	2[3] 4[4] 40[5]
Right of Way Sprayer	Weed Control Weed and Brush Control	Liquid Liquid	2.0 2.0	50[6] 2.5[6]
Broadcast Application of Granules	Golf Courses	Granular	1.0	40
Turfgun (Applicator) Turfgun (Mixer/Loader)	Turf Turf	Liquid, WDG, WP Liquid, WDG, WP	1.0 1.0	5 100[7]
Push Cyclone Spreader	Turf	Granular	1.0	5

HED Records Center Series 361 Science Reviews - File R115090 - Page 44 of 81

ED_005172C_00001675-00044

Notes for Table B1.

1. Label rates are from the Use Closure Memo of 7/17/2005.

2. Except as noted, the acres treated per day values are from ExpoSAC Policy 9 "Standard Values for Daily Acres Treated in Agriculture", Revised 7/5/2000.

3. The area treated for Backpack Sprayer (Mix/Load/Apply) is 40 gallons per day from ExpoSAC Policy 9 divided by the label recommended spray volume of 20 gallons per acre.

4. The area treated for Backpack Sprayer (Apply Only) is 4 acres per day based upon the acreage treated in CA DPR HS-1769 normalized to an 8 hour day. The spray volume was 25 gallons per acre.

5. The area treated for a mixer/loader supporting a backpack applicator crew is 40 acres per based upon a crew size of 10.

6. The area treated for ROW sprayers was determined by the dividing the daily spray volume handled (1000 gallons per day) from ExpoSAC Policy 9 by the label recommended spray volume of 20 gallons per acre for general weed control and 400 gallons per acre for woody brush control.

7. Based upon a mixer loader at a central location supporting a PCO crew of 20 applicators.

HED Records Center Series 361 Science Reviews - File R115090 - Page 45 of 81

ED_005172C_00001675-00045

Table B2 - Exposure Data Used for Occupational Handler/Applicator Risk Assessment

Exposure Scenarios (See notes for PPE Descriptions)	Baseline Dermal (mg/lb ae)	Baseline Inhalation (ug/lb ae)	Single Layer Dermal (mg/lb ae)	Double Layer Dermal (mg/lb ae)	PF5 Respirator Inhalation (ug/lb ae)	PF10 Respirator Inhalation (ug/lb ae)	Engineering Control Dermal (mg/lb ae)	Engineering Control Inhalation (ug/lb ae)
Mixer Loader Unit Exposure Values								
Mix/Load Wettable Powder (WP) Formulations (1)	3.7	43	0.17	0.13	8.6	4.3	0.0098	0.24
Mix/Load Dry Flowable (DF) Formulations	0.066	0.77	0.066	0.047	0.15	0.077	N/A	N/A
Mix/Load Liquid Formulations (2)	2.9	1.2	0.023	0.017	0.24	0.12	0.0086	0.083
Load Granular Formulations (3)	0.0084	1.7	0.0069	0.0034	0.34	0.17	0.00017	0.034
Applicator Unit Exposure Values								
Aerial Application (4)	N/A	N/A	N/A	N/A	N/A	N/A	0.005	0.068
Groundboom Application (5)	0.014	0.74	0.014	0.011	0.15	0.074	0.005	0.043
Backpack Application (8)	ND	54	0.24	0.22	0.9	0.45	NA	NA
Right of Way (ROW) Application (9)	1.3	3.9	6.1	ND	10.8	5.4	NA	NA
Turf Gun Application (11)	No Data	1.0	0.73	0.40	0.20	0.10	NA	NA
Broadcast Spreader Application (12)	0.0099	1.2	0.0072	0.0042	0.24	0.12	0.0021	0.22
Mixer/Loader/Applicator Unit Exposure Values								
Mix/Load/Apply WP with a Turfgun (13)	No Data	62	0.74	0.4	12.4	6.2	0.65	7.7
Mix/Load/Apply Liquid Flowables with a Turfgun (14)	No Data	1.9	0.5	0.27	0.38	0.19	Not Feasible	Not Feasible
Mix/Load/Apply WD Granules with a Turfgun (15)	No Data	2.2	0.59	0.34	0.44	0.22	Not Feasible	Not Feasible
Mix/Load/Apply Liquids with Backpack Sprayer (16)	No Data	30	2.5	1.6	6.0	3.0	Not Feasible	Not Feasible
Load/Apply Granules with a Push Cyclone Spreader (17)	0.35	7.5	0.22	0.11	1.5	0.75	Not Feasible	Not Feasible
Flagger Unit Exposure Values								
Flag Aerial Spray Applications (18)	0.011	0.35	0.012	0.01	0.07	0.035	0.00022	0.007

Notes - PPE Descriptions

Baseline Dermal - includes long sleeve shirts, long pants, shoes and socks.
Single Layer Dermal - includes water resistant gloves over Baseline PPE
Double Layer Dermal - includes Tyvek or cotton coveralls over Single Layer PPE
PF5 Respirator Inhalation - filtering facepiece disposable respirator (i.e. dustmask) with a protection factor of 5
PF10 Respirator Inhalation - half face cartridge respirator with a protection factor of 10

HED Records Center Series 361 Science Reviews - File R115090 - Page 46 of 81

ED_005172C_00001675-00046

Table B3: Sources of Exposure Data Used In The Occupational Handler Exposure And Risk Calculations

Exposure Scenario (Number)	Data Source	Comments[2, 3]
Mixer/Loader		
Mix/Load Wettable Powder (WP) Formulations (1)	PHED[1]	**Baseline:** Hands, dermal, and inhalation = ABC grades. Hands = 7 replicates; Dermal = 22 to 45 replicates, and Inhalation = 44 replicates. Low confidence in the dermal/hands data due to the low number of hand replicates. Medium confidence in inhalation data. No protection factor was needed to define the unit exposure value. **PPE:** Hands = ABC grades. Hands = 24 replicates. The same dermal data are used as for baseline coupled with a 50% protection factor to account for an additional layer of clothing. Hands = ABC grades. Hands = 24 replicates. Medium confidence in hand data. A respirator protection factor of 5 is applied to estimate the use of a filtering facepiece disposable respirator (i.e. a dust mask). A respirator protection factor of 10 is applied to estimate the use of a half face elastomeric facepiece respirator with cartridges (i.e. half face respirator). **Engineering Controls**: Dermal = AB grade. Hand and inhalation = all grade. Hands = 9 replicates; dermal = 6 to 15 replicates; and inhalation = 15 replicates. Low confidence in the hand, dermal, and inhalation data. No protection factor was needed to define the unit exposure value. Engineering controls are water soluble packets.
Mix/Load Dry Flowable (DF) Formulations	PHED V1.1	**Baseline:** Hand, inhalation, and dermal data = acceptable grades. Hands = 7 replicates; Dermal = 16 to 26 replicates; and Inhalation = 23 replicates. Low confidence in hand/dermal data because of number of hand replicates. Inhalation data are high confidence. No protection factor was needed to define the unit exposure value. **PPE:** Hands = acceptable grades. Hands = 21 replicates. High confidence in all dermal data. As appropriate, the same dermal and inhalation data were used as for the baseline coupled with a 50% protection factor to account for an additional layer of clothing. A respirator protection factor of 5 is applied to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half face respirator. **Engineering Controls: N/A**
Mix/Load Liquid Formulations (2)	PHED	**Baseline:** Hands, dermal, and inhalation = acceptable grades. Hands = 53 replicates; Dermal = 72 to 122 replicates; and Inhalation = 85 replicates. High confidence in hand, dermal, and inhalation data. No protection factor was needed to define the unit exposures. **PPE:** The same dermal data are used as for baseline coupled with a 50% protection factor to account for an additional layer of clothing. Hands = acceptable grades. Hands = 59 replicates. High confidence in hand data. A respirator protection factor of 5 is applied to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half-face respirator. **Engineering Controls:** Hands, dermal, and inhalation = acceptable grades. Hands = 31 replicates; Dermal = 16 to 22 replicates; and Inhalation = 27 replicates. High confidence in hand, dermal, and inhalation data.
Load Granules (3)	PHED	**Baseline:** Dermal = 33 - 78 replicates, ABC grades. Hand = 10 replicates, All grade. Inhalation = 58 replicates, AB grade. Low confidence due to poor grade quality of hand replicates and low replicate number. High confidence in inhalation data. No protection factor was needed to define the unit exposure value. **Single Layer:** Dermal = 33 - 78 replicates, ABC grades. Gloved Hand = 45 replicates, AB grade. Medium confidence in dermal and hand data. . **Double Layer**: Dermal = 12 - 59 replicates, ABC grades. Gloved Hand = 45 replicates, AB grade. Low confidence in dermal data due to low replicate number for many body parts. **Engineering Control**: The same hand, dermal and inhalation data are used as for baseline with a 98% protection factor to account for the use of engineering controls.
Applicator		
Aerial Application (4)	PHED	**Engineering Controls:** Hands = ABC grade, dermal and inhalation = ABC grade. Hands= 34 replicates, dermal = 24 to 48 replicates, and inhalation = 23 replicates. Medium confidence in dermal, hand, and inhalation data. No protection factor was needed to define the unit exposure value. **EPA has no data for this scenario, other than enclosed cockpits – the engineering control.**

Table B3: Sources of Exposure Data Used In The Occupational Handler Exposure And Risk Calculations

Exposure Scenario (Number)	Data Source	Comments[2, 3]
Groundboom Application (5)	PHED	**Baseline**: Hand, dermal, and inhalation = acceptable grades. Hands = 29 replicates, dermal = 23 to 42 replicates, and inhalation = 22 replicates. High confidence in hand, dermal, and inhalation data. No protection factors were needed to define the unit exposure values. **PPE:** The same dermal data are used as for baseline coupled with a 50% protection factor to account for an additional layer of clothing. Hands = ABC grades. Hands = 21 replicates. Medium confidence in hand data. A respirator protection factor of 5 is applied to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half-face respirator. **Engineering Controls**: Hand and dermal = ABC grade. Inhalation = acceptable grades. Hands = 16 replicates, dermal = 20 to 31 replicates; and inhalation = 16 replicates. Medium confidence in the hand and dermal data. High confidence in inhalation data. No protection factor needed to define the unit exposure value. Protective gloves not used.
Backpack Application (8)	CA DPR HS-1769	HS-1769 "Exposure of Hand Applicators to Triclopyr in Forest Settings, 1995 " which was conducted by the California Department of Pesticide Regulation. Ten applicators were monitored for two days for a total of 20 replicates as they applied Garlon using Solo Backpack Sprayers which were filled from a 300 gallon mixing tank. The workers treated an average of 3.2 acres during each 9 hour day with a spray volume of 25 gallons per acre and an application rate of 1.0 lb triclopyr ae per acre. The actual spraying time was 360 minutes per day with the remainder of time spent placing plastic bags over the seedlings at the start of the workday, removing the bags at the end of the day, pulling hose, lunch/rest breaks and donning monitoring clothing and equipment. Dermal exposures were monitored using long sleeve t-shirt and knee length socks, hand and face/neck exposures were monitored using Chubbs baby wipes and inhalation exposures were monitored using glass fiber filters. The workers typically wore coveralls over the dosimeters. The results of the knee high socks were extrapolated to the thighs. **Baseline**: Inhalation data = B grade with 16 replicates. Dermal data is not available. High confidence in inhalation data. **PPE:** Gloved Hands = A grade data with 20 replicates. Dermal = A grade data with 20 replicates. High confidence in hand and dermal data. A respirator protection factor of 5 is applied to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half-face respirator.
Right of Way Sprayer Application (9)	PHED Right of Way Sprayer Data	**Baseline:** Hands = 16 replicates with ABC grade data, dermal = 4 to 20 replicates with ABC grade data, and inhalation = 16 replicates with AB grade data. Low confidence due to lack of dermal replicates. No protection factor was needed to define the unit exposure value. **PPE:** Hands = 4 replicates with AB grade data, dermal = 4 to 20 replicates with ABC grade data. The same dermal data are used as for baseline coupled with a 50% protection factor to account for an additional layer of clothing. Low confidence due to low number of dermal and hand replicates. A respirator protection factor of 5 is applied to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half-face respirator. **Engineering Controls:** No data is available.
Turfgun Application (11)	ORETF OMA002	**Baseline:** No ungloved data **PPE**: Dermal and hands = B grade; Inhalation = B grade; Dermal = 10 replicates, hands = 10 replicates; and inhalation = 10 replicates. Medium confidence in inhalation, dermal, and hand data due to low number of replicates. A 50% protection factor to account for an additional layer of clothing. A respirator protection factor of 5 is applied to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half-face respirator. **Engineering Controls:** Not considered feasible for this exposure scenario.
Broadcast Spreader (12) Application	PHED	**Baseline**: Dermal = 1-5 replicates, AB grades. Hand = 5 replicates, AB grade. Inhalation = 5 replicates, AB grade. Low confidence due to inadequate replicate number. **PPE:** The same dermal data are used as for baseline coupled with a 50% protection factor to account for an additional layer of clothing. The same hand are used as for baseline coupled with a 90% protection factor to account for the use of gloves. A respirator protection factor of 5 is applied to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half-face respirator. **Engineering Control:** Dermal = 2 - 30 replicates, AB grade. Hand = 17 replicates, AB grade. Neck data has only two replicates. Other body parts have 27 - 30 replicates. High Confidence except for neck data. Inhalation = 37 replicates, AB grade. High Confidence

Table B3: Sources of Exposure Data Used In The Occupational Handler Exposure And Risk Calculations		
Exposure Scenario (Number)	**Data Source**	**Comments[2, 3]**
Mixer/Loader/Applicator (M/L/A)		
M/L/A WP with a Turfgun (13)	ORETF OMA002	**Baseline:** No ungloved data **PPE**: Dermal and hands = B grade with 15 replicates; Inhalation = B grade with 15 replicates. High confidence in inhalation, dermal, and hand data. A 50% protection factor to account for an additional layer of clothing. A respirator protection factor of 5 is applied to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half-face respirator. **Engineering Controls:** Not considered feasible for this exposure scenario.
M/L/A Liquids with a Turfgun (14)	ORETF OMA002	Same as above for scenario 13. Liquid flowable formulations were used in 15 replicates of the ORETF study.
M/L/A DF with a Turfgun (15)	ORETF OMA002	Same as above for scenario 13. The water dispersable granules were used in 15 replicates of the ORETF study.
M/L/A Liquids with a Backpack Sprayer (16)	PHED	**Baseline:** No Data **PPE:** Hands = C grades. Hands = 11 replicates. Low confidence in hand data. The same dermal data are used as for baseline coupled with a 50% protection factor to account for an additional layer of clothing. A respirator protection factor of 5 is applied to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half-face respirator. **Engineering Controls:** Not considered feasible for this exposure scenario.
Load/Apply Granules with a Push Cyclone Spreader (17)	ORETF OMA001	**Baseline:** Dermal and ungloved hands = AB grade with 20 replicates; Inhalation = AB grade with 40 replicates. High confidence in inhalation, dermal, and hand data. **PPE**: Dermal and gloved hands = AB grade with 20 replicates; High confidence in dermal, and hand data. A 50% protection factor to account for an additional layer of clothing. A respirator protection factor of 5 is applied to baseline inhalation data to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half-face respirator. **Engineering Controls:** Not considered feasible for this exposure scenario.

HED Records Center Series 361 Science Reviews - File R115090 - Page 49 of 81

ED_005172C_00001675-00049

Table B3: Sources of Exposure Data Used In The Occupational Handler Exposure And Risk Calculations		
Exposure Scenario (Number)	**Data Source**	**Comments[2, 3]**
Flagger		
Flag Aerial Spray Applications (18)	PHED	**Baseline:** Hands, dermal, and inhalation = acceptable grades. Dermal = 18 to 28 replicates; hands = 30 replicates; and inhalation = 28 replicates. High confidence in dermal, hand, and inhalation data. No protection factor was required to calculate unit exposures. **PPE**: The same dermal data are used as for baseline coupled with a 50% protection factor to account for an additional layer of clothing. Hand = acceptable grades. Hands = 6 replicates. Low confidence in gloved hand data due to small number (6) of replicates. A respirator protection factor of 5 is applied to estimate the use of a dust mask. A respirator protection factor of 10 is applied to estimate the use of a half-face respirator. **Engineering Controls**: The same data are used as for baseline coupled with a 98% protection factor to account for the use of an engineering control (e.g., sitting in a vehicle).

Notes

1. PHED refers to the Pesticide Handler Exposure Database Version 1.1 PHED Surrogate Exposure Guide of August 1998.

2. The data grade and confidence categories are assigned as follows:

Grade A data	= Lab recovery is 90 to 110 percent with a CV $\leq$15. Field recovery is 70 to 120 percent. Storage stability data are optional.
Grade B data	= Lab recovery is 80 to 110 percent with a CV $\leq$25. Field recovery is 50 to 120 percent. Storage stability data are optional.
Grade C data	= Lab recovery is 70 to 120 percent with a CV $\leq$33. Field recovery is 30 to 120 percent or is missing. Storage stability data is 50 to 120 percent
Grade D data	= Lab recovery is 60 to 120 percent with a CV $\leq$33. Field recovery and storage stability data are optional.
Grade E data	= Does not meet above criteria.

High Confidence	= grade A and B data and 15 or more replicates per body part
Medium Confidence	= grade A, B, and C data and 15 or more replicates per body part
Low Confidence	= grade A, B, C, D and E data <u>or</u> any combination of grades with less than 15 replicates.

- **PHED grading criteria only affect one aspect of the exposure assessment. The other exposure factors should also be considered in the risk management decision.**

ED_005172C_00001675-00050

Table B4 - Exposure Factors and Formulas for Dicamba	
Exposure Factors	**Formulas**
Dermal Absorption = 15 percent	Daily Exposure = Application Rate * Acres treated * Unit Exposure Value
Inhalation Absorption = 100 percent	Daily Dose = (Daily Exposure * Absorption factor)/Body Weight
NOAEL for Short/Intermediate/Long Term Dermal Exposures = 45 mg/kg/day (based upon an oral developmental rat study)	MOE = NOAEL/Daily Dose
NOAEL for Short/Intermediate/Long Term Inhalation Exposures = 45 mg/kg/day (based upon an oral developmental rat study)	Combined MOE = 1/((1/Dermal MOE)+(1/Inhalation MOE))
Body Weight = 70 kg	

HED Records Center Series 361 Science Reviews - File R115090 - Page 51 of 81

ED_005172C_00001675-00051

Table B5 - Dicamba Handler Combined MOEs

Exposure Scenario	Crop Type	Application Rate (lb ae/acre)	Acres/Day	Lb a.i. Handled per Day	Base-line	Single Layer	Single Layer PF5	Single Layer PF10	Double Layer	Double Layer PF5	Double Layer PF10	Engineering Control
Mixer/Loader (M/L)												
M/L WP for Groundboom	Golf Courses	1	40	40	130	1100	2300	2600	1300	2800	3300	46000
M/L WP for Turfgun Application	turf	1	100	100	**53**	460	920	1100	500	1100	1300	18000
M/L WDG for Aerial	Fallow Land	2	1200	2400	120	120	130	130	170	180	180	NA
M/L WDG for Aerial	Corn	0.5	1200	600	490	490	520	530	670	730	740	NA
M/L WDG for Groundboom	Fallow Land	2	200	400	740	740	780	790	1000	1100	1100	NA
M/L WDG for Groundboom	Corn	0.5	200	100	3000	3000	3100	3200	4000	4400	4400	NA
M/L WDG for Groundboom	Golf Courses	1	40	40	7400	7400	7800	7900	10000	11000	11000	NA
M/L WDG for Turf Gun	Turf	1	100	100	3000	3000	3100	3200	4000	4400	4400	NA
M/L Liquids for Aerial	Sugar Cane	2.8	1200	3360	**2.1**	200	250	260	250	330	340	680
M/L Liquids for Aerial	Soybeans, Range Land, Pasture, Fallow (RPF)	2	1200	2400	**3**	280	360	370	340	460	480	960
M/L Liquids for Aerial	Small Grains, Corn	0.5	1200	600	**12**	1100	1400	1500	1400	1800	1900	3800
M/L Liquids for Groundboom	Sugar Cane	2.8	200	560	**13**	1200	1500	1600	1500	2000	2000	4100
M/L Liquids for Groundboom	Soybean, RPF	2	200	400	**18**	1700	2100	2200	2100	2700	2900	5700
M/L Liquids for Groundboom	Small Grains, Corn	0.5	200	100	**72**	6800	8500	8800	8200	11000	11000	23000
M/L Liquids for Groundboom	Sod Farms	1	80	80	**90**	8500	11000	11000	10000	14000	14000	29000
M/L Liquids for Groundboom	Golf Courses	1	40	40	180	17000	21000	22000	21000	27000	29000	57000
M/L Liquids for Row Sprayer	Right of Way Areas (ROW)	2	50	100	**72**	6800	8500	8800	8200	11000	11000	23000
M/L Liquids for Turf Gun	Turf	1	100	100	**72**	6800	8500	8800	8200	11000	11000	23000
M/L Liquids for Backpack Sprayer	Forest Site Prep	2	40	80	**90**	8500	11000	11000	10000	14000	14000	29000
Load Granulars for Broadcast Spreader	Golf Courses	1.0	40	40	27000	29000	57000	65000	36000	93000	120000	280000

HED Records Center Series 361 Science Reviews - File R115090 - Page 52 of 81

ED_005172C_00001675-00052

Table B5 - Dicamba Handler Combined MOEs

Exposure Scenario	Crop Type	Application Rate (lb ae/acre)	Acres/Day	Lb a.i. Handled per Day	Base-line	Single Layer	Single Layer PF5	Single Layer PF10	Double Layer	Double Layer PF5	Double Layer PF10	Engineering Control
Applicator (APP)												
Aerial Application	Sugar Cane	2.8	1200	3360	ND	ND	ND	ND	ND	ND	ND	1100
Aerial Application	Soybean, RPF	2	1200	2400	ND	ND	ND	ND	ND	ND	ND	1600
Aerial Application	Small Grains, Corn	0.5	1200	600	ND	ND	ND	ND	ND	ND	ND	6400
Groundboom Application	Sugar Cane	2.8	200	560	2000	2000	2500	2600	2400	3100	3300	7100
Groundboom Application	Soybean, RPF	2	200	400	2800	2800	3500	3600	3300	4400	4600	9900
Groundboom Application	Small Grains, Corn	0.5	200	100	11000	11000	14000	14000	13000	18000	18000	40000
Groundboom Application	Sod Farms	1	80	80	14000	14000	18000	18000	16000	22000	23000	50000
Groundboom Application	Golf Courses	1	40	40	28000	28000	35000	36000	33000	44000	46000	99000
ROW Application	ROW	2	50	100	160	500	530	530	660	710	720	ND
Backpack Application	Forest Site Prep	2	4	8	ND	410	430	430	ND	ND	ND	ND
Turfgun Application	turf	1.0	5	5	ND	5700	5700	5700	10000	10000	10000	ND
Broadcast Spreader Application	Golf Courses	1.0	40	40	29000	35000	60000	66000	43000	91000	110000	150000
Mixer/Loader/Applicator (M/L/A)												
M/L/A Wettable Powder with Turfgun	turf	1	5	5	ND	3600	5100	5400	5200	8700	9500	6500
M/L/A WDG with Turfgun	turf	1	5	5	ND	6900	7100	7100	12000	12000	12000	ND
M/L/A Liquid Flowables with Turfgun	turf	1	5	5	ND	8200	8400	8400	15000	15000	15000	ND
M/L/A Liquids with Backpack Sprayer	ROW, RPF	2	4	8	ND	970	1000	1000	1500	1600	1600	ND
Load/Apply Granules with a Push Cyclone	turf	1	5	5	ND	16000	18000	19000	26000	35000	37000	ND
Flagger												
Flag Aerial Application	Sugar Cane	2.8	1200	3360	470	440	500	510	470	550	560	23000
Flag Aerial Application	Soybean, RPF	2	1200	2400	660	610	700	720	660	760	780	33000
Flag Aerial Application	Small Grains, Corn	0.5	1200	600	2600	2400	2800	2900	2600	3100	3100	130000

HED Records Center Series 361 Science Reviews - File R115090 - Page 53 of 81

ED_005172C_00001675-00053

Appendix C - Occupational Post-Application Risks of Dicamba Exposures

Chemical:	Dicamba
Reason:	Short/Intermediate Term Exposure
Date:	07/15/05
Assessor:	TD

Crops	Applicable TC Groups	Spreadsheet Number
Cereal Grains	Field Row/Low Medium	C1
Corn, Early	Field Row/Tall	C2
Corn, Late	Field Row/Tall	C3
Sorghum	Field Row/Tall	C4
Sugarcane	Sugarcane	C5
Turf/Sod	Turf	C6

DFR/TTR Data Defaults:	
Initial Percent of Rate as DFR (%):	20
Dissipation Rate per day (%):	10

Toxicology & Exposure Factor Inputs:	
Uncertainty Factor:	100
NOAEL (mg/kg/day):	45
Source of NOAEL:	Rat Repro Study (Oral)
Adult Exposure Duration (hrs/day):	8
Adult Body Weight (kg):	70
Dermal Abs. (%):	15

Appendix C - Occupational Post-Application Risks of Dicamba Exposures
Spreadsheet C1

Chemical:	Dicamba
Reason:	Short/Intermediate Term Exposure
Transfer Coefficient Group:	Field/row crop, low/medium
Specific Crop(s) Considered:	Cereal Grains
Application Rate (lb ae/A):	0.5
Application Rate Source:	Use Closure Rate for Wheat

DFR Data Summary

Data Source (enter 1 if data available, 0 if defaults):	0
Source:	
Slope of Semilog Regression:	
[Initial] (ug/cm2):	
Study Application Rate (lb ae/A):	0.5
Limit of Quantification (ug/cm2):	

[Note: Enter application rate of crop if no data available in study rate cell.]

Exposure Inputs Summary

Exposure Potential	Transfer Coefficients (cm2/hour)		Activities
	Used For RA	Range	
Very Low	N/A	N/A	N/A
Low	100	TBD	Irrigation, scouting, thinning, weeding immature/low foliage plants
Medium	1500	486 to 2760	Irrigation, scouting, weeding mature/high foliage plants

DAT	DFR LEVELS (ug/cm2)		DOSE (mg/kg/day)		MOES	
	Not Adjusted	Adjusted For Rate	Low Exposure	Medium Exposure	Low	Medium
0	1.122	1.122	0.0019	0.0288	23398	1560

HED Records Center Series 361 Science Reviews - File R115090 - Page 55 of 81

Appendix C - Occupational Post-Application Risks of Dicamba Exposures
Spreadsheet C2

Chemical:	Dicamba
Reason:	Short/Intermediate Term Exposure
Transfer Coefficient Group:	Field/row crop, tall
Specific Crop(s) Considered:	Corn - Early Post Emergence
Application Rate (lb ae/A):	0.5
Application Rate Source:	Use Closure Memo

DFR Data Summary

Data Source (enter 1 if data available, 0 if defaults):	0
Source:	N/A
Slope of Semilog Regression:	N/A
[Initial] (ug/cm2):	N/A
Study Application Rate (lb ae/A):	0.5
Limit of Quantification (ug/cm2):	N/A

[Note: Enter application rate of crop if no data available in study rate cell.]

Exposure Inputs Summary

Exposure Potential	Transfer Coefficients (cm2/hour)		Activities
	Used For RA	Range	
Very Low	N/A	N/A	N/A
Low	100	TBD	scouting, weeding immature/low foliage plants
Medium	400	418 to 1980	scouting, weeding more mature/foliaged plants
High	N/A	N/A	scouting, irrigation, weeding mature/full foliage plants

Comments: Applied from corn emergence through the five leaf stage or eight inches tall

DAT	DFR LEVELS (ug/cm2)		DOSE (mg/kg/day)			MOES		
	Not Adjusted	Adjusted For Rate	Low Exposure	Med Exposure	High Exposure	Low	Medium	High
0	1.122	1.122	0.0019	0.0077	N/A	23398	5849	N/A

HED Records Center Series 361 Science Reviews - File R115090 - Page 56 of 81

Appendix C - Occupational Post-Application Risks of Dicamba Exposures
Spreadsheet C3

Chemical:	Dicamba
Reason:	Short/Intermediate Term Exposure
Transfer Coefficient Group:	Field/row crop, tall
Specific Crop(s) Considered:	Corn - Late Post Emergence
Application Rate (lb ae/A):	0.25
Application Rate Source:	Use Closure Memo

DFR Data Summary

Data Source (enter 1 if data available, 0 if defaults):	0
Source:	N/A
Slope of Semilog Regression:	N/A
[Initial] (ug/cm2):	N/A
Study Application Rate (lb ae/A):	0.25
Limit of Quantification (ug/cm2):	N/A

[Note: Enter application rate of crop if no data available in study rate cell.]

Exposure Inputs Summary

Exposure Potential	Transfer Coefficients (cm2/hour)		Activities
	Used For RA	Range	
Very Low	N/A	N/A	N/A
Low	100	TBD	scouting, weeding immature/low foliage plants
Medium	400	418 to 1980	scouting, weeding more mature/foliaged plants
High	1000	418 to 1980	scouting, irrigation, weeding mature/full foliage plants
Very High	N/A	N/A	N/A

Comment: Application may be made from 8 to 36 inch tall corn or 15 days before tassel emergence, whichever comes first.

DAT	DFR LEVELS (ug/cm2)		DOSE (mg/kg/day)			MOES		
	Not Adjusted	Adjusted For Rate	Low Exposure	Med Exposure	High Exposure	Low	Medium	High
0	0.561	0.561	0.0010	0.0038	0 0096	46796	11699	4680

HED Records Center Series 361 Science Reviews - File R115090 - Page 57 of 81

Appendix C - Occupational Post-Application Risks of Dicamba Exposures
Spreadsheet C4

Chemical:	Dicamba
Reason:	Short/Intermediate Term Exposure
Transfer Coefficient Group:	Field/row crop, tall
Specific Crop(s) Considered:	Sorghum
Application Rate (lb ae/A):	0.25
Application Rate Source:	Use Closure Memo

DFR Data Summary

Data Source (enter 1 if data available, 0 if defaults):	0
Source:	N/A
Slope of Semilog Regression:	N/A
[Initial] (ug/cm2):	N/A
Study Application Rate (lb ae/A):	0.25
Limit of Quantification (ug/cm2):	N/A

[Note: Enter application rate of crop if no data available in study rate cell.]

Exposure Inputs Summary

Exposure Potential	Transfer Coefficients (cm2/hour)		Activities
	Used For RA	Range	
Very Low	N/A	N/A	N/A
Low	100	TBD	scouting, irrigating immature/low foliage plants
Medium	400	418 to 1980	scouting, irrigating more mature/foliaged plants
High	1000	418 to 1980	scouting, irrigating mature/foliaged plants

DAT	DFR LEVELS (ug/cm2)		DOSE (mg/kg/day)			MOES		
	Not Adjusted	Adjusted For Rate	Low Exposure	Medium Exposure	High Exposure	Low	Medium	High
0	0.561	0.561	0.0010	0.0038	0.0096	46796	11699	4680

HED Records Center Series 361 Science Reviews - File R115090 - Page 58 of 81

Appendix C - Occupational Post-Application Risks of Dicamba Exposures
Spreadsheet C5

Chemical:	Dicamba
Reason:	Short/Intermediate Term Exposure
Transfer Coefficient Group:	Sugarcane
Specific Crop(s) Considered:	Sugarcane
Application Rate (lb ae/A):	2.8
Application Rate Source:	Use Closure Memo

DFR Data Summary

Data Source (enter 1 if data available, 0 if defaults):	0
Source:	N/A
Slope of Semilog Regression:	N/A
[Initial] (ug/cm2):	N/A
Study Application Rate (lb ae/A):	2.8
Limit of Quantification (ug/cm2):	N/A

[Note: Enter application rate of crop if no data available in study rate cell.]

Exposure Inputs Summary

Exposure Potential	Transfer Coefficients (cm2/hour)		Activities
	Used For RA	Range	
Very Low	N/A	N/A	N/A
Low	N/A	N/A	N/A
Medium	1000	418 to 1980	Scouting immature plants
High	2000	418 to 1980	Scouting mature plants
Very High	N/A	N/A	N/A

Comments: Application may be made anytime after weeds have emerged but before sugar cane close-in.

DAT	DFR LEVELS (ug/cm2)		DOSE (mg/kg/day)		MOEs	
	Not Adjusted	Adjusted For Rate	Medium Exposure	High Exposure	Medium	High
0	6.283	6.283	0.1077	0.2154	418	209

HED Records Center Series 361 Science Reviews - File R115090 - Page 59 of 81

Appendix C - Occupational Post-Application Risks of Dicamba Exposures
Spreadsheet C6

Chemical:	Dicamba
Reason:	Short/Intermediate Term Exposure
Transfer Coefficient Group:	Turf
Specific Crop(s) Considered:	Golf course and sodfarm turf
Application Rate (lb ae/A):	1
Application Rate Source:	Use Closure Memo

DFR Data Summary

Data Source (enter 1 if data available, 0 if defaults):	1
Source:	Vanquish Study MRID 449590-01
Slope of Semilog Regression: (CA TTR Data)	N/A
[Initial] (ug/cm2): (FL TTR Data)	0.29
Study Application Rate (lb ae/A):	1
Limit of Quantification (ug/cm2):	0.00089

Exposure Inputs Summary

Exposure Potential	Transfer Coefficients (cm2/hour)		Activities
	Used For RA	Range	
Very Low	N/A	N/A	N/A
Low	3400	N/A	Mowing
Medium	N/A	N/A	N/A
High	6800	N/A	Transplanting, handweeding
Very High	N/A	N/A	N/A

DAT	DFR LEVELS (ug/cm2)		DOSE (mg/kg/day)		MOEs	
	Not Adjusted	Adjusted For Rate	Low Exposure	High Exposure	Low	High
0	0.290	0.290	0.017	0.034	2662	1331

HED Records Center Series 361 Science Reviews - File R115090 - Page 60 of 81

Appendix D: Residential Handler Exposure Data and Risk Calculations for Dicamba

HED Records Center Series 361 Science Reviews - File R115090 - Page 61 of 81

Table D1: Unit Exposure Data for Dicamba Residential Exposure Assessment			
Scenario	Data Source	Unit Exposure Values (Per lb AE Handled)	Data Confidence
Residential Handler Scenarios			
1 - Hand Application of Granules	PHED	Dermal = 114 mg Inhalation = 467 ug	N = 16 dermal ,hand and inhalation replicates with grade ABC data. Hand data was for gloved hand and required 10X adjustment for use without gloves.
2 - Belly Grinder Application	PHED	Dermal = 110 mg Inhalation = 62 ug	N = 20 to 45 dermal replicates, ABC grades. Hand replicates = 23, ABC grades. Medium Confidence N = 40 Inhalation replicates, AB grades, High Confidence.
3. Load/Apply Granules with a Broadcast Spreader	ORETF[1]	Dermal = 0.68 mg Inhalation = 0.91 ug	Grade AB Data. N = 30 replicates. High Confidence despite large variability in results.
4. Mix/Load/Apply with a Hose-end Sprayer (Mix your own)	ORETF[1]	Dermal = 11 mg Inhalation = 16 ug	Grade A Data. N = 30 replicates. High Confidence.
5. Mix/Load/Apply with a Hose-end Sprayer (Ready to Use)	ORETF[1]	Dermal = 2.6 mg Inhalation = 11 ug	Grade A Data. N = 30 replicates. High Confidence.
6. Mix/Load/Apply with Hand Held Pump Sprayer	MRID[2] 444598-01	Dermal = 38 mg Inhalation = 9 ug	A total of 40 replicates per application method were monitored in this study. Half of the people wore gloves and the other half did not. The clothing scenario represents short-sleeved shirt, short pants, and no gloves. The data are considered high quality by the Agency.
7. Mix/Load/Apply with Ready to Use Sprayer	MRID 444598-01	Dermal = 54 mg Inhalation = 67 ug	

Notes for Table 1

1. This study involved the application of granular and liquid formulations of Dacthal to residential lawns. It was reviewed by Health Canada and Gary Bangs in Document #D261948.

2. This study involved the application of liquid carbaryl to home garden vegetables. It was reviewed by Jeff Dawson in Document #D287251.

HED Records Center Series 361 Science Reviews - File R115090 - Page 62 of 81

ED_005172C_00001675-00062

Table D2- Dicamba Short Term MOEs for Homeowner Applications to Lawns

Exposure Scenario	Application Rates (lb ae/Acre)	Treated Areas (Acre/day)	Amount of A.E. Handled per Day (lbs)	Daily Exposure (mg/day)[a]		Daily Dose (mg/kg/day)[b]		Combined Daily Dose (mg/kg/day)[c]	Dicamba MOE[d]
				Dermal	Inhalation	Dermal	Inhalation		
1 - Apply Granules by Hand or Shaker Can	1.0	0.023	0.023	2.62	1.1e-02	5.6e-03	1.5e-04	5.8e-03	7796
2 - Load/Apply Granules with a Belly Grinder	1.0	0.023	0.023	2.53	1.4e-03	5.4e-03	2.0e-05	5.4e-03	8269
3 - Load/Apply Granules with a Broadcast Spreader	1.0	0.500	0.500	0.34	4.6e-05	7.3e-04	6.5e-07	7.3e-04	61710
4 - Mix/Load/Apply Liquids with a Hose-end Sprayer (Mix your own)	1.0	0.500	0.500	5.5	8.0e-03	1.2e-02	1.1e-04	1.2e-02	3782
5 - Mix/Load/Apply Liquids with a Hose-end Sprayer (Ready to Use)	1.0	0.500	0.500	1.3	5.5e-03	2.8e-03	7.9e-05	2.9e-03	15711
6 - Mix/Load/Apply Liquids with Hand Held Pump Sprayer	1.0	0.023	0.023	0.9	2.1e-04	1.9e-03	3.0e-06	1.9e-03	23990
7 - Mix/Load/Apply Liquids with Ready to Use Sprayer	1.0	0.023	0.023	1.2	1.5e-03	2.7e-03	2.2e-05	2.7e-03	16770

a Daily Exposure (mg/day) = Application Rate (lb ae/Acre) * Treated Area (Acre/day) * Unit Exposure Value (mg or µg exposure/ lb ae handled) *[1mg/1000µg (conversion factor if necessary)].
b Daily Dose (mg/kg/day) = Daily Exposure (mg/day) * Absorption Factor (0.15 for dermal; 1.0 for inhalation) ÷ Body Weight (70kg).
c Combined Daily Dose (mg/kg/day) = Dermal Daily Dose (mg/kg/day) + Inhalation Daily Dose (mg/kg/day).
d MOE = NOAEL / Daily Dose (mg/kg/day) where NOAEL = 45mg/kg/day and the target MOE is 100.

APPENDIX E - Dicamba Turf Transferable Residue (TTR) Data

SPREADSHEET E1 - Dicamba TTR DATA SUMMARY

Treatment	App Rate (lb ae/A)	GPA	Initial TTR (ug/cm2)	Initial TTR (Percent)	MAX TTR (ug/cm2)	Max TTR (Percent)	Slope Factor	Percent Relative Error	N	R2	Half Life (days)
MRID 446557-02 North Carolina Trial 1 - Effect of Form											
DMA Mix	0.2	9.9	0.021	1.0	0.055	2.5	-1.99		12	0.80	0.35
MRID 446557-03 North Carolina Trial 2 - Effect of Spray Volume											
DMA Mix	0.22	2.0	0.027	1.10	0.035	1.4	-1.78		12	0.64	0.39
DMA Mix	0.22	5.0	0.036	1.5	0.036	1.5	-2.09		12	0.94	0.33
DMA Mix	0.22	20	0.021	0.84	0.028	1.1	-1.99		12	0.90	0.35
Avg			0.028	1.15			-2.05			0.81	0.34
MRID 450331-01- California Trial											
DMA Mix	0.21	9.9	0.030	1.3	0.03	1.3	-0.38		24	0.82	1.81
MRID 450331-01- Wisconsin Trial											
DMA Mix	0.205	9.4	0.027	1.20	0.034	1.5	N/A	N/A	N/A	N/A	N/A
MRID 449590-01 Vanquish Study											
Florida	1	50	0.100	0.90	0.29	2.6	-1.73		32	0.73	0.40
California	1	50	0.130	1.20	0.13	1.2	-0.62		40	0.95	1.11
Pennsylvania	1	50	0.086	0.77	0.13	1.2	-0.43		40	0.81	1.61
Pennsylvania	1	50	0.003	0.02	0.003	0.02	N/A				
AVG				1.1		1.6	-1.3			0.74	0.67
MAX				1.5		2.6	0.0			0.95	1.81
MIN				0.8		1.1	-2.1			0.00	0.00

Spreadsheet E2: MRID 446557-02 NC1 Trial (2,4-D DMA, MCPP-p and Dicamba)

DAT	Dicamba Raw Data (ng/cm2)	Dicamba Adjusted (ng/cm2)	Percent TTR	LN	Rainfall (inches)
Pre	<0.879				
0	12	18	0.80	2.89	0
0	16	23	1.03	3.15	0
0	16	23	1.03	3.14	0
0.50	29	43	1.90	3.75	0
0.50	39.5	57	2.55	4.05	0
0.50	45.7	66	2.96	4.19	0
1	8	11	0.49	2.40	0
1	7	10	0.45	2.32	0
1	7	10	0.42	2.25	0
2	0.45	0.65	0.03	-0.43	0
2	0.45	0.65	0.03	-0.43	0
2	0.45	0.65	0.03	-0.43	0
3	0.45	0.65	0.03	-0.43	0.06
3	0.45	0.65	0.03	-0.43	0.06
3	0.45	0.65	0.03	-0.43	0.06
4	0.45	0.65	0.03	-0.43	0
4	0.45	0.65	0.03	-0.43	0
4	0.45	0.65	0.03	-0.43	0
5	0.45	0.65	0.03	-0.43	0
5	0.45	0.65	0.03	-0.43	0
5	0.45	0.65	0.03	-0.43	0
6	0.45	0.65	0.03	-0.43	0
6	0.45	0.65	0.03	-0.43	0
6	0.45	0.65	0.03	-0.43	0

Application Method	Groundboom
Application Rate (lbs ae/A)	0.2
Gallons/Acre	9.89
LOQ(ng/cm2)	0.879
LOD(ng/cm2)	Not Specified

	Avg TTR	Percent TTR
DAT 0.0	21	1.0
DAT 0.5	55	2.5

Field Recovery

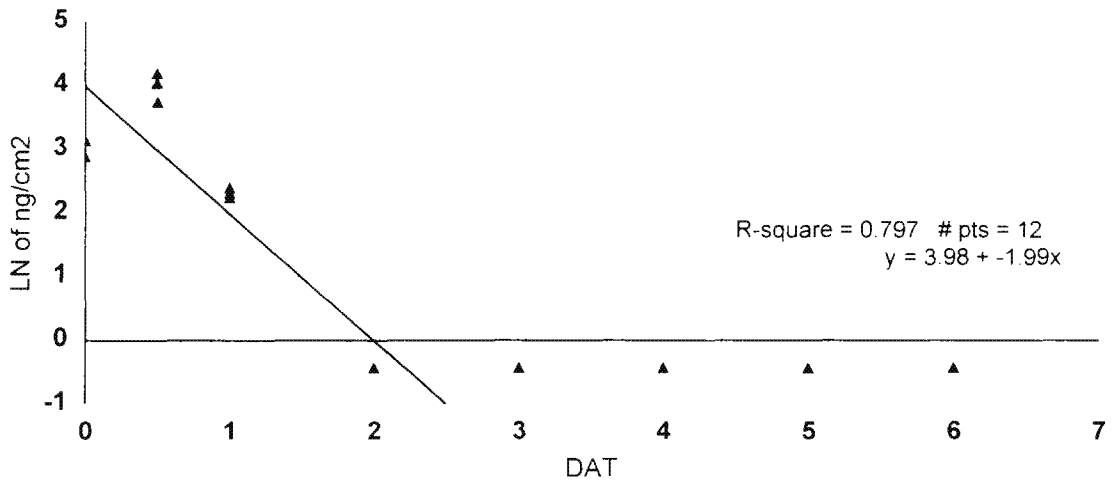
(Percent) 81.4 @ 4ng/cm2 (n=6, SD = 12.1)
74.5 @ 40ng/cm2 (n=6, SD = 9.9)
68.9 for DAT 0 samples (n=6, SD=6.3)
87.1 for DAT 6 samples (n=6, SD=5.9)

Regression Output:	
Constant	3.98
Std Err of Y Est	0.82
R Squared	0.80
No. of Observations	12
Degrees of Freedom	10
X Coefficient(s)	-1.99
Std Err of Coef.	0.32
Half Life (days)	0.35

TTR values were corrected for field recovery of 68.9 percent

Note. DAT 1 samples were collected one hour early due to threat of rain as stated in the protocol deviation.

NC Trial 1 - Dicamba in 2,4-D DMA MIX



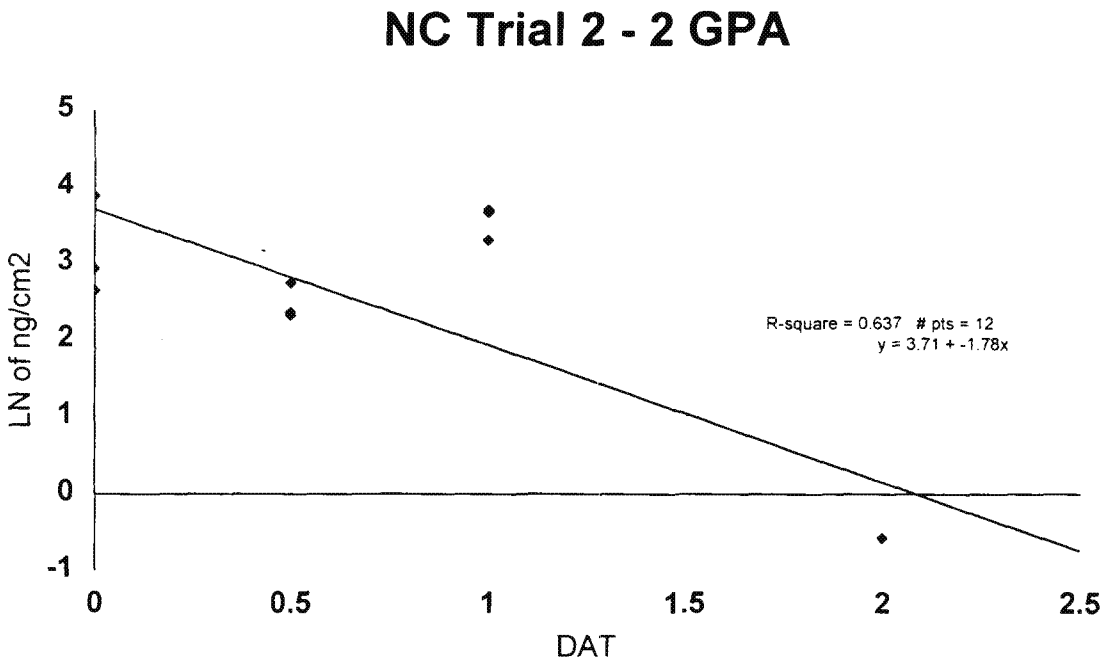
Spreadsheet E3: MRID 446557-03 NC2 Trial 2 GPA Treatment (2,4-D DMA with MCPP-p DMA and Dicamba DMA)

DAT	Dicamba Raw Data (ng/cm2)	Dicamba Adjusted (ng/cm2)	LN	Rainfall (inches)
Pre	<0.879			
0	11	14	2.65	0
0	38	48	3.88	0
0	15	19	2.93	0
0.50	12	16	2.74	0
0.50	8.0	10.2	2.32	0
0.50	8.3	10.6	2.36	0
1	31	40	3.70	0
1	21	27	3.30	0
1	30	39	3.66	0
2	0.44	0.56	-0.57	0.17
2	0.44	0.56	-0.57	0.17
2	0.44	0.56	-0.57	0.17
3 to 14	0.44			

Application Method		Groundboom
Application Rate (lbs ae/A)		0.22
Gallons/Acre		2
LOQ(ng/cm2)		0.879
LOD(ng/cm2)		Not Specified
	Avg TTR	**Percent TTR**
DAT 0.0	27	1.1
DAT 1.0	35	1.4
Regression Output:		
Constant		3.71
Std Err of Y Est		1.09
R Squared		0.64
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)		-1.78
Std Err of Coef.		0.42
Half Life (days)		0.39

Field Recovery (percent)
79.4 @ 4ng/cm2 (n=6, SD = 3.6)
77.2 @ 40ng/cm2 (n=6, SD = 4.9)
80.2 for DAT 0 samples (n=6, SD=4.1)
76.4 for DAT 6 samples (n=6, SD=3.8)
78.3 (n=12, SD = 4.2)

All values were corrected for field recovery of 78 percent



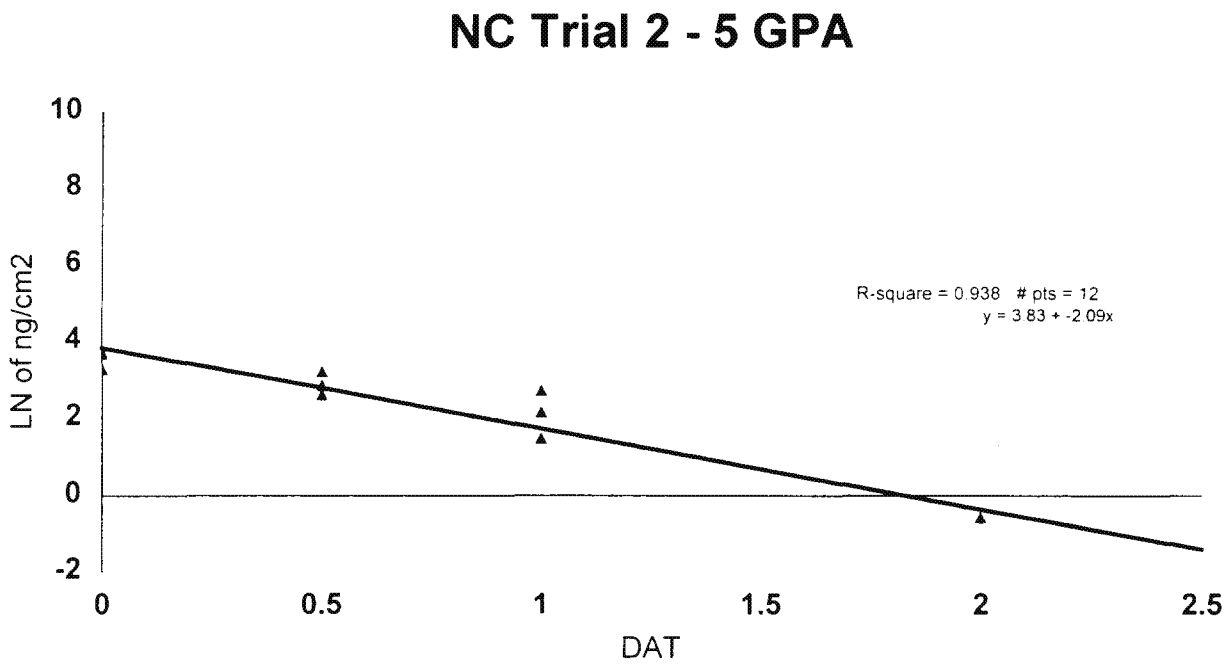
Spreadsheet E4: MRID 446557-03 NC2 Trial 5 GPA Treatment (2,4-D DMA with MCPP-p DMA and Dicamba DMA)

DAT	Dicamba Raw Data (ng/cm2)	Dicamba Adjusted (ng/cm2)	LN	Rainfall (inches)
Pre	<0.879			
0	33	42	3.74	0
0	31	39	3.67	0
0	21	26	3.27	0
0.50	19	25	3.20	0
0.50	13	17	2.84	0
0.50	11	14	2.61	0
1.00	6.8	8.8	2.17	0
1.00	3.5	4.4	1.49	0
1.00	11.8	15	2.72	0
2	0.44	0.56	-0.57	0.17
2	0.44	0.56	-0.57	0.17
2	0.44	0.56	-0.57	0.17

Field Recovery
79.4 @ 4ng/cm2 (n=6, SD = 3.6)
77.2 @ 40ng/cm2 (n=6, SD = 4.9)
80.2 for DAT 0 samples (n=6, SD=4.1)
76.4 for DAT 6 samples (n=6, SD=3.8)
78.3 (n=12, SD = 4.2)

Application Method		**Groundboom**
Application Rate (lbs ae/A)		0.22
Gallons/Acre		5
LOQ(ng/cm2)		0.879
LOD(ng/cm2)		Not Specified
	Avg TTR	**Percent TTR**
DAT 0.0	36	1.5
Regression Output:		
Constant		3.83
Std Err of Y Est		0.44
R Squared		0.94
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)		-2.09
Std Err of Coef.		0.17
Half Life (days)		0.33

All values were corrected for field recovery of 78 percent



Spreadsheet E5: MRID 446557-03 NC2 Trial 20 GPA Treatment (2,4-D DMA with MCPP-p DMA and Dicamba DMA)

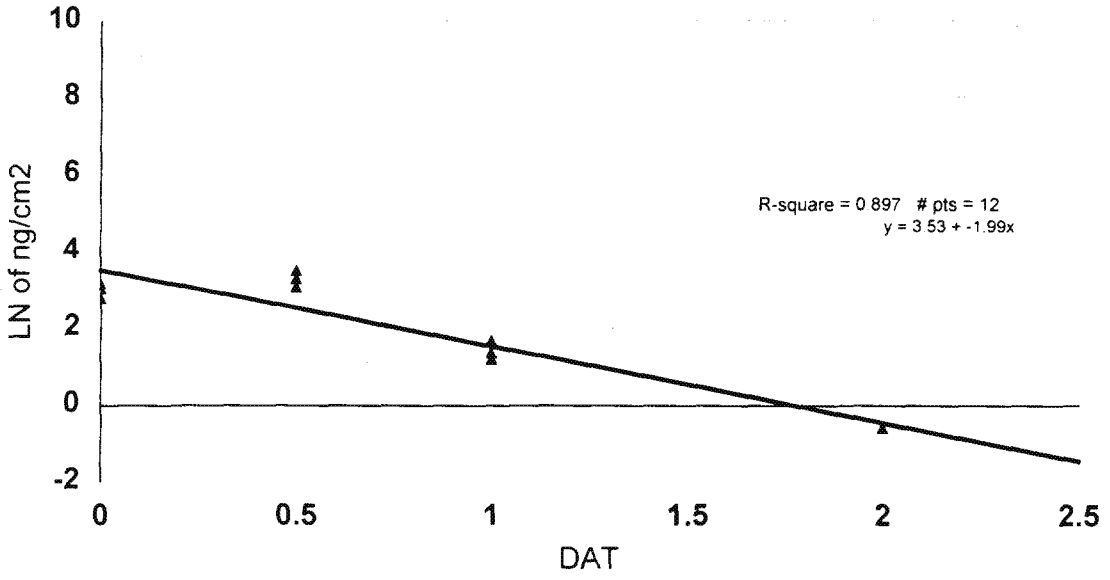
DAT	Dicamba Raw Data (ng/cm2)	Dicamba Adjusted (ng/cm2)	LN	Rainfall (inches)
Pre	<0.879			
0.0	19	24	3.19	0
0.0	13	16	2.80	0
0.0	17	21	3.06	0
0.50	17	22	3.09	0
0.50	26	34	3.52	0
0.50	21	27	3.31	0
1.00	3	3.4	1.21	0
1.00	3	4.0	1.38	0
1.00	4	5.4	1.69	0
2	0.44	0.56	-0.57	0.17
2	0.44	0.56	-0.57	0.17
2	0.44	0.56	-0.57	0.17

Field Recovery
79.4 @ 4ng/cm2 (n=6, SD = 3.6)
77.2 @ 40ng/cm2 (n=6, SD = 4.9)
80.2 for DAT 0 samples (n=6, SD=4.1)
76.4 for DAT 6 samples (n=6, SD=3.8)
78.3 (n=12, SD = 4.2)

Application Method		**Groundboom**
Application Rate (lbs ae/A)		0.22
Gallons/Acre		20
LOQ(ng/cm2)		0.879
LOD(ng/cm2)		Not Specified
	Avg TTR	**Percent TTR**
DAT 0.0	21	0.84
DAT 0.5	28	1.12
Regression Output:		
Constant		3.53
Std Err of Y Est		0.54
R Squared		0.90
No. of Observations		12
Degrees of Freedom		10
X Coefficient(s)		-1.99
Std Err of Coef.		0.21
Half Life (days)		0.35

All values were corrected for field recovery of 78 percent

NC Trial 2 - 20 GPA



Spreadsheet E6: MRID 446557-03 (2,4-D DMA with MCPP-p DMA and Dicamba DMA)

DAT	GPA	Dicamba Raw Data (ng/cm2)	Dicamba Adjusted (ng/cm2)	LN	Rainfall (inches)
Pre		<0.879			
0	2	11	14	2.64	0
0	2	38	48	3.88	0
0	2	15	19	2.95	0
0	5	33	42	3.73	0
0	5	31	39	3.67	0
0	5	21	27	3.28	0
0	20	19	24	3.18	0
0	20	13	16	2.80	0
0	20	17	22	3.07	0
0.50	2	12	15	2.72	0
0.50	2	8.0	10	2.32	0
0.50	2	8.3	11	2.35	0
0.50	5	17	22	3.07	0
0.50	5	26	33	3.50	0
0.50	5	21	27	3.28	0
0.50	20	17	22	3.07	0
0.50	20	26	33	3.50	0
0.50	20	21	27	3.28	0
1	2	31	39	3.67	0
1	2	21	27	3.28	0
1	2	30	38	3.64	0
1	5	6.8	9	2.16	0
1	5	3.5	4	1.49	0
1	5	11.8	15	2.71	0
1	20	3	4	1.34	0
1	20	3	4	1.34	0
1	20	4	5	1.62	0
2	2.00	0.44	0.49	-0.71	0.17
2	2.00	0.44	0.49	-0.71	0.17
2	2.00	0.44	0.49	-0.71	0.17
2	5.00	0.44	0.49	-0.71	0.17
2	5.00	0.44	0.49	-0.71	0.17
2	5.00	0.44	0.49	-0.71	0.17
2	20.00	0.44	0.49	-0.71	0.17
2	20.00	0.44	0.49	-0.71	0.17
2	20.00	0.44	0.49	-0.71	0.17

Application Method	Groundboom
Application Rate (lbs ae/A)	0.22
Gallons/Acre	2, 5 or 20
LOQ(ng/cm2)	0.879
LOD(ng/cm2)	Not Specified

	Avg TTR	Percent TTR
DAT 0.0	28	1.1
DAT 0.5	22	0.9

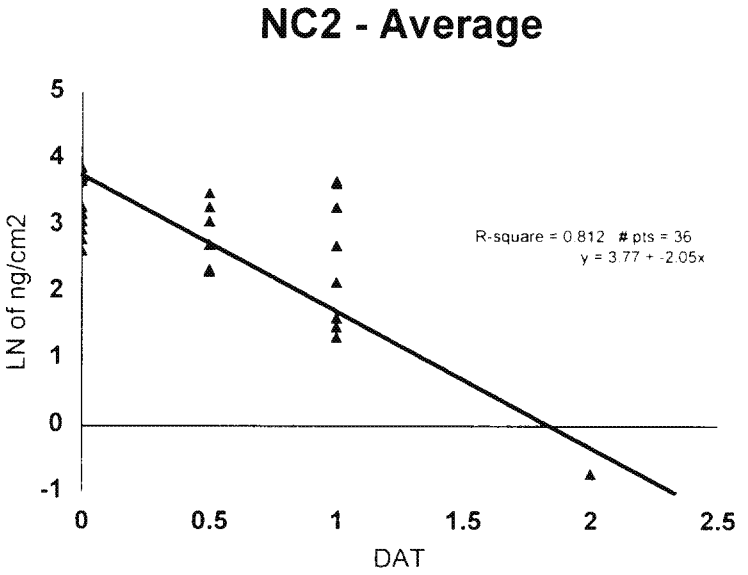
Field Recovery

79.4 @ 4ng/cm2 (n=6, SD = 3.6)
77.2 @ 40ng/cm2 (n=6, SD = 4.9)
80.2 for DAT 0 samples (n=6, SD=4.1)
76.4 for DAT 6 samples (n=6, SD=3.8)
78.3 (n=12, SD = 4.2)

Regression Output:

Constant	3.77
Std Err of Y Est	0.75
R Squared	0.81
No of Observations	36
Degrees of Freedom	34
X Coefficient(s)	-2.05
Std Err of Coef.	0.17
Half Life (days)	0.34

All values were corrected for field recovery of 78 percent



Spreadsheet E7: MRID 450331-01 CA Trial with 2,4-D DMA , MCPP-p and Dicamba)

DAT	Dicamba Raw Data (ng/cm2)	Dicamba Adjusted (ng/cm2)	LN	Rainfall (inches)
Pre	0.088			
0.042	23	31	3.43	0
0.042	25	34	3.53	0
0.042	19	26	3.27	0
0.17	23	31	3.43	0
0.17	23	32	3.45	0
0.17	20	27	3.30	0
0.33	13	18	2.89	0
0.33	14	19	2.94	0
0.33	10	14	2.64	0
0.5	114	156	5.05	0
0.5	165	226	5.42	0
0.5	204	279	5.63	0
1	6	8.0	2.08	0
1	4	6.1	1.81	0
1	5	6.8	1.92	0
2	6	8.0	2.08	0
2	5	7.1	1.96	0
2	3.8	5.2	1.64	0
3	3.7	5.0	1.62	0
3	3.8	5.2	1.64	0
3	3.5	4.8	1.57	0
4	3.3	4.6	1.52	0
4	2.2	3.0	1.08	0
4	2.4	3.2	1.17	0
7	1.7	2.3	0.85	0
7	1.5	2.0	0.71	0
7	1.0	1.4	0.31	0

Values were adjusted for average field recovery of 72.7 at DAT 0
Note - DAT 0.5 samples were taken at night when there was dew.

Application Method	**Groundboom**
Application Rate (lbs ae/A)	0.21
Gallons/Acre	9.9
LOQ(ng/cm2)	0.879
LOD(ng/cm2)	0.088

	Avg TTR	Percent TTR
DAT 0.042	30	1.3
DAT 0.5	221	9.5

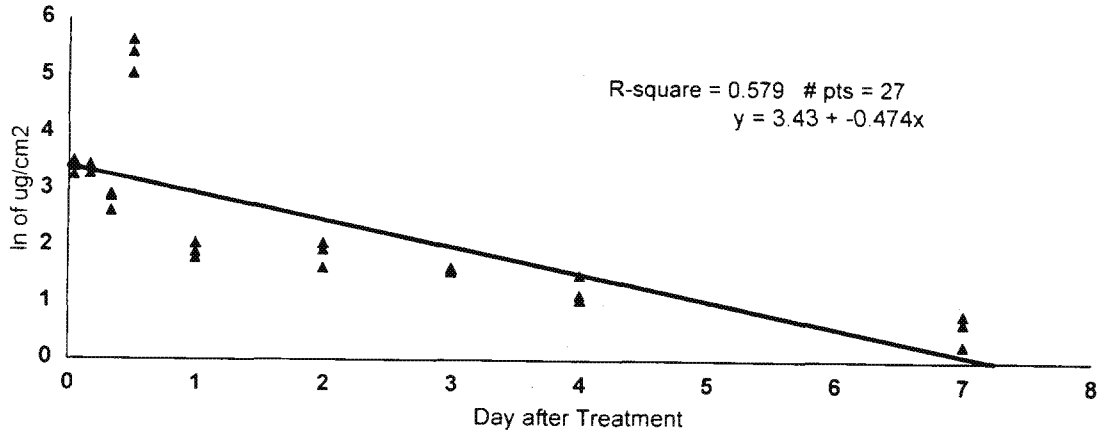
Field Recovery (from MRID 446557-02)
(Percent)
81.4 @ 4ng/cm2 (n=6, SD = 12.1)
74.5 @ 40ng/cm2 (n=6, SD = 9.9)
68.9 for DAT 0 samples (n=6, SD=6.3)
87.1 for DAT 6 samples (n=6, SD=5.9)

Field Recovery (from MRID 446557-03)
79.4 @ 4ng/cm2 (n=6, SD = 3.6)
77.2 @ 40ng/cm2 (n=6, SD = 4.9)
80.2 for DAT 0 samples (n=6, SD=4.1)
76.4 for DAT 6 samples (n=6, SD=3.8)
78.3 (n=12, SD = 4.2)

Average Recovery
80.4 @ 4 ng/cm2 (n=12)
75.9 @ 40 ng/cm2 (n=12)
72.7 @ DAT 0 (n=12)
82.7 @ DAT 6 (n=12)

Regression Output:	**Including DAT 0.5**
Constant	3.43
Std Err of Y Est	0.92
R Squared	0.58
No. of Observations	27
Degrees of Freedom	25
X Coefficient(s)	-0.47
Std Err of Coef.	0.081
Relative Error	17.0
Half Life	1.46

California Trial - 2,4-D DMA Mix



.›preadsheet E8: MRID 450331-01 CA Trial with 2,4-D DMA , MCPP-p and Dicamba)

DAT	Dicamba Raw Data (ng/cm2)	Dicamba Adjusted (ng/cm2)	LN	Rainfall (inches)
Pre	0.088			
0.042	23	31	3.43	0
0.042	25	34	3.53	0
0.042	19	26	3.27	0
0.17	23	31	3.43	0
0.17	23	32	3.45	0
0.17	20	27	3.30	0
0.33	13	18	2.89	0
0.33	14	19	2.94	0
0.33	10	14	2.64	0
1	6	8.0	2.08	0
1	4	6.1	1.81	0
1	5	6.8	1.92	0
2	6	8.0	2.08	0
2	5	7.1	1.96	0
2	3.8	5.2	1.64	0
3	3.7	5.0	1.62	0
3	3.8	5.2	1.64	0
3	3.5	4.8	1.57	0
4	3.3	4.6	1.52	0
4	2.2	3.0	1.08	0
4	2.4	3.2	1.17	0
7	1.7	2.3	0.85	0
7	1.5	2.0	0.71	0
7	1.0	1.4	0.31	0

Values were adjusted for average field recovery of 72.7 at DAT 0

Application Method	**Groundboom**
Application Rate (lbs ae/A)	0.21
Gallons/Acre	9.9
LOQ(ng/cm2)	0.879
LOD(ng/cm2)	0.088

	Avg TTR	Percent TTR
DAT 0.042	30	1.3

Field Recovery (from MRID 446557-02)

(Percent)
81.4 @ 4ng/cm2 (n=6, SD = 12.1)
74.5 @ 40ng/cm2 (n=6, SD = 9.9)
68.9 for DAT 0 samples (n=6, SD=6.3)
87.1 for DAT 6 samples (n=6, SD=5.9)

Field Recovery (from MRID 446557-03)

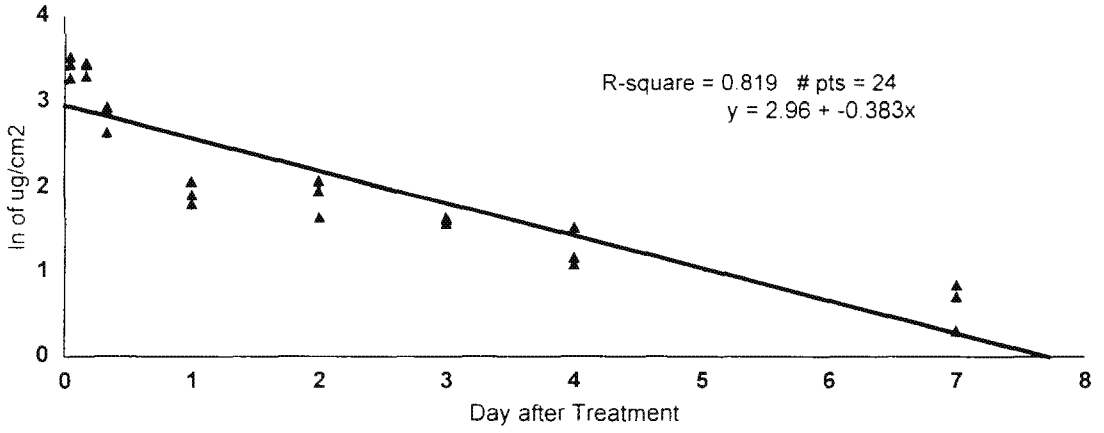
79.4 @ 4ng/cm2 (n=6, SD = 3.6)
77.2 @ 40ng/cm2 (n=6, SD = 4.9)
80.2 for DAT 0 samples (n=6, SD=4.1)
76.4 for DAT 6 samples (n=6, SD=3.8)
78.3 (n=12, SD = 4.2)

Average Recovery

80.4 @ 4 ng/cm2 (n=12)
75.9 @ 40 ng/cm2 (n=12)
72.7 @ DAT 0 (n=12)
82.7 @ DAT 6 (n=12)

Regression Output:	Excluding DAT 0.5
Constant	2.96
Std Err of Y Est	0.42
R Squared	0.82
No. of Observations	24
Degrees of Freedom	22
X Coefficient(s)	-0.38
Std Err of Coef.	0.038
Relative Error	10.0
Half Life	1.81

California Trial - 2,4-D DMA Mix



Spreadsheet E9: MRID 450331-01 WI Trial with 2,4-D DMA, MCPP-p and Dicamba)

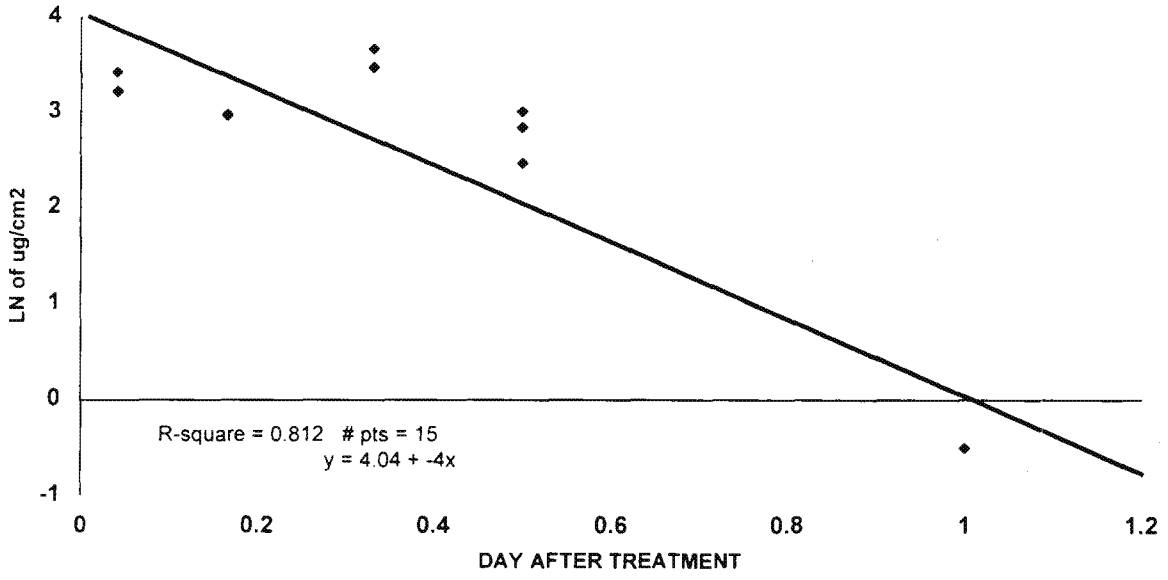
DAT	Dicamba Raw Data (ng/cm2)	Dicamba Adjusted (ng/cm2)	LN	Rainfall (inches)
Pre	0.088			
0.042	22	31	3.42	0
0.042	18	25	3.22	0
0.042	18	25	3.21	0
0.17	14.0	19	2.96	0
0.17	14	20	2.97	0
0.17	14.0	19	2.96	0
0.33	23	32	3.47	0.025
0.33	23	32	3.46	0.025
0.33	28	39	3.65	0.025
0.5	8.5	12	2.45	0.145
0.5	12.3	17	2.83	0.145
0.5	15	20	2.99	0.145
1	0.44	1	-0.50	0.19
1	0.44	1	-0.50	0.19
1	0.44	1	-0.50	0.19

Application Method		**Groundboom**
Application Rate (lbs ae/A)		0.205
Gallons/Acre		9.42
LOQ(ng/cm2)		0.879
LOD(ng/cm2)		0.088
	Avg TTR	**Percent TTR**
DAT 0.0042	27	1.2
DAT 0.33	34	1.5

Regression Output:	
Constant	4.01
Std Err of Y Est	0.71
R Squared	0.81
No. of Observations	15.00
Degrees of Freedom	13.00
X Coefficient(s)	-4.12
Std Err of Coef.	0.55
Half Life (days)	0.17

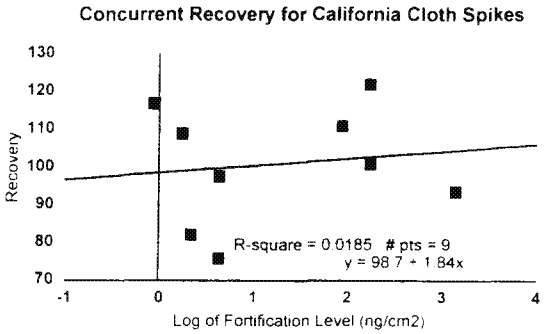
Values were adjusted for average field recovery of 72.7 at DAT 0

2,4-D DMA Dissipation on Turf in Wisconsin (When Applied with MCPP and Dicamba)

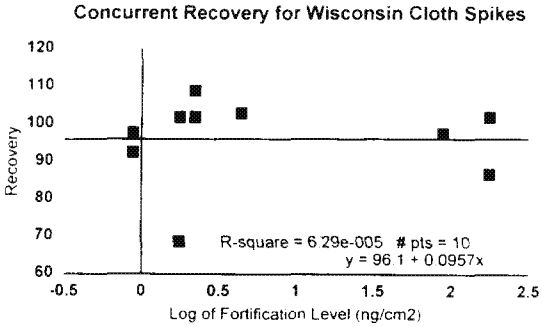


Spreadsheet E10 - Concurrent Laboratory Recovery for MRID 450331-01

Site	ng/cm2	Log	recovery
California	87.9	1.944	111
	176	2.246	101
	2.2	0.342	82.3
	4.39	0.642	75.9
	1.76	0.246	109
	0.879	-0.056	117
	4.39	0.642	97.7
	176	2.246	122
	1410	3.149	93.6
Mean			101
SD			14.6



Wisconsin	87.9	1.944	97.7
	176	2.246	86.9
	2.2	0.342	109
	2.2	0.342	102
	0.879	-0.056	92.6
	1.76	0.246	68.8
	0.879	-0.056	97.8
	1.76	0.246	102
	4.39	0.642	103
	176	2.246	102
Mean			96.2
STD			10.8



Spreadsheet E11: MRID 449590-01 FL Trial without Irrigation

DAT	Dicamba Raw Data (ug/cm2)	Dicamba Adjusted (ug/cm2)	LN	Rainfall (inches)
Pre	0.088			
0.000	0.061	0.070	-2.67	
0.000	0.091	0.104	-2.26	
0.000	0.102	0.117	-2.14	
0.000	0.0502	0.058	-2.85	
0.17	0.076	0.087	-2.44	
0.17	0.032	0.037	-3.31	
0.17	0.048	0.056	-2.89	
0.17	0.0597	0.069	-2.68	
0.33	0.198	0.227	-1.48	
0.33	0.207	0.238	-1.44	
0.33	0.298	0.342	-1.07	
0.33	0.322	0.370	-1.00	
1	0.011	0.013	-4.34	
1	0.008	0.009	-4.72	
1	0.010	0.011	-4.52	
1	0.0101	0.012	-4.46	
1.5	0.034	0.039	-3.25	
1.5	0.045	0.052	-2.97	
1.5	0.030	0.034	-3.37	
1.5	0.047	0.054	-2.92	
2	0.00045	0.0005	-7.57	0.71
2	0.00045	0.0005	-7.57	0.71
2	0.00332	0.0038	-5.57	0.71
2	0.00045	0.0005	-7.57	0.71
2.5	0.00547	0.0063	-5.07	
2.5	0.00314	0.0036	-5.63	
2.5	0.00395	0.0045	-5.40	
2.5	0.00592	0.0068	-4.99	
3	0.00045	0.0005	-7.57	
3	0.00045	0.0005	-7.57	
3	0.00045	0.0005	-7.57	
3	0.00045	0.0005	-7.57	

Application Method	**Groundboom**
Application Rate (lbs ae/A)	1
Gallons/Acre	50
Cloth Size (cm2)	5600
LOQ (ug/sample)	5
LOQ(ug/cm2)	0.00089
LOD(ug/cm2)	N/a

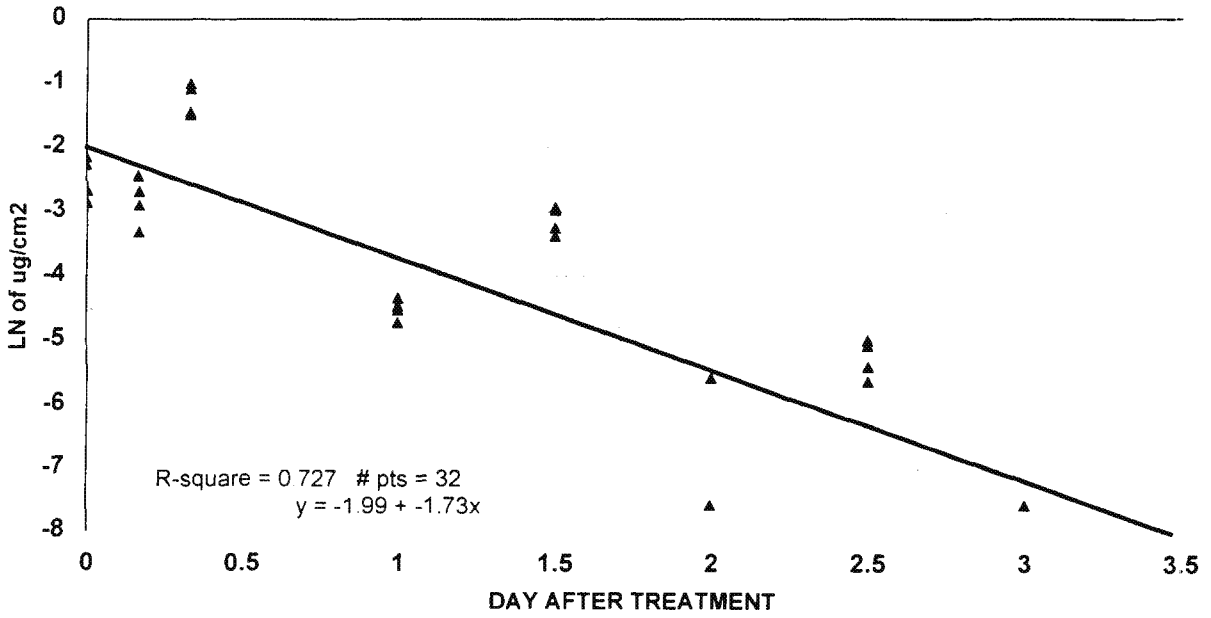
	Avg TTR	Percent TTR
DAT 0.0042	0.087	0.78
DAT 0.33	0.29	2.6

Regression Output:	
Constant	-1.99
Std Err of Y Est	1.15
R Squared	0.73
No. of Observations	32
Degrees of Freedom	30
X Coefficient(s)	-1.73
Std Err of Coef.	0.19
Half Life (days)	0.40

Average Recovery
89.3 @ 0.0045 ug/cm2 (n=3, SD = 1.2)
84.8 @ 0.36 ug/cm2 (n=3, SD = 12)
87.1 overall (n=6, SD = 8.11)

Values were adjusted for overall average field recovery of 87.1 percent

Dicamba Dissipation on Turf in Florida (When Applied as Vanquish by Itself)



Spreadsheet E12: MRID 449590-01 CA Trial without Irrigation

DAT	Dicamba Raw Data (ug/cm2)	Dicamba Adjusted (ug/cm2)	LN	Rainfall (inches)
Pre	0.088			
0.000	0.123	0.155	-1.87	
0.000	0.106	0.133	-2.01	
0.000	0.099	0.125	-2.08	
0.000	0.101	0.127	-2.06	
0.17	0.088	0.111	-2.20	
0.17	0.092	0.115	-2.16	
0.17	0.083	0.105	-2.25	
0.17	0.0861	0.108	-2.22	
0.33	0.065	0.081	-2.51	
0.33	0.067	0.085	-2.47	
0.33	0.066	0.084	-2.48	
0.33	0.061	0.077	-2.57	
1	0.083	0.104	-2.27	
1	0.079	0.099	-2.31	
1	0.059	0.074	-2.60	
1	0.0655	0.082	-2.50	
1.5	0.063	0.080	-2.53	
1.5	0.064	0.080	-2.52	
1.5	0.061	0.076	-2.57	
1.5	0.0597	0.075	-2.59	
2	0.0466	0.059	-2.84	
2	0.0571	0.072	-2.63	
2	0.0402	0.051	-2.98	
2	0.0409	0.051	-2.97	
2.5	0.0328	0.041	-3.19	
2.5	0.037	0.047	-3.07	
2.5	0.0303	0.038	-3.27	
2.5	0.0301	0.038	-3.27	
3	0.0294	0.037	-3.30	
3	0.0321	0.040	-3.21	
3	0.0255	0.032	-3.44	
3	0.0163	0.021	-3.89	
5	0.00314	0.004	-5.53	
5	0.00413	0.005	-5.26	
5	0.00377	0.005	-5.35	
5	0.00251	0.003	-5.76	
7	0.00162	0.002	-6.20	
7	0.00162	0.002	-6.20	
7	0.00117	0.001	-6.52	
7	0.00162	0.002	-6.20	

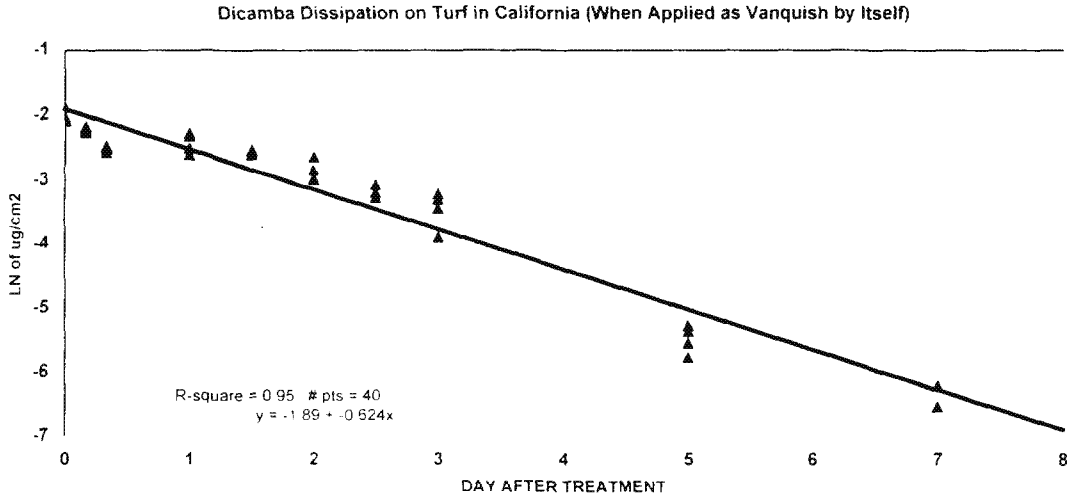
Application Method	**Groundboom**
Application Rate (lbs ae/A)	1
Gallons/Acre	50
Cloth Size (cm2)	5600
LOQ (ug/sample)	5
LOQ(ug/cm2)	0.00089
LOD(ug/cm2)	N/a

	Avg TTR	Percent TTR
DAT 0.0	0.13	1.2

Regression Output:	
Constant	-1.66
Std Err of Y Est	0.32
R Squared	0.95
No. of Observations	40
Degrees of Freedom	38
X Coefficient(s)	-0.62
Std Err of Coef.	0.023
Half Life (days)	1.11

Average Recovery
80.7 @ 0.0045 ug/cm2 (n=3, SD = 5.0)
78.4 @ 0.36 ug/cm2 (n=3, SD = 2.6)
79.5 overall (n=6, SD = 3.8)

Values were adjusted for overall average field recovery of 79.5 percent



Spreadsheet E13: MRID 449590-01 PA Trial without Irrigation

DAT	Dicamba Raw Data (ug/cm2)	Dicamba Adjusted (ug/cm2)	LN	Rainfall (inches)
Pre	0.00045			
0.000	0.010	0.012	-4.44	
0.000	0.089	0.103	-2.28	
0.000	0.099	0.114	-2.17	
0.000	0.0996	0.115	-2.16	
0.17	0.092	0.106	-2.25	
0.17	0.126	0.145	-1.93	
0.17	0.104	0.120	-2.12	
0.17	0.127	0.147	-1.92	
0.33	0.072	0.083	-2.49	
0.33	0.079	0.091	-2.40	
0.33	0.052	0.060	-2.82	
0.33	0.0804	0.093	-2.38	
1	0.074	0.086	-2.46	
1	0.061	0.070	-2.66	
1	0.063	0.073	-2.62	
1	0.0553	0.064	-2.75	
1.5	0.066	0.076	-2.57	
1.5	0.054	0.063	-2.77	
1.5	0.054	0.063	-2.77	
1.5	0.0642	0.074	-2.60	
2	0.07	0.081	-2.52	
2	0.0484	0.056	-2.88	
2	0.0633	0.073	-2.62	
2	0.0466	0.054	-2.92	
2.5	0.0309	0.036	-3.33	
2.5	0.0382	0.044	-3.12	
2.5	0.0436	0.050	-2.99	
2.5	0.0547	0.063	-2.76	
3	0.044	0.051	-2.98	0.06
3	0.0364	0.042	-3.17	0.06
3	0.0282	0.033	-3.42	0.06
3	0.0391	0.045	-3.10	0.06
5	0.0171	0.020	-3.92	
5	0.0103	0.012	-4.43	
5	0.00915	0.011	-4.55	
5	0.00682	0.008	-4.84	
7	0.00278	0.003	-5.74	
7	0.00341	0.004	-5.54	
7	0.0061	0.007	-4.96	
7	0.00368	0.004	-5.46	

Application Method	**Groundboom**
Application Rate (lbs ae/A)	1
Gallons/Acre	50
Cloth Size (cm2)	5600
LOQ (ug/sample)	5
LOQ(ug/cm2)	0.00089
LOD(ug/cm2)	N/a

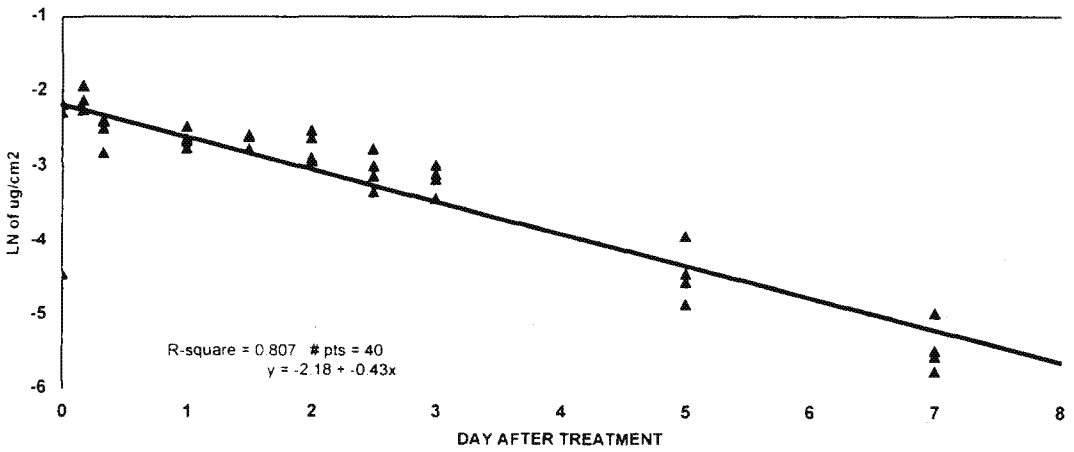
	Avg TTR	Percent TTR
DAT 0.0	0.086	0.77
DAT 0.17	0.13	1.2

Regression Output:	
Constant	-2.18
Std Err of Y Est	0.46
R Squared	0.81
No. of Observations	40
Degrees of Freedom	38
X Coefficient(s)	-0.43
Std Err of Coef.	0.034
Half Life (days)	1.61

Average Recovery
86.7 @ 0.0045 ug/cm2 (n=3, SD = 4.2)
86.5 @ 0.36 ug/cm2 (n=3, SD = 0.58)
86.6 overall (n=6, SD = 2.7)

Values were adjusted for overall average field recovery of 86.6 percent

Dicamba Dissipation on Turf in PA (When Applied as Vanquish by Itself)



Spreadsheet E14: MRID 449590-01 PA Trial with Irrigation

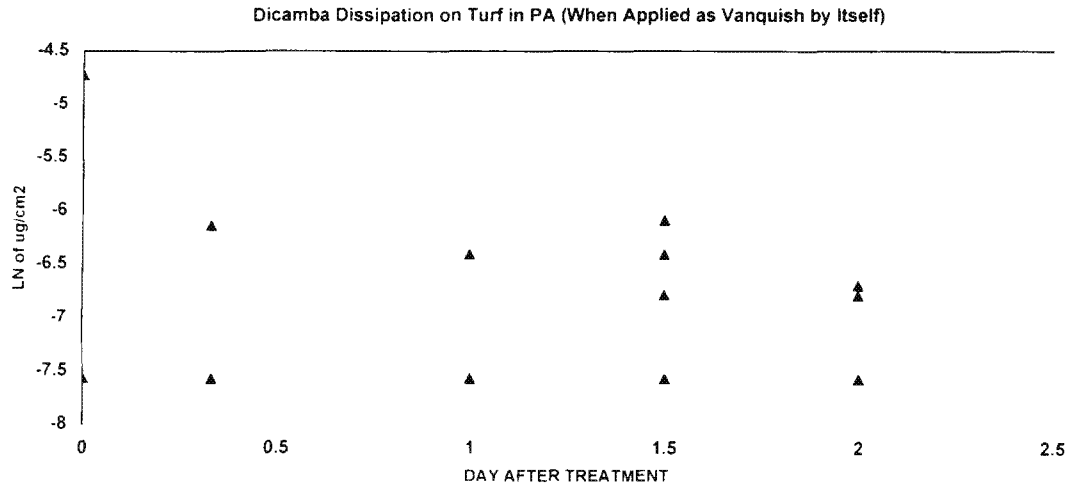
DAT	Dicamba Raw Data (ug/cm2)	Dicamba Adjusted (ug/cm2)	LN	Rainfall or Irrigation (inches)
Pre	0.088			
0.000	0.00045	0.00052	-7.56	0.28
0.000	0.00045	0.00052	-7.56	0.28
0.000	0.008	0.00890	-4.72	0.28
0.000	0.00045	0.00052	-7.56	0.28
0.33	0.00045	0.00052	-7.56	
0.33	0.00188	0.00217	-6.13	
0.33	0.00045	0.00052	-7.56	
0.33	0.00045	0.00052	-7.56	
1	0.00045	0.00052	-7.56	
1	0.00045	0.00052	-7.56	
1	0.00045	0.00052	-7.56	
1	0.00144	0.00166	-6.40	
1.5	0.00144	0.00166	-6.40	
1.5	0.00045	0.00052	-7.56	
1.5	0.00099	0.00114	-6.78	
1.5	0.00197	0.00227	-6.09	
2	0.00108	0.00125	-6.69	
2	0.00099	0.00114	-6.78	
2	0.00108	0.00125	-6.69	
2	0.00045	0.00052	-7.56	

Application Method	**Groundboom**
Application Rate (lbs ae/A)	1
Gallons/Acre	50
Cloth Size (cm2)	5600
LOQ (ug/sample)	5
LOQ(ug/cm2)	0.00089
LOD(ug/cm2)	N/a

	Avg TTR	Percent TTR
DAT 0.0	0.00262	0.02331

Average Recovery
86.7 @ 0.0045 ug/cm2 (n=3, SD = 4.2)
86.5 @ 0.36 ug/cm2 (n=3, SD = 0.58)
86.6 overall (n=6, SD = 2.7)

Values were adjusted for overall average field recovery of 86.6 percent



Appendix F - Residential Turf Post Application Risk Assessment for Dicamba

Spreadsheet F3: Short Term Risks

Turf and Soil Residue Levels Based Upon California Data from MRID 450331-01

DAT	TTR for Dermal (ug/cm2)	TTR for HTM Ingestion (ug/cm2)	TTR for OTM Ingestion (ug/cm2)	[Soil] For Ingestion (ppm)
0	0.143	0.561	2.2	7.5
1	0.10	0.38	1.53	5.14
2	0.07	0.26	1.05	3.52
3	0.05	0.18	0.72	2.40
4	0.03	0.12	0.49	1.64
5	0.021	0.08	0.34	1.12
6	0.015	0.06	0.23	0.77
AVG	0.060	0.24	0.94	3.16
GM	0.046	0.18	0.72	2.40

Toddler Short Term MOEs

	Dermal Exposure		Hand to Mouth (HTM) Exposure		Object to Mouth (OTM) Exposure		Soil Ingestion Exposure		Combined Exposure	
	Dose	MOE	Dose	MOE	Dose	MOE	Dose	MOE	Dose	MOE
AVG	0.0062	7207	0.0063	7157	0.0016	28629	2.1E-005	2136508	0.014	3186

Adult Short Term MOEs

DAT	Yardwork		Golfing	
	Dose	MOE	Dose	MOE
AVG	0.0037	12061	0.0003	174886

Appendix F - Residential Turf Post Application Risk Assessment for Dicamba

Spreadsheet F1: Input Values	Acute	Short Term
Label Application Rate (lb ae/acre):	1.00	1.00
Study Application Rate (lb ae/acre):	1.00	0.21
Limit of Quantification (ug/cm2):	0.00088	0.00088
Transferable Residue (% of Rate) For Hand-to-Mouth Ingestion Exposures	5	5
Transferable Residue (% of Rate) For Object-to-Mouth Ingestion Exposures	20	20
Predicted Time (0) TTR For Hand-to-Mouth Ingestion (ug/cm2) based upon label rate:	0.56	0.56
Predicted Time (0) TTR For Object-to-Mouth Ingestion (ug/cm2) based upon label rate:	2.2	2.2
Predicted Time (0) Total Deposition For Soil Ingestion (ug/cm2) based upon label rate:	11.2	11.2
Maximum Transferable Residue (% of Study Rate)	2.60	1.3
TTR Data Source:	449590-01	450331-01
Slope of Semilog Regression for Day 0 to Day 7		-0.38
Maximum TTR	0.29	
Initial TTR for DAT 0		0.030
Adult Dermal Exposure Duration On Lawns (hr/day):	2	
Toddler Dermal Exposure Duration On Lawns (hr/day):	2	
Toddler Hand-to-Mouth Duration On Lawns (hr/day):	2	
Adult Dermal Exposure Duration While Golfing (hr/day):	4	
Short-term Adult Dermal TC On Lawns (cm2/hr):	14500	
Short-term Adult Dermal TC While Golfing (cm2/hr):	500	
Short-term Toddler Dermal TC On Lawns (cm2/hr):	5200	
Toddler Hand Surface Area (cm2/both hands):	20	
Toddler Short-Term Frequency of Hand-to-Mouth Events (events/hour):	20	
Object-to-Mouth Surface Area Contacted (cm2 mouthed):	25	
Soil Ingestion (mg soil ingested/day):	100	
Soil Density (cm3/gram):	0.67	
Saliva Extraction Factor (50 percent/100):	0.5	
Uncertainty Factor:	1000	
Oral NOAEL (mg/kg/day) for Acute Exposures :	300	
Oral NOAEL (mg/kg/day) for Short Term Exposures:	45	
Adult Body Weight (kg)	70	
Toddler Body Weight (kg):	15	
Dicamba Dermal Absorption Factor (DA)	0.15	

Appendix F - Residential Turf Post Application Risk Assessment for Dicamba

Spreadsheet F2: Acute Risks

Turf and Soil Residue Levels

DAT	TTR for Dermal	TTR for HTM Ingestion	TTR for OTM Ingestion	[Soil] For Ingestion
	(ug/cm2)	(ug/cm2)	(ug/cm2)	(ppm)
0	0.290	0.56	2.2	7.5

Adult Acute MOEs

DAT	Yardwork		Golfing	
	Dose	MOE	Dose	MOE
0	0.0180	16647	0.00124	241379

Toddler Acute MOEs

DAT	Dermal Exposure		Hand to Mouth (HTM) Exposure		Object to Mouth (OTM) Exposure		Soil Ingestion Exposure		Combined Exposure	
	Dose	MOE	Dose	MOE	Dose	MOE	Dose	MOE	Dose	MOE
0	0.0302	9947	0.0150	20053	0.0037	80214	5.0E-005	5986112	0.049	6134

Note: Doses are in mg/kg/day

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Chemical: Dicamba

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