Data Evaluation Record on the Acute Toxicity of Dicamba DGA + Glyphosate Ethanolamine Salt to Terrestrial Vascular Plants: Vegetative Vigor

PMRA Submission Number {.....} **EPA MRID Number 49953901**

Data Requirement:
PMRA Data Code: 9.8.4 (TGAI) or 9.8.6 (EP)
EPA DP Barcode:
OECD Data Point: IIA 8.12 (TGAI) and IIIA 10.8.1.1 (EP)
EPA Guideline: 850.4150

Test material: **MON 76832 Formulation (Dicamba DGA + Glyphosate Ethanolamine Salt)**
A.I. Dicamba acid **Purity:** 9.9%
A.I. Glyphosate acid **Purity:** 19.2%
Common name:
Chemical name: IUPAC:
CAS name:
CAS No.:
Synonyms:

Primary Reviewer: Michael Wagman **Date:** {.....}
{ ERB6/EFED/OCSPP/EPA }
MICHAEL WAGMAN Digitally signed by MICHAEL WAGMAN Date: 2018.10.31 16:48:07 -04'00'

Secondary Reviewer(s): Brian Kiernan **Date:** {.....}
{ ERB6/EFED/OCSPP/EPA }
Digitally signed by Mark Corbin Date: 2018.10.31 17:11:54 -04'00'

This Data Evaluation Record may have been altered by the Environmental Fate and Effects Division subsequent to signing by CDM/CSS-Dynamac JV personnel.

Reference/Submission No.: {.....}

Company Code {.....} [For PMRA]
Active Code {.....} [For PMRA]
Use Site Category: {.....} [For PMRA]
EPA PC Code: **128931 (Dicamba DGA)**
103605 (Glyphosate ethanolamine salt)
Date Evaluation Completed: {31-10-2018}

CITATION: Orvos, A.R., J.R. Porch, and A. Siddiqui. 2016. MON 76832: A Toxicity Test to Determine the Effects on Vegetative Vigor of Tomatoes and Soybeans. Unpublished study performed by Wildlife International, Easton, Maryland, USA, and sponsored by Monsanto Company, St. Louis, Missouri, USA. Wildlife International Project No. 139P-127; Monsanto Study No. MSL0027819. Study completed June 22, 2016.

EXECUTIVE SUMMARY:

The effect of **MON 76832 (Dicamba DGA + Glyphosate ethanolamine salt)** on the vegetative vigor of dicot (soybean, *Glycine max;* and tomato, *Lycopersicon esculentum*) crops was studied. No monocots were studied. Nominal concentrations of MON76832 formulation were 0.0042, 0.0083, 0.017, 0.033, 0.067, and 0.133 lb product/A. Nominal concentrations of Dicamba acid were 0 (negative control), 0.0004, 0.0008, 0.0016, 0.0032, 0.0064, and 0.0128 lb ae/A Dicamba acid, and nominal concentrations of Glyphosate acid were 0 (negative control), 0.00080, 0.0016, 0.0032, 0.0064, 0.0128, and 0.0256 lb ae/A Glyphosate acid. Concentrations of both Dicamba and Glyphosate were analytically confirmed at all treatment levels, and were measured concentrations of <0.00018 (LOQ, negative control), 0.00043, 0.00086, 0.0017, 0.0034, 0.0069, and 0.014 lb ae/A Dicamba acid, and <0.00018 (LOQ, negative control), 0.00084, 0.0017, 0.0033, 0.0065, 0.014, and 0.027 lb ae/A Glyphosate acid.

The growth medium used in the vegetative vigor test was a kaolinite clay, sand and peat mix (loamy sand, pH 6.9, organic carbon 1.1%). On day 21 the surviving plants per pot were recorded and cut at soil level for measuring the

plant height and dry weight.

Survival in the negative control was 100%. There were no significant inhibitions in survival in the two dicots studied compared to the negative control ($p>0.05$).

There were significant inhibitions in soybean and tomato seedling height compared to the negative control. Significant inhibitions in soybean height were 25, 31, 42 and 54% at 0.0017, 0.0034, 0.0069, and 0.014 lb ae/A Dicamba acid, respectively (0.0033, 0.0065, 0.014, and 0.027 lb ae/A Glyphosate acid) (Jonckheere-Terpstra Step-Down test, $p<0.05$). Significant inhibitions in tomato height were 13 and 50% at the 0.0017, 0.0034, 0.0069, and 0.014 lb ae/A Dicamba acid treatment levels, respectively (0.014 and 0.027 lb ae/A Glyphosate acid) (Dunnett's test, $p<0.05$).

There were also significant inhibitions in soybean and tomato dry weight compared to the negative control. The reviewer found significant inhibitions in soybean dry weight of 13, 26, 30, 41 and 51% at 0.00086, 0.0017, 0.0034, 0.0069, and 0.014 lb ae/A Dicamba acid (measured), respectively (0.0017, 0.0033, 0.0065, 0.014, and 0.027 lb ae/A Glyphosate acid), and in tomato dry weight of 9, 12, 24, 35, 48 and 60% at 0.00043, 0.00086, 0.0017, 0.0034, 0.0069, and 0.014 lb ae/A Dicamba acid (measured), respectively (0.00084, 0.0017, 0.0033, 0.0065, 0.014, and 0.027 lb ae/A Glyphosate acid) compared to the negative control (Williams test, $p<0.05$).

Based on the reviewer's vegetative vigor results, the most sensitive dicot species was tomato, based on dry weight, with NOAEC, IC_{05} and IC_{25} values of <0.00043, 0.000251 and 0.00191 lb ae/A Dicamba acid (measured), respectively, and <0.00084, 0.000488 and 0.00373 lb ae/A Glyphosate acid (measured), respectively.

Based on total formulation concentrations (based on nominal application rates), the most sensitive dicot species was tomato, based on dry weight, with NOAEC and IC_{25} values of <0.0042 and 0.018 lb total formulation MON 76832/A.

The reviewer used measured test concentrations in all analyses.

The occurrence of phytotoxic visual effects (referred in the study report as "plant condition" was determined from observation. The severity of effects ranged from none to moderate phytotoxic effects in soybean and tomato (≤64). Phytotoxic effects included chlorosis, necrosis, leaf curl, and stem curl; phytotoxic effects exhibited a dose-response relationship.

Maximum Labeled Rate: Not reported

Results Synopsis

Dicamba Acid (based on measured concentrations)

Monocot

Most sensitive monocot: Monocots were not studied

EC_{50}/IC_{50}: N/A	95% C.I.: N/A
EC_{25}/IC_{25}: N/A	95% C.I.: N/A
EC_{05}/IC_{05}: N/A	95% C.I.: N/A
NOAEC: N/A	
Slope: N/A	95% C.I.: N/A

Dicot

Most sensitive dicot: Tomato, based on dry weight

EC_{50}/IC_{50}: 0.00782 lb ae/A 95% C.I.: 0.00648-0.00945 lb ae/A
EC_{25}/IC_{25}: 0.00191 lb ae/A 95% C.I.: 0.00153-0.00234 lb ae/A
EC_{05}/IC_{05}: 0.000251 lb ae/A 95% C.I.: 0.000085-0.000442 lb ae/A
NOAEC: <0.00043 lb ae/A
Slope: N/A 95% C.I.: N/A

Glyphosate Acid (based on measured concentrations)

Monocot

Most sensitive monocot: Monocots were not studied

EC_{50}/IC_{50}: N/A 95% C.I.: N/A
EC_{25}/IC_{25}: N/A 95% C.I.: N/A
EC_{05}/IC_{05}: N/A 95% C.I.: N/A
NOAEC: N/A
Slope: N/A 95% C.I.: N/A

Dicot

Most sensitive dicot: Tomato, based on dry weight

EC_{50}/IC_{50}: 0.0153 lb ae/A 95% C.I.: 0.0127- 0.0185 lb ae/A
EC_{25}/IC_{25}: 0.00373 lb ae/A 95% C.I.: 0.00299-0.00458 lb ae/A
EC_{05}/IC_{05}: 0.000488 lb ae/A 95% C.I.: 0.000164-0.000861 lb ae/A
NOAEC: <0.00084 lb ae/A
Slope: N/A 95% C.I.: N/A

Mon 76832 Formulation (based on nominal concentration)

Monocot

Most sensitive monocot: Monocots were not studied

EC_{50}/IC_{50}: N/A 95% C.I.: N/A
EC_{50}/IC_{25}: N/A 95% C.I.: N/A
EC_{50}/IC_{05}: N/A 95% C.I.: N/A
NOAEC: N/A
Slope: N/A 95% C.I.: N/A

Dicot

Most sensitive dicot: Tomato, based on dry weight

EC_{50}/IC_{50}: 0.0756 lb product/A 95% C.I.: 0.0598—0.0956 lb product/A
EC_{25}/IC_{25}: 0.0185 lb product/A 95% C.I.: 0.0121—0.0282 lb product/A
NOAEC: <0.00417 lb ae/A

Table 1 (Tier II studies). Summary of most sensitive parameters by species (lb ae/A Dicamba acid).

Species	Endpoint	NOAEC[1]	EC_{25}/IC_{25}	EC_{50}/IC_{50}
Soybean	Dry weight	0.00043	0.00214	0.0122
Tomato	Dry weight	0.000251[2]	0.00191	0.00782

[1] IC_{05} used when NOAEC undefined/not suitable for risk assessment
[2] IC_{05} presented in place of NOAEC

Table 1a (Tier II studies). Summary of most sensitive parameters by species (lb ae/A Glyphosate acid).

Species	Endpoint	NOAEC[1]	EC_{25}/IC_{25}	EC_{50}/IC_{50}
Soybean	Dry weight	0.00084	0.00419	0.0238
Tomato	Dry weight	0.000488[2]	0.00373	0.0153

[1] IC_{05} used when NOAEC undefined/not suitable for risk assessment
[2] IC_{05} presented in place of NOAEC

This study is scientifically sound and is classified as **acceptable** in combination with the eight additional species included in MRID 50103801.

I. MATERIALS AND METHODS

GUIDELINE FOLLOWED: This study was conducted in compliance with OCSPP Guideline 850.4150: Vegetative Vigor (January 2012). The reviewer evaluated the study methods according to EPA Ecological Effects Test Guidelines, OCSPP Guideline 850.4150: Vegetative Vigor. There were some deficiency and deviations noted by the reviewer.

1. Two dicots, and no monocots were included in this study. EPA guidance recommends testing 6 dicots and 4 monocots. A subsequent study, completed November 10, 2016, included 6 additional dicots and 4 monocots.

2. CEC and percent moisture were not reported.

3. The physico-chemical properties of the test material were not reported.

The deficiency and deviations did not have an impact on the acceptability of this study.

COMPLIANCE: Signed and dated GLP, Quality Assurance and Data Confidentiality statements were provided. This study was conducted in compliance with USEPA Good Laboratory Practice Standards (40 CFR, Part 160, 1989), with the following exceptions: periodic analyses of well water for potential contaminants were not performed according to GLP standards, but were performed using a certified laboratory and standard EPA methods.

A. MATERIAL

1. Test Material: **MON 76832 (Dicamba DGA + Glyphosate ethanolamine salt)**

Description: Green Liquid

Lot No./Batch No.: GLP-1304-22586-F; expiration date February 10, 2017

Purity: Dicamba Acid: 9.9%
Glyphosate Acid: 19.2%

Stability of compound under test conditions: Recoveries of Dicamba acid from the spray solutions were 106-107%

(n=10). Dicamba spike recoveries were 101-109% was 96.0-106.5% (n=3). Recoveries of Glyphosate acid from the spray solutions were 100-106% (n=10). Glyphosate spike recoveries were 107-119% (n=3). Stability was not determined.

(OECD recommends chemical stability in water and light)

Storage conditions of test chemicals: The test material was stored under ambient conditions in darkness.

Table 2. Physical/chemical properties of Dicamba DGA + Glyphosate ethanolamine salt.

Parameter	Values	Comments
Water solubility at 20°C	Not reported	
Vapor pressure	Not reported	
UV absorption	Not reported	
pKa	Not reported	
Kow	Not reported	

2. Test organism:

Monocotyledonous species: No monocots were studied. *EPA recommends four monocots in two families, including corn.*
Dicotyledonous species: Soybean (*Glycine max*, Fabaceae; Viking 2265) and tomato (*Lycopersicon esculentum*, Solanaceae; Rutgers). *EPA recommends six dicots in four families, including soybean and a root crop.*

OECD recommends a minimum of three species selected for testing, at least one from each of the following categories: Category 1: ryegrass, rice, oat, wheat, and sorghum; Category 2: mustard, rape, radish, turnip, and Chinese cabbage; Category 3: vetch, mung bean, red clover, fenugreek, lettuce, and cress.

Seed source: Soybean obtained from Johnny's Selected Seeds; and tomato obtained from Meyer Seed Company.
Prior seed treatment/sterilization: The seeds were not treated with any type of fungicides, insecticides, or any pesticides.
Historical % germination of seed: Soybean, 88%; and tomato, 90%.
Seed storage, if any: Not reported.

B. STUDY DESIGN:

1. Experimental Conditions

a. Limit test: None.

b. Range-finding study: None.

c. Definitive Study

Table 3: Experimental Parameters - Vegetative Vigor.

Parameters	Vegetative Vigor	
	Details	**Remarks**
		Criteria
Duration of the test	21 days	
		Recommended test duration is 14-21 days. *OECD recommends that the test be terminated no sooner than 14 days after 50 percent of the control seedlings have emerged*
Number of seeds/plants/species/ replicate	5 seedlings per replicate, 1 seedling per pot.	
		Five plants per replicate are recommended.
Number of plants retained after thinning	Thinned to one plant per pot (if necessary).	
Number of replicates Control: Adjuvant control: Treated:	 8 N/A 8	
		Four replicates per dose should be used. *OECD recommends a minimum of four replicates per treatment*

Parameters	Vegetative Vigor	
	Details	**Remarks** ***Criteria***
Test concentrations (lb ai/A) Nominal: Measured:	Dicamba acid 0 (negative control), 0.00040, 0.00080, 0.0016, 0.0032, 0.0064, and 0.0128 lb ae/A Dicamba acid. Glyphosate acid 0 (negative control), 0.00080, 0.0016, 0.0032, 0.0064, 0.0128, and 0.0256 lb ae/A Glyphosate acid. Dicamba acid <0.00018 (LOQ, negative control), 0.00043, 0.00086, 0.0017, 0.0034, 0.0069, and 0.014 lb ae/A Dicamba acid Glyphosate acid <0.00018 (LOQ, negative control), 0.00084, 0.0017, 0.0033, 0.0065, 0.014, and 0.027 lb ae/A Glyphosate acid.	Nominal concentrations for MON 76832 formulation: 0.0042, 0.0083, 0.017, 0.033, 0.067, and 0.133 lb formulation/A. *Five test concentrations should be used with a dose range of 2X or 3X progression* *OECD recommends three concentrations, preferably with application rates equivalent to 0.0 (control), 1.0, 10.0 and 100 mg substance per kg of oven-dried soil.*
Method and interval of analytical verification LOQ: LOD:	Spray solutions were analyzed by HPLC using an Agilent Model 1200 with an Agilent series 1200 VWD. 0.0018 lb ae/A Dicamba and Glyphosate acid. Not reported.	Both Dicamba acid and Glyphosate acid were analytically confirmed.
Adjuvant (type, percentage, if used)	N/A	
Test container (pot) Size/Volume Material: (glass/polystyrene)	Pots with diameter of 11 cm x 10 cm depth. Plastic	*Non-porous containers should be used.* *OECD recommends that non-porous plastic or glazed pot be used.*
Growth facility	Greenhouse	

Parameters	Vegetative Vigor	
	Details	**Remarks** ***Criteria***
Method/depth of seeding	Soybean at 20 mm depth; tomato at 10 mm depth.	
<u>Test material application</u> Application time including the plant growth stage Number of applications Application interval Method of application	 After planting 1 N/A- single application Application of the test substance was made using an overhead track sprayer (De Vries) equipped with a TeeJet 8002E nozzle operated at 20 psi, approximately 41 cm above the soil surface (200 L/ha nominal spray volume)	
<u>Details of soil used</u> Geographic location Depth of soil collection Soil texture % sand % silt % clay pH: % organic carbon CEC Moisture at 1/3 atm (%)	 N/A N/A Loamy sand 88 6 6 6.9 1.1% Not reported Not reported	Mixture of kaolinite clay, sand and peat, with limestone added to buffer the pH. Organic Matter: 1.9% *Soil mixes containing sandy loam, loam, or clay loam soil with no greater than 2% organic matter are preferable. Glass beads, rock wool, and 100% acid washed sand are not preferred.* *OECD prefers the soil to be sieved (0.5 cm) to remove coarse fragments. Carbon content should not exceed 1.5% (3% organic matter). Fine particles (under 20um) makeup should be between 10 and 20%. The recommended pH is between 5.0 and 7.5.*
Details of nutrient medium, if used	Slow-release fertilizer was added to provide nutrients essential for plant growth.	
<u>Watering regime and schedules</u> Water source/type: Volume applied: Interval of application: Method of application:	Top watered once post-application, then sub-irrigation. Well water. Not reported. Daily. The plants were bottom watered daily as needed.	 *EPA prefers that bottom watering be utilized for Vegetative Vigor studies so that the chemical is not leached out of the soil during the test.*

Parameters	Vegetative Vigor	
	Details	**Remarks** ***Criteria***
Any pest control method/fertilization, if used	Not reported.	
<u>Test conditions</u> Temperature: Photoperiod: Light intensity and quality: Relative humidity:	Mean 22.6°C, range 15.43-31.74°C 16L:8D Natural sunlight supplemented with artificial light. Mean 16.0 moles PAR, range 13.8-22.6 moles PAR Mean 53.14%, range 15.19-92.80%	*EPA prefers that the cold vs warm loving plants be tested in two separate groups to optimize plant growth.* *OECD prefers that the temperature, humidity and light conditions be suitable for maintaining normal growth of each species for the test period.*
<u>Reference chemical (if used)</u> Name: Concentrations:	N/A	
Other parameters, if any	None	

2. Observations:

Table 4: Observation Parameters - Vegetative Vigor.

Parameters	Vegetative Vigor	
	Details	Remarks
Parameters measured (e.g., number of germinated seeds, emerged seedlings, plant height, dry weight or other endpoints)	- Survival - Shoot height - Mean dry weight - Phytotoxicity	
Measurement technique for each parameter	Phytotoxicity and survival were visually determined. Height was measured from the surface of the soil to the apical meristem. Mean dry weight was determined following drying (drying time and temperature not reported.)	
Observation intervals	Each pot was inspected weekly, survival determined. Dry weight and shoot height were recorded at study termination.	
Other observations, if any	N/A	
Were raw data included?	Yes	
Phytotoxicity rating system, if used	No effect, 0; slight effect, 10-30, moderate effect, 40-60; severe effect, 70-90; complete effect/plant death, 100.	Frans, R.E. and R.E. Talbert, 1977.

II. RESULTS and DISCUSSION:

A. INHIBITORY EFFECTS:

1. Vegetative Vigor:

Survival in the negative control was 100%. The study author and reviewer found no significant inhibitions in survival in the two dicots studied compared to the negative control ($p>0.05$).

The study author found significant inhibitions in soybean and tomato seedling height compared to the negative control. Significant inhibitions in soybean height were 25, 31, 42 and 54% at nominal MON76832

concentrations of 0.017, 0.033, 0.67 and 0.13 lb/A, respectively (Dunnett's test, p<0.05; nominal concentrations of 0.0016, 0.0032, 0.0064 and 0.0128 lb ae/A Dicmaba acid and nominal concentrations of 0.0032, 0.0064, 0.0128, and 0.0256 lb ae/A Glyphosate acid, respectively), compared to the negative control. Significant inhibitions in tomato height were 13 and 50% at the nominal MON76832 concentrations of 0.067 and 0.13 lb/A, respectively (Dunnett's test, p<0.05; 0.0064 and 0.0128 lb ae/A nominal Dicamba acid concentrations and 0.0128 and 0.0256 lb ae/A nominal Glyphosate acid treatment levels, respectively), compared to the negative control).

The study author found significant inhibitions in soybean and tomato dry weight compared to the negative control. Significant dry weight inhibitions in soybean were 12, 26, 30, 40 and 51%, and in tomato were 12, 24, 35, 48 and 60%, at nominal MON76832 concentrations of 0.0083, 0.017, 0.033, 0.067 and 0.13 lb/A, respectively (Dunnett's test, p<0.05; nominal dicamba acid concentrations of 0.0008, 0.0016, 0.0032, 0.0064 and 0.0128 lb ae/A and 0.0016, 0.0032, 0.0064, 0.0128, and 0.0256 lb ae/A nominal Glyphosate acid concentrations, respectively), compared to the negative control).

The study author determined the most sensitive dicot was tomato, based on dry weight, with nominal MON76832 NOEC and EC_{25} values of 0.0042 lb/A and 0.0184, respectively (0.00041 and 0.00183 lb ae/A nominal Dicamba acid and 0.00080 and 0.0035 lb ae/A Glyphosate acid, respectively. No monocots were tested.

The occurrence of phytotoxic effects was determined from visual observation. There were none to moderate phytotoxic effects in soybean and tomato (≤64). Phytotoxic effects included chlorosis, necrosis, leaf curl, and stem curl; phytotoxic effects were dose-related. Mean soybean plant conditions on day 21 were 1, 19, 31, 35, 38, 49, and 53 in the negative control, 0.0042, 0.0083, 0.017, 0.033, 0.067 and 0.13 lb/A nominal MON76832 concentrations (0, 0.0004, 0.0008, 0.0016, 0.0032, 0.0064 and 0.0.0128 lb ae/A nominal Dicamba acid and 0, 0.0008, 0.0016, 0.0032, 0.0064, 0.0128, and 0.0256 lb ae/A nominal Glyphosate acid, respectively). Mean tomato plant conditions on day 21 were 3, 8, 15, 32, 50, 57 and 61 in the negative control, 0.0042, 0.0083, 0.017, 0.033, 0.067 and 0.13 lb/A nominal MON76832 concentrations (0, 0.0004, 0.0008, 0.0016, 0.0032, 0.0064 and 0.0.0128 lb ae/A nominal Dicamba acid and 0, 0.0008, 0.0016, 0.0032, 0.0064, 0.0128, and 0.0256 lb ae/A nominal Glyphosate acid, respectively)

B. REPORTED STATISTICS:

Survival, replicate shoot dry weight, and height mean and standard deviations were determined. Dunnett's test was used to establish the LOER and NOER by determining which treatment groups differed significantly (one-tailed, $p < 0.05$) from the control group. Mean survival, dry weight, and height of the control and treatment groups were compared using the DUNNETT option of the GLM (general linear model) procedure of SAS version 9.4. Statistical analyses for species also included, if appropriate, the determination of effect rates (ER estimates) and their confidence limits using the non-linear regression analysis of Bruce and Versteeg when reductions in test endpoints among one or more treatment groups were 25% or more relative to control means. Analyses were conducted using the NLIN procedure of SAS version 9.4. Nominal concentrations were used for all analyses.

Table 5: Reported Effect of Dicamba DGA+ Glyphosate Ethanolamine Salt on 21-Day Vegetative Vigor

Species	Results summary for height in lbs ae/A Dicamba acid (Glyphosate acid))*									
	height (cm)	NOEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Soybean[1]	19.9-43.5	0.0008 (0.0016)	ND	N/A	0.0022 (0.0043)	0.0016-0.0030 (0.0032-0.0059)	0.0092 (0.018)	0.0077-0.011 (0.015-0.021)	N/A	N/A
Tomato[2]	18.7-40.9	0.0033 (0.0064)	ND	N/A	0.0085 (0.017)	0.0077-0.0095) 0.015-0.018	0.0129 (0.025)	0.0121-0.0136 (0.024-0.026)	N/A	N/A

ND- Not determined. NC- Not calculable.
* Nominal Values in lbs ae/A dicamba acid and lbs ae/A glyphosate acid are based on the proportions of dicamba acid (9.9%) and glyphosate acid (19.2%) in MON 76832
[1] Significant decrease in soybean height, inhibition of 25, 31, 42 and 54% at the 0.0016, 0.0032, 0.0064 and 0.0128 lb ae/A dicamba acid treatment levels (0.0032, 0.0064, 0.0128, and 0.0256 lb ae/A Glyphosate acid), respectively, compared to the negative control (Dunnett's test, $p<0.05$).
[2] Significant decrease in tomato height, inhibition of 13 and 50% at the 0.0064 and 0.0128 lb ae/A dicamba acid treatment levels (0.0128 and 0.0256 lb ae/A Glyphosate acid), respectively, compared to the negative control (Dunnett's test, $p<0.05$).

Table 5a: Reported Effect of Dicamba DGA+ Glyphosate Ethanolamine Salt on 21-Day Vegetative Vigor

Species	Results summary for biomass in lbs ae/A Dicamba acid (lbs ae/A Glyphosate acid)*									
	weight (g)	NOEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Soybean[1]	2.91-5.88	0.0004 (0.0008)	ND	N/A	0.0020 (0.0039)	0.0014—0.0030 (0.0026-0.0059)	0.012 (0.023)	0.0092—0.015 (0.018-0.029)	N/A	N/A
Tomato[2]	2.84-7.18	0.0004 (0.0008)	ND	N/A	0.0018 (0.0035)	0.0012—0.0028 (0.0023-0.0054)	0.0075 (0.015)	0.0059—0.0095 (0.011-0.018)	N/A	N/A

ND- Not determined. NC- Not calculable
* Nominal Values in lbs ae/A dicamba acid and lbs ae/A glyphosate acid are based on the proportions of dicamba acid (9.9%) and glyphosate acid (19.2%) in MON 76832
[1] Significant decrease in soybean dry weight, inhibition of 12, 26, 30, 40 and 51% at the 0.0008, 0.0016, 0.0032, 0.0064 and 0.0128 lb ae/A dicamba acid treatment levels (0.0016, 0.0032, 0.0064, 0.0128, and 0.0256 lb ae/A Glyphosate acid), respectively, compared to the negative control (Dunnett's test, $p<0.05$).
[2] Significant decrease in tomato dry weight, inhibition of 12, 24, 35, 48 and 60% at the 0.0008, 0.0016, 0.0032, 0.0064, and 0.0128 lb ae/A dicamba acid treatment levels (0.0016, 0.0032, 0.0064, 0.0128, and 0.0256 lb ae/A Glyphosate acid), respectively, compared to the negative control (Dunnett's test, $p<0.05$).

Table 5b Reported Effect of Dicamba DGA+ Glyphosate Ethanolamine Salt on 21-Day Vegetative Vigor

Species	Results summary for survival in lbs ae/A Dicamba acid (lbs ae/A Glyphosate acid)*									
	%	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Soybean	100	0.013 (0.026)	ND	N/A	>0.013 (>0.026)	N/A	0.013 (>0.026)	N/A	N/A	N/A
Tomato	100	0.013 (0.026)	ND	N/A	>0.013 (>0.026)	N/A	0.013 (>0.026	N/A	N/A	N/A

ND- Not determined. NC- Not calculable.
* Nominal Values in lbs ae/A dicamba acid and lbs ae/A glyphosate acid are based on the proportions of dicamba acid (9.9%) and glyphosate acid (19.2%) in MON 76832
No statistical differences were detected between any treatment groups and control groups for the survival endpoint.

Plant Injury Index*			
Control Plants (soybean and tomato)	Treated Soybean	Treated Tomato	Formulation Blank
0-6	0-60	0-64	N/A

*0 = no effect; 10-30 = slight effect; 40-60 = moderate effect; 70-90 = severe effect; 100 = complete effect/death of entire plant.

C. VERIFICATION OF STATISTICAL RESULTS BY THE REVIEWER:

All analyses were conducted comparing treated to the negative control. These analyses were conducted using CETIS version 1.8.7.12 and backend settings approved for use by EFED on 10/20/2015. Data for each endpoint were tested to determine if their distributions were normal and if their variances were homogeneous using Shapiro-Wilk's and Levene's tests, respectively. Data that satisfied these assumptions were subjected to Dunnett's and William's tests, and data that did not satisfy these assumptions were subjected to the non-parametric Mann-Whitney U and Jonckheere's tests. Measured concentrations were used in the analyses for all treatment levels. Linear (survival) and nonlinear (height and dry weight) regression models were used to interpret EC/ICx values.

The reviewer found similar significant height inhibitions as the study author in soybean (Jonckheere-Terpstra Step-Down test, $p<0.0001$) and tomato (Dunnett's test, $p=0.0005$) with NOAECs (based on measured concentrations) of 0.0017 lbs ae/A Dicamba acid (0.0033 lbs ae/A, Glyphosate acid) and 0.0069 lbs ae/A Dicamba acid (0.014 lbs ae/A, Glyphosate acid), respectively. Compared with the study author, the reviewer also found similar significant inhibitions in soybean dry weight of 13, 26, 30, 41 and 51% at measured Dicamba acid treatment concentrations of 0.00086, 0.0017, 0.0034, 0.00069 and 0.014 lbs ae/A (0.0017, 0.0033, 0.0065, 0.014, and 0.027 lb ae/A Glyphosate acid), respectively with a NOAEC (Williams test, $p<0.05$) of 0.00043 lbs ae/A dicamba acid (0.00084 lbs ae/A Glyphosate acid).

However, for tomato dry weight, where the study author determined the NOAEC to be 0.0004 lb ae/A dicamba acid (0.0008 lb ae/A glyphosate acid), based on nominal concentrations and 12% inhibition at the 0.0008 lb ae/A dicamba acid treatment level (0.0016 lb ae/A glyphosate acid), the reviewer determined that the 9% effect observed at the 0.00043 lbs ae/A measured dicamba acid treatment level (0.00086 lbs ae/A glyphosate acid) was significant compared to the negative control (Williams test, $p<0.05$). Therefore, the reviewer-determined NOAEC for tomato dry weight was determined to be less than 0.00043 lbs ae/A dicamba acid (0.00086 lbs ae/A glyphosate acid). This

difference is a result of the study author using Dunnett's test to determine significance, while due to the monotonic trend in the data, the reviewer used William's test.

Table 6: Reviewer Determined Effect of Dicamba DGA+ Glyphosate Ethanolamine Salt on 21-Day Vegetative Vigor

Species	Results summary for height (lbs ae/A Dicamba acid)									
	height (cm)	NOAEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Soybean[1]	19.9-43.5	0.00086	0.000333	0.00018-0.000499	0.0024	0.00205-0.00278	0.00945	0.00816-0.0109	N/A	N/A
Tomato[2]	18.7-40.9	0.0034	0.00498	0.00363-0.00588	0.009	0.00816-0.00983	0.0136	0.0126-0.0146	N/A	N/A

ND- Not determined. NC- Not calculable.
[1] Significant decrease in soybean height, inhibition of 25, 31, 42 and 54% at the 0.0017, 0.0034, 0.0069, and 0.014 lb ae/A Dicamba acid treatment levels, respectively, compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$).
[2] Significant decrease in tomato height, inhibition of 13 and 50% at the 0.0069 and 0.014 lb ae/A Dicamba acid treatment levels, respectively, compared to the negative control (Dunnett's test, $p<0.05$).

Table 6a: Reviewer Determined Effect of Dicamba DGA+ Glyphosate Ethanolamine Salt on 21-Day Vegetative Vigor

Species	Results summary for biomass (lbs ae/A Dicamba acid)									
	Weight (g)	NOAEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Soybean[1]	2.91-5.88	0.00043	0.000176	6.85E-05-0.000315	0.00214	0.00177-0.00257	0.0122	0.00974-0.0152	N/A	N/A
Tomato[2]	2.84-7.18	<0.00043	0.000251	0.000085-0.000442	0.00191	0.00153-0.00234	0.00782	0.00648-0.00945	N/A	N/A

ND- Not determined. NC- Not calculable.
[1] Significant decrease in soybean dry weight, inhibition of 13, 26, 30, 41 and 51% at the 0.00086, 0.0017, 0.0034, 0.0069, and 0.014 lb ae/A Dicamba acid treatment levels, respectively, compared to the negative control (Williams test, $p<0.05$).
[2] Significant decrease in tomato dry weight, inhibition of 9, 12, 24, 35, 48 and 60% at the 0.00043, 0.00086, 0.0017, 0.0034, 0.0069, and 0.014 lb ae/A Dicamba acid treatment levels, respectively, compared to the negative control (Williams test, $p<0.05$).

Table 6b: Reviewer Determined Effect of Dicamba DGA+ Glyphosate Ethanolamine Salt on 21-Day Vegetative Vigor

Species	Results summary for survival (lbs ae/A Dicamba acid)									
	%	NOAEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Soybean	100	0.014	>0.014	N/A	>0.014	N/A	>0.014	N/A	N/A	N/A
Tomato	100	0.014	>0.014	N/A	>0.014	N/A	>0.014	N/A	N/A	N/A

ND- Not determined. NC- Not calculable.

Table 7: Reviewer Determined Effect of Dicamba DGA+ Glyphosate Ethanolamine Salt on 21-Day Vegetative Vigor

Species	Results summary for height (lbs ae/A Glyphosate acid)									
	height (cm)	NOAEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Soybean[1]	19.9-43.5	0.0017	0.00065	0.00035-0.000978	0.00469	0.00401-0.00545	0.0186	0.016-0.0215	N/A	N/A
Tomato[2]	18.7-40.9	0.0065	0.0101	0.00745-0.0118	0.0177	0.0162-0.0193	0.0263	0.0245-0.0282	N/A	N/A

ND- Not determined. NC- Not calculable.
[1] Significant decrease in soybean height, inhibition of 25, 31, 42 and 54% at the 0.0033, 0.0065, 0.014, and 0.027 lb ae/A Glyphosate acid treatment levels, respectively, compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$).
[2] Significant decrease in tomato height, inhibition of 13 and 50% at the 0.014 and 0.027 lb ae/A Glyphosate acid treatment levels, respectively, compared to the negative control (Dunnett's test, $p<0.05$).

Table 7a: Reviewer Determined Effect of Dicamba DGA+ Glyphosate Ethanolamine Salt on 21-Day Vegetative Vigor

Species	Results summary for biomass (lbs ae/A Glyphosate acid)									
	Weight (g)	NOAEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Soybean[1]	2.91-5.88	0.00084	0.000344	0.000133-0.000615	0.00419	0.00345-0.00504	0.0238	0.0191-0.0298	N/A	N/A
Tomato[2]	2.84-7.18	<0.00084	0.000488	0.000164-0.000861	0.00373	0.00299-0.00458	0.0153	0.0127-0.0185	N/A	N/A

ND- Not determined. NC- Not calculable.
[1] Significant decrease in soybean dry weight, inhibition of 13, 26, 30, 41 and 51% at the 0.0017, 0.0033, 0.0065, 0.014, and 0.027 lb ae/A Glyphosate acid treatment levels, respectively, compared to the negative control (Williams test, $p<0.05$).
[2] Significant decrease in tomato dry weight, inhibition of 9, 12, 24, 35, 48 and 60% at the 0.00084, 0.0017, 0.0033, 0.0065, 0.014, and 0.027 lb ae/A Glyphosate acid treatment levels, respectively, compared to the negative control (Williams test, $p<0.05$).

Table 7b: Reviewer Determined Effect of Dicamba DGA+ Glyphosate Ethanolamine Salt on 21-Day Vegetative Vigor

Species	Results summary for survival (lbs ae/A Glyphosate acid)									
	%	NOAEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Soybean	100	0.027	>0.027	N/A	>0.027	N/A	>0.027	N/A	N/A	N/A
Tomato	100	0.027	>0.027	N/A	>0.027	N/A	>0.027	N/A	N/A	N/A

ND- Not determined. NC- Not calculable.

Plant Injury Index*			
Control Plants	Treated Soybean	Treated Tomato	Formulation Blank
0-6	0-60	0-64	N/A

*0 = no effect; 10-30 = slight effect; 40-60 = moderate effect; 70-90 = severe effect; 100 = complete effect/death of entire plant.

Dicamba Acid

Monocot

Most sensitive monocot: Monocots were not studied

EC_{50}/IC_{50}: N/A 95% C.I.: N/A
EC_{25}/IC_{25}: N/A 95% C.I.: N/A
EC_{05}/IC_{05}: N/A 95% C.I.: N/A
NOAEC: N/A
Slope: N/A 95% C.I.: N/A

Dicot

Most sensitive dicot: Tomato, based on dry weight

EC_{50}/IC_{50}: 0.00782 lb ae/A 95% C.I.: 0.00648-0.00945 lb ae/A
EC_{25}/IC_{25}: 0.00191 lb ae/A 95% C.I.: 0.00153-0.00234 lb ae/A
EC_{05}/IC_{05}: 0.000251 lb ae/A 95% C.I.: 0.000085-0.000442 lb ae/A
NOAEC: <0.00043 lb ae/A
Slope: N/A 95% C.I.: N/A

Glyphosate Acid

Monocot

Most sensitive monocot: Monocots were not studied

EC_{50}/IC_{50}: N/A 95% C.I.: N/A
EC_{50}/IC_{25}: N/A 95% C.I.: N/A
EC_{50}/IC_{05}: N/A 95% C.I.: N/A
NOAEC: N/A
Slope: N/A 95% C.I.: N/A

Most sensitive dicot: Tomato, based on dry weight

EC_{50}/IC_{50}: 0.0153 lb ae/A	95% C.I.: 0.0127- 0.0185 lb ae/A
EC_{25}/IC_{25}: 0.00373 lb ae/A	95% C.I.: 0.00299-0.00458 lb ae/A
EC_{05}/IC_{05}: 0.000488 lb ae/A	95% C.I.: 0.000164-0.000861 lb ae/A
NOAEC: <0.00084 lb ae/A	
Slope: N/A	95% C.I.: N/A

D. STUDY DEFICIENCIES:

1. Two dicots, and no monocots were included in this study. EPA guidance recommends testing 6 dicots and 4 monocots. A subsequent study, completed November 10, 2016, included 6 additional dicots and 4 monocots.

2. CEC and percent moisture were not reported.

3. The physico-chemical properties of the test material were not reported.

E. REVIEWER'S COMMENTS:

The reviewer and study author results were similar. Monocots were not studied. The study author determined the most sensitive dicot was tomato, based on dry weight, with nominal MON76832 formulation NOEC and EC_{25} values of 0.0042 lb/A and 0.0184, respectively (0.00041 and 0.00183 lb ae/A nominal Dicamba acid and 0.00080 and 0.0035 lb ae/A Glyphosate acid, respectively.

The reviewer determined the most sensitive dicot was also tomato, based on dry weight, but determined slightly different endpoints with calculated NOAEC, IC_{05} and IC_{25} values in dicamba acid of <0.00043, 0.000251 and 0.00191 lb ae/A (<0.00084, 0.000488 and 0.00373 lb ae/A glyphosate acid), respectively, based on measured concentrations. This difference is a result of the study author using Dunnett's test to determine significance, while due to the monotonic trend in the data, the reviewer used William's test.

This study included two active ingredients Dicamba and Glyphosate acid, and the study author analytically confirmed the concentrations of both these active ingredients in the test solutions. The reviewer used these measured concentrations in their analyses. The study author used the nominal concentrations of Dicamba and Glyphosate acid in their analyses.

The reviewer's results are presented in the Executive Summary and Conclusions sections of this DER.

The in-life portion of this study was initiated on April 1, 2016 and completed on May 5, 2016.

F. CONCLUSIONS:

This study is scientifically sound] and in combination with MRID 50103801, which evaluates the effect of the MON76832 formulation on 8 additional test species, is classified as **acceptable**. The most sensitive dicot species was tomato, based on dry weight, with NOAEC, IC_{05} and IC_{25} values in terms of Dicamba acid of <0.00043, 0.000251 and 0.00191 lb ae/A, respectively, and in terms of Glyphosate acid of <0.00084, 0.000488 and 0.00373 lb ae/A, respectively.

Dicamba Acid
Most sensitive monocot and EC_{25}/IC_{25}: Monocots were not tested
Most sensitive dicot and EC_{25}/IC_{25}: Tomato (dry weight; 0.00191 lb ae/A Dicamba acid)

Glyphosate Acid
Most sensitive monocot and EC_{25}/IC_{25}: Monocots were not tested
Most sensitive dicot and EC_{25}/IC_{25}: Tomato (dry weight; 0.00373 lb ae/A Glyphosate acid)

Total Formulation
Most sensitive monocot and EC_{25}/IC_{25}: Monocots were not tested
Most sensitive dicot and EC_{25}/IC_{25}: Tomato (dry weight; 0.019 lb Total Formulation/A)

III. REFERENCES:

1. U.S. Environmental Protection Agency. 2012. Series 850- Ecological Effects Test Guidelines, OCSPP Number 850.4150: Vegetative Vigor.

2. Frans, Robert E. and Ronald E. Talbert. 1977. Design of Field Experiments and the Measurement and Analysis of Plant Responses. Pages 15-23 in B. Truelove, ed. Research Methods in Weed Science. Southern Weed Science Society, Auburn University, Alabama.

3. SAS Institute, Inc. 2002-2012. SAS Proprietary Software Version 9.4, Cary, NC.

4. Bruce, Robert D. and Donald J. Versteeg. 1992. A Statistical Procedure for Modeling Continuous Toxicity Data. Environmental Toxicology and Chemistry. 11: 1485-1494.

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) — **Wildlife International**

Batch ID:	18-7114-5709	**Test Type:**	Vegetative Vigor Tier II	**Analyst:**	
Start Date:	12 Apr-16	**Protocol:**	OCSPP 850.4150 Plant Vegetative Vigor	**Diluent:**	
Ending Date:	05 Feb-17 18:26	**Species:**	Lycopersicon esculentum	**Brine:**	
Duration:	299d 18h	**Source:**	Meyer Seed Co., Baltimore, MD	**Age:**	

Sample ID:	08-2912-2478	**Code:**	49953901 d-toma	**Client:**	CDM Smith - T. Nelis
Sample Date:	12 Apr-16	**Material:**	Dicamba (#1918-00-9)	**Project:**	
Receive Date:	05 Feb-17 18:26	**Source:**	Monsanto Company		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
11-1160-6424	Height	0.0034	0.0069	0.004844	7.34%		Dunnett Multiple Comparison Test
08-4532-8581	Survival	0.014	>0.014	NA	NA		Mann-Whitney U Two-Sample Test
20-4428-7640	Weight	0.00043	0.00086	0.0006081	10.5%		Dunnett Multiple Comparison Test
20-5436-1909	Weight	<0.00043	0.00043	NA	7.98%		Williams Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	lbs ae/A	95% LCL	95% UCL	TU	Method
05-3634-4384	Height	IC5	0.00498	0.00363	0.00588		Nonlinear Regression
		IC10	0.00622	0.00511	0.00713		
		IC25	0.009	0.00816	0.00983		
		IC50	0.0136	0.0126	0.0146		
12-8662-1839	Weight	IC5	0.000251	0.000085	0.000442		Nonlinear Regression
		IC10	0.000536	0.000341	0.000763		
		IC25	0.00191	0.00153	0.00234		
		IC50	0.00782	0.00648	0.00945		

Height Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	37.4	35.4	39.3	33.6	40	0.832	2.35	6.3%	0.0%
0.00043		8	36.5	33.9	39	32.8	40.8	1.08	3.06	8.39%	2.41%
0.00086		8	37.9	35.8	40	32.4	40	0.881	2.49	6.57%	-1.4%
0.0017		8	40.7	39.1	42.2	38.2	43.4	0.642	1.82	4.47%	-8.76%
0.0034		8	40.9	39.5	42.4	38.6	44.2	0.611	1.73	4.22%	-9.5%
0.0069		8	32.7	30.5	34.8	29	37	0.919	2.6	7.95%	12.6%
0.014		8	18.7	17.1	20.4	16.6	22.2	0.692	1.96	10.4%	49.8%

Survival Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	1	1	1	1	1	0	0	0.0%	0.0%
0.00043		8	1	1	1	1	1	0	0	0.0%	0.0%
0.00086		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0017		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0034		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0069		8	1	1	1	1	1	0	0	0.0%	0.0%
0.014		8	1	1	1	1	1	0	0	0.0%	0.0%

Weight Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	7.18	6.67	7.69	6.38	8.19	0.215	0.608	8.48%	0.0%
0.00043		8	6.52	5.7	7.33	5.44	8.12	0.345	0.977	15.0%	9.2%
0.00086		8	6.33	5.64	7.02	5.31	7.74	0.292	0.826	13.1%	11.8%
0.0017		8	5.44	5.15	5.74	5.03	6.04	0.125	0.354	6.5%	24.2%
0.0034		8	4.64	4.14	5.14	4.01	5.64	0.211	0.597	12.9%	35.4%
0.0069		8	3.77	3.5	4.04	3.09	4.08	0.115	0.324	8.59%	47.5%
0.014		8	2.84	2.43	3.26	2.26	3.76	0.175	0.495	17.4%	60.4%

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Wildlife International**

Height Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	39.8	36.4	40	33.6	39.2	37	38.2	34.8
0.00043		32.8	39.2	40.8	40	33.8	34.8	34.8	35.6
0.00086		32.4	37.4	37.8	39.8	38.8	39.8	40	37.2
0.0017		38.4	38.2	40.2	41	41.8	40	43.4	42.2
0.0034		38.6	41.2	40.2	40.6	39.6	40.6	42.4	44.2
0.0069		30.2	32.8	35.4	29	37	31.8	33.2	32
0.014		18.8	18.8	16.6	17	17.4	21	22.2	18.2

Survival Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	1	1	1	1
0.00043		1	1	1	1	1	1	1	1
0.00086		1	1	1	1	1	1	1	1
0.0017		1	1	1	1	1	1	1	1
0.0034		1	1	1	1	1	1	1	1
0.0069		1	1	1	1	1	1	1	1
0.014		1	1	1	1	1	1	1	1

Weight Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	8.19	7.79	7.22	6.38	6.85	7.33	7.13	6.53
0.00043		5.5	5.93	6.53	7.75	8.12	5.44	6.58	6.29
0.00086		5.47	5.31	6.42	5.71	7.02	6.7	7.74	6.26
0.0017		5.2	5.04	5.51	5.4	5.53	5.03	6.04	5.78
0.0034		5.09	4.28	4.56	4.01	4.06	4.29	5.19	5.64
0.0069		4.08	3.94	3.82	3.09	4.03	3.94	3.57	3.68
0.014		3.14	2.61	2.65	2.43	2.26	3.23	3.76	2.65

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) — **Wildlife International**

Batch ID:	21-2747-4346	**Test Type:**	Vegetative Vigor Tier II	**Analyst:**	
Start Date:	12 Apr-16	**Protocol:**	OCSPP 850.4150 Plant Vegetative Vigor	**Diluent:**	
Ending Date:	06 Feb-17 06:47	**Species:**	Lycopersicon esculentum	**Brine:**	
Duration:	300d 7h	**Source:**	Meyer Seed Co., Baltimore, MD	**Age:**	

Sample ID:	17-3673-6006	**Code:**	49953901 g-toma	**Client:**	CDM Smith - T. Nelis
Sample Date:	12 Apr-16	**Material:**	Glyphosate	**Project:**	
Receive Date:	06 Feb-17 06:47	**Source:**	Monsanto Company		
Sample Age:	NA	**Station:**			

Batch Note: MON 76832 - Dicamba + Glyphosate; glyphosate measured test concentrations

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
16-3226-2860	Height	0.0065	0.014	0.009539	7.34%		Dunnett Multiple Comparison Test
05-2923-8929	Survival	0.027	>0.027	NA	NA		Mann-Whitney U Two-Sample Test
04-8985-7173	Weight	0.00084	0.0017	0.001195	10.5%		Dunnett Multiple Comparison Test
19-8489-4781	Weight	<0.00084	0.00084	NA	7.98%		Williams Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	lbs ae/A	95% LCL	95% UCL	TU	Method
07-2641-3931	Height	IC5	0.0101	0.00745	0.0118		Nonlinear Regression
		IC10	0.0125	0.0104	0.0142		
		IC25	0.0177	0.0162	0.0193		
		IC50	0.0263	0.0245	0.0282		
17-1003-8008	Weight	IC5	0.000488	0.000164	0.000861		Nonlinear Regression
		IC10	0.00104	0.000663	0.00149		
		IC25	0.00373	0.00299	0.00458		
		IC50	0.0153	0.0127	0.0185		

Height Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	37.4	35.4	39.3	33.6	40	0.832	2.35	6.3%	0.0%
0.00084		8	36.5	33.9	39	32.8	40.8	1.08	3.06	8.39%	2.41%
0.0017		8	37.9	35.8	40	32.4	40	0.881	2.49	6.57%	-1.4%
0.0033		8	40.7	39.1	42.2	38.2	43.4	0.642	1.82	4.47%	-8.76%
0.0065		8	40.9	39.5	42.4	38.6	44.2	0.611	1.73	4.22%	-9.5%
0.014		8	32.7	30.5	34.8	29	37	0.919	2.6	7.95%	12.6%
0.027		8	18.7	17.1	20.4	16.6	22.2	0.692	1.96	10.4%	49.8%

Survival Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	1	1	1	1	1	0	0	0.0%	0.0%
0.00084		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0017		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0033		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0065		8	1	1	1	1	1	0	0	0.0%	0.0%
0.014		8	1	1	1	1	1	0	0	0.0%	0.0%
0.027		8	1	1	1	1	1	0	0	0.0%	0.0%

Weight Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	7.18	6.67	7.69	6.38	8.19	0.215	0.608	8.48%	0.0%
0.00084		8	6.52	5.7	7.33	5.44	8.12	0.345	0.977	15.0%	9.2%
0.0017		8	6.33	5.64	7.02	5.31	7.74	0.292	0.826	13.1%	11.8%
0.0033		8	5.44	5.15	5.74	5.03	6.04	0.125	0.354	6.5%	24.2%
0.0065		8	4.64	4.14	5.14	4.01	5.64	0.211	0.597	12.9%	35.4%
0.014		8	3.77	3.5	4.04	3.09	4.08	0.115	0.324	8.59%	47.5%
0.027		8	2.84	2.43	3.26	2.26	3.76	0.175	0.495	17.4%	60.4%

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Wildlife International**

Height Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	39.8	36.4	40	33.6	39.2	37	38.2	34.8
0.00084		32.8	39.2	40.8	40	33.8	34.8	34.8	35.6
0.0017		32.4	37.4	37.8	39.8	38.8	39.8	40	37.2
0.0033		38.4	38.2	40.2	41	41.8	40	43.4	42.2
0.0065		38.6	41.2	40.2	40.6	39.6	40.6	42.4	44.2
0.014		30.2	32.8	35.4	29	37	31.8	33.2	32
0.027		18.8	18.8	16.6	17	17.4	21	22.2	18.2

Survival Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	1	1	1	1
0.00084		1	1	1	1	1	1	1	1
0.0017		1	1	1	1	1	1	1	1
0.0033		1	1	1	1	1	1	1	1
0.0065		1	1	1	1	1	1	1	1
0.014		1	1	1	1	1	1	1	1
0.027		1	1	1	1	1	1	1	1

Weight Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	8.19	7.79	7.22	6.38	6.85	7.33	7.13	6.53
0.00084		5.5	5.93	6.53	7.75	8.12	5.44	6.58	6.29
0.0017		5.47	5.31	6.42	5.71	7.02	6.7	7.74	6.26
0.0033		5.2	5.04	5.51	5.4	5.53	5.03	6.04	5.78
0.0065		5.09	4.28	4.56	4.01	4.06	4.29	5.19	5.64
0.014		4.08	3.94	3.82	3.09	4.03	3.94	3.57	3.68
0.027		3.14	2.61	2.65	2.43	2.26	3.23	3.76	2.65

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Wildlife International**

Batch ID:	01-3956-7167	**Test Type:**	Vegetative Vigor Tier II	**Analyst:**	
Start Date:	12 Apr-16	**Protocol:**	OCSPP 850.4150 Plant Vegetative Vigor	**Diluent:**	
Ending Date:		**Species:**	Glycine max	**Brine:**	
Duration:	NA	**Source:**	Johnny's Selected Seeds, ME	**Age:**	

Sample ID:	11-8435-8824	**Code:**	49953901 d-soyb	**Client:**	CDM Smith - T. Nelis
Sample Date:	12 Apr-16	**Material:**	Dicamba (#1918-00-9)	**Project:**	
Receive Date:		**Source:**	Monsanto Company		
Sample Age:	NA	**Station:**			

Batch Note: MON 76832 - Dicamba + Glyphosate; measured Dicamba test concentrations

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
02-6659-2734	Height	0.00086	0.0017	0.001209	NA		Jonckheere-Terpstra Step-Down Test
20-6100-1667	Height	0.00086	0.0017	0.001209	4.26%		Mann-Whitney U Two-Sample Test
18-8129-5577	Survival	0.014	>0.014	NA	NA		Mann-Whitney U Two-Sample Test
11-5161-6482	Weight	0.00043	0.00086	0.0006081	7.72%		Dunnett Multiple Comparison Test
12-9177-7881	Weight	0.00043	0.00086	0.0006081	5.9%		Williams Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	lbs ae/A	95% LCL	95% UCL	TU	Method
19-0344-1538	Height	IC5	0.000333	0.00018	0.000499		Nonlinear Regression
		IC10	0.000697	0.000515	0.000897		
		IC25	0.0024	0.00205	0.00278		
		IC50	0.00945	0.00816	0.0109		
08-1767-3612	Weight	IC5	0.000176	6.85E-05	0.000315		Nonlinear Regression
		IC10	0.000449	0.000292	0.00064		
		IC25	0.00214	0.00177	0.00257		
		IC50	0.0122	0.00974	0.0152		

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Wildlife International**

Height Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	43.1	41.6	44.5	39.6	44.8	0.6	1.7	3.94%	0.0%
0.00043		8	43.5	40.8	46.2	36.6	46	1.14	3.21	7.38%	-1.1%
0.00086		8	41.9	40.2	43.6	38.2	43.8	0.716	2.03	4.83%	2.61%
0.0017		8	32.5	31.2	33.7	29.8	34.6	0.508	1.44	4.43%	24.6%
0.0034		8	29.8	28.4	31.2	27.4	32.2	0.597	1.69	5.67%	30.8%
0.0069		8	25.1	23	27.2	21.2	28.6	0.88	2.49	9.92%	41.8%
0.014		8	19.9	18.7	21.1	18.2	21.8	0.501	1.42	7.12%	53.7%

Survival Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	1	1	1	1	1	0	0	0.0%	0.0%
0.00043		8	1	1	1	1	1	0	0	0.0%	0.0%
0.00086		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0017		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0034		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0069		8	1	1	1	1	1	0	0	0.0%	0.0%
0.014		8	1	1	1	1	1	0	0	0.0%	0.0%

Weight Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	5.88	5.57	6.19	5.34	6.45	0.132	0.372	6.33%	0.0%
0.00043		8	5.56	5.09	6.03	4.73	6.42	0.2	0.565	10.2%	5.48%
0.00086		8	5.15	4.8	5.5	4.51	5.84	0.147	0.415	8.06%	12.5%
0.0017		8	4.33	4.06	4.6	3.91	4.9	0.114	0.323	7.46%	26.4%
0.0034		8	4.12	3.76	4.47	3.54	4.71	0.151	0.427	10.4%	30.0%
0.0069		8	3.5	3.26	3.74	3.06	3.88	0.102	0.29	8.28%	40.5%
0.014		8	2.91	2.74	3.08	2.63	3.22	0.0704	0.199	6.84%	50.6%

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Wildlife International**

Height Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	43.4	43.4	43.6	41.8	44.8	39.6	44.8	43
0.00043		44.2	45.8	44.4	44	36.6	46	46	41.2
0.00086		38.2	43	43	43.4	42.6	42	43.8	39.4
0.0017		31.2	33	34.6	32.2	32.6	29.8	33.2	33
0.0034		31.2	28.6	29.2	30.2	27.4	32.2	31.2	28.2
0.0069		24.2	28.6	26.2	24.4	26.4	27.2	22.4	21.2
0.014		18.6	21.6	21.8	19	21.2	19.2	19.8	18.2

Survival Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	1	1	1	1
0.00043		1	1	1	1	1	1	1	1
0.00086		1	1	1	1	1	1	1	1
0.0017		1	1	1	1	1	1	1	1
0.0034		1	1	1	1	1	1	1	1
0.0069		1	1	1	1	1	1	1	1
0.014		1	1	1	1	1	1	1	1

Weight Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	6.27	6.45	5.96	5.76	6	5.34	5.8	5.48
0.00043		6.42	5.46	6.09	5.36	4.73	5.95	5.47	5
0.00086		4.51	5.44	5.1	4.86	5.36	4.84	5.24	5.84
0.0017		3.91	4.03	4.9	4.5	4.21	4.42	4.12	4.54
0.0034		4.18	3.79	4.71	3.77	3.54	4.63	4.37	3.94
0.0069		3.29	3.7	3.66	3.23	3.75	3.88	3.43	3.06
0.014		2.63	3.06	2.81	2.78	3.22	2.98	3.05	2.74

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Wildlife International**

Batch ID:	16-6609-4678	**Test Type:**	Vegetative Vigor Tier II	**Analyst:**	
Start Date:	12 Apr-16	**Protocol:**	OCSPP 850.4150 Plant Vegetative Vigor	**Diluent:**	
Ending Date:		**Species:**	Glycine max	**Brine:**	
Duration:	NA	**Source:**	Johnny's Selected Seeds, ME	**Age:**	

Sample ID:	12-6835-2958	**Code:**	49953901 g-soyb	**Client:**	CDM Smith - T. Nelis
Sample Date:	12 Apr-16	**Material:**	Glyphosate	**Project:**	
Receive Date:		**Source:**	Monsanto Company		
Sample Age:	NA	**Station:**			

Batch Note: MON 76832 - Dicamba + Glyphosate - measured test concentrations of Glyphosate

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
07-8790-6064	Height	0.0017	0.0033	0.002369	NA		Jonckheere-Terpstra Step-Down Test
14-5192-4525	Height	0.0017	0.0033	0.002369	4.26%		Mann-Whitney U Two-Sample Test
08-6374-3635	Survival	0.027	>0.027	NA	NA		Mann-Whitney U Two-Sample Test
01-0993-2246	Weight	0.00084	0.0017	0.001195	7.72%		Dunnett Multiple Comparison Test
01-6389-5358	Weight	0.00084	0.0017	0.001195	5.9%		Williams Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	lbs ae/A	95% LCL	95% UCL	TU	Method
20-5295-7609	Height	IC5	0.00065	0.00035	0.000978		Nonlinear Regression
		IC10	0.00136	0.001	0.00176		
		IC25	0.00469	0.00401	0.00545		
		IC50	0.0186	0.016	0.0215		
16-6899-3394	Weight	IC5	0.000344	0.000133	0.000615		Nonlinear Regression
		IC10	0.000877	0.000569	0.00125		
		IC25	0.00419	0.00345	0.00504		
		IC50	0.0238	0.0191	0.0298		

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Wildlife International**

Height Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	43.1	41.6	44.5	39.6	44.8	0.6	1.7	3.94%	0.0%
0.00084		8	43.5	40.8	46.2	36.6	46	1.14	3.21	7.38%	-1.1%
0.0017		8	41.9	40.2	43.6	38.2	43.8	0.716	2.03	4.83%	2.61%
0.0033		8	32.5	31.2	33.7	29.8	34.6	0.508	1.44	4.43%	24.6%
0.0065		8	29.8	28.4	31.2	27.4	32.2	0.597	1.69	5.67%	30.8%
0.014		8	25.1	23	27.2	21.2	28.6	0.88	2.49	9.92%	41.8%
0.027		8	19.9	18.7	21.1	18.2	21.8	0.501	1.42	7.12%	53.7%

Survival Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	1	1	1	1	1	0	0	0.0%	0.0%
0.00084		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0017		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0033		8	1	1	1	1	1	0	0	0.0%	0.0%
0.0065		8	1	1	1	1	1	0	0	0.0%	0.0%
0.014		8	1	1	1	1	1	0	0	0.0%	0.0%
0.027		8	1	1	1	1	1	0	0	0.0%	0.0%

Weight Summary

C-lbs ae/A	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	5.88	5.57	6.19	5.34	6.45	0.132	0.372	6.33%	0.0%
0.00084		8	5.56	5.09	6.03	4.73	6.42	0.2	0.565	10.2%	5.48%
0.0017		8	5.15	4.8	5.5	4.51	5.84	0.147	0.415	8.06%	12.5%
0.0033		8	4.33	4.06	4.6	3.91	4.9	0.114	0.323	7.46%	26.4%
0.0065		8	4.12	3.76	4.47	3.54	4.71	0.151	0.427	10.4%	30.0%
0.014		8	3.5	3.26	3.74	3.06	3.88	0.102	0.29	8.28%	40.5%
0.027		8	2.91	2.74	3.08	2.63	3.22	0.0704	0.199	6.84%	50.6%

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Wildlife International**

Height Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	43.4	43.4	43.6	41.8	44.8	39.6	44.8	43
0.00084		44.2	45.8	44.4	44	36.6	46	46	41.2
0.0017		38.2	43	43	43.4	42.6	42	43.8	39.4
0.0033		31.2	33	34.6	32.2	32.6	29.8	33.2	33
0.0065		31.2	28.6	29.2	30.2	27.4	32.2	31.2	28.2
0.014		24.2	28.6	26.2	24.4	26.4	27.2	22.4	21.2
0.027		18.6	21.6	21.8	19	21.2	19.2	19.8	18.2

Survival Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	1	1	1	1
0.00084		1	1	1	1	1	1	1	1
0.0017		1	1	1	1	1	1	1	1
0.0033		1	1	1	1	1	1	1	1
0.0065		1	1	1	1	1	1	1	1
0.014		1	1	1	1	1	1	1	1
0.027		1	1	1	1	1	1	1	1

Weight Detail

C-lbs ae/A	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	6.27	6.45	5.96	5.76	6	5.34	5.8	5.48
0.00084		6.42	5.46	6.09	5.36	4.73	5.95	5.47	5
0.0017		4.51	5.44	5.1	4.86	5.36	4.84	5.24	5.84
0.0033		3.91	4.03	4.9	4.5	4.21	4.42	4.12	4.54
0.0065		4.18	3.79	4.71	3.77	3.54	4.63	4.37	3.94
0.014		3.29	3.7	3.66	3.23	3.75	3.88	3.43	3.06
0.027		2.63	3.06	2.81	2.78	3.22	2.98	3.05	2.74