

Message

From: MACINNES, ALISON [AG/1000] [/O=MONSANTO/OU=NA-1000-01/CN=RECIPIENTS/CN=AAMACI]
Sent: 7/31/2017 10:34:14 AM
To: BHAKTA, TINA [AG/1000] [tina.bhakta@monsanto.com]
Subject: FW: Volatility deck
Attachments: Dicamba Volatility Summary.pptx

This is what I sent William

From: MACINNES, ALISON [AG/1000]
Sent: Wednesday, July 26, 2017 4:29 PM
To: ABRAHAM, WILLIAM [AG/1005] <william.abraham@monsanto.com>
Subject: Volatility deck

William,

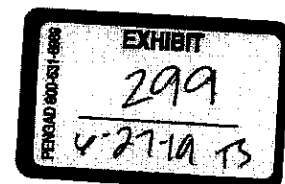
Here is the volatility deck. The key 14 slides or so are first. Everything else is in the backup section. My cell is 636-236-8944 if you need to contact me at all.

I'll look forward to hearing about the discussion!

Alison

BADER FARMS ET AL v. MONSANTO ET AL.

EXHIBIT
PLTF-299



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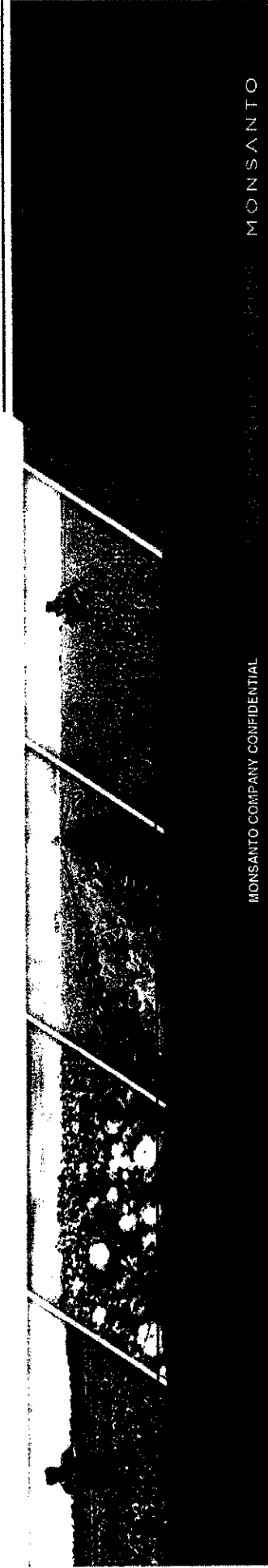
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ROUNDUP READY®
XTEND
CROP SYSTEM



Dicamba Volatility Summary



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New Test Methods Needed to be Developed to Measure the Low Levels of Dicamba that Volatilize

Product	Amount of Dicamba Acid Applied	Amount of Dicamba Acid Trapped on PUF	Percentage of Dicamba Trapped
Banvel®	1.448 x 10 ⁷ ng	6499 ng	0.045%
XtendiMax with VaporGrip™	1.448 x 10 ⁷ ng	8.58 ng	0.000059%

Dicamba measured using the humidome volatility test method developed by Monsanto scientists and presented at and published by ASTM*

*Gawlick, W. K., Wright, D. R., MacInnes, A., Hemminghaus, J. W., Webb, J. K., Vermolenka, V. I., Su, W., "A Method to Determine the Relative Volatility of Auxin Herbicide Formulations," *Pesticide Formulation and Delivery Systems: 35th Volume, ASTM STP1587*, G. R. Goss, Ed., ASTM International, West Conshohocken, PA, 2016, pp. 24-32, doi:10.1520/STP158720150006

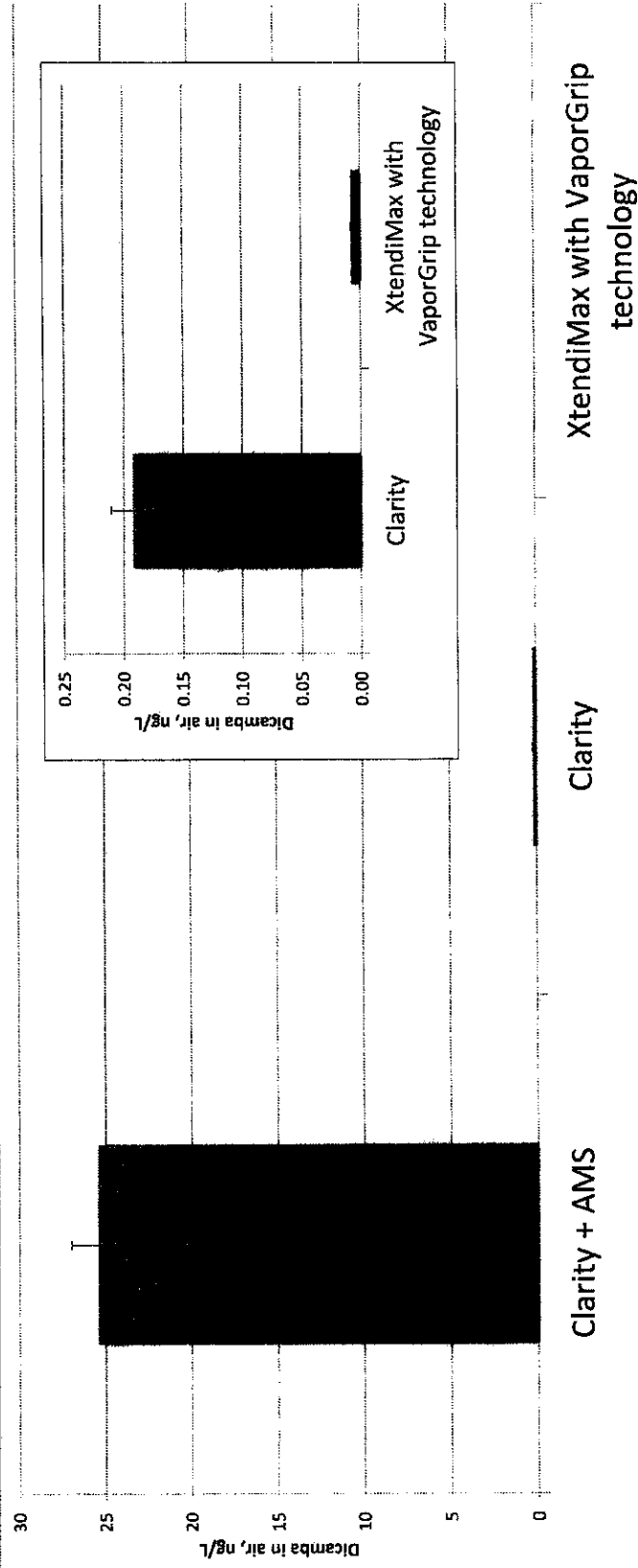
Difficult to measure such small differences from a bulk solution as is typical of the thermal gravimetric analysis (TGA)

The amount of dicamba that volatilizes is an extremely small percentage of the total amount of dicamba sprayed on the soil

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Ammonium Sulfate (AMS) increases the volatility potential of dicamba

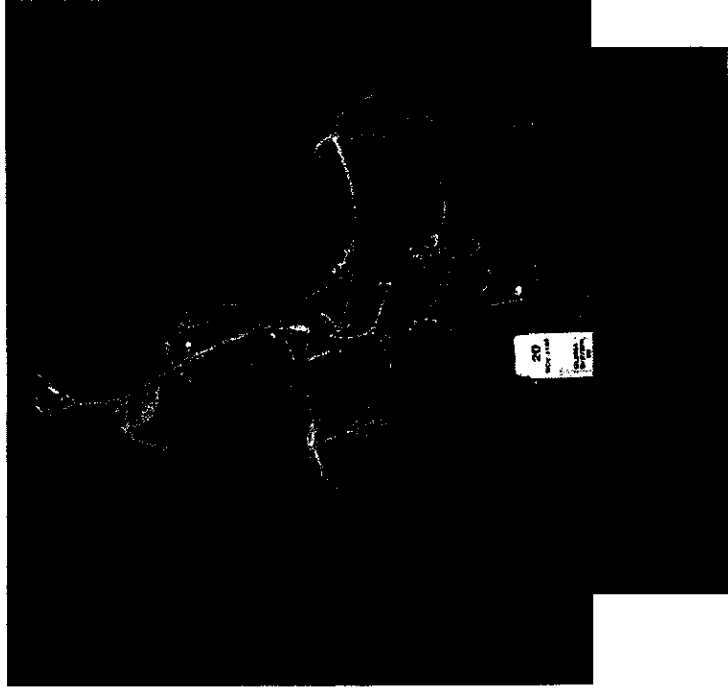
Do not tank mix products containing ammonium salts such as ammonium sulfate and urea ammonium nitrate



Source: Monsanto Internal Testing; DCV 1175

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RR2Y Soybeans Exposed for 24 hours to Dicamba Tank Mixtures in the Hoop House, Assessed for Injury Response at 14 DAT



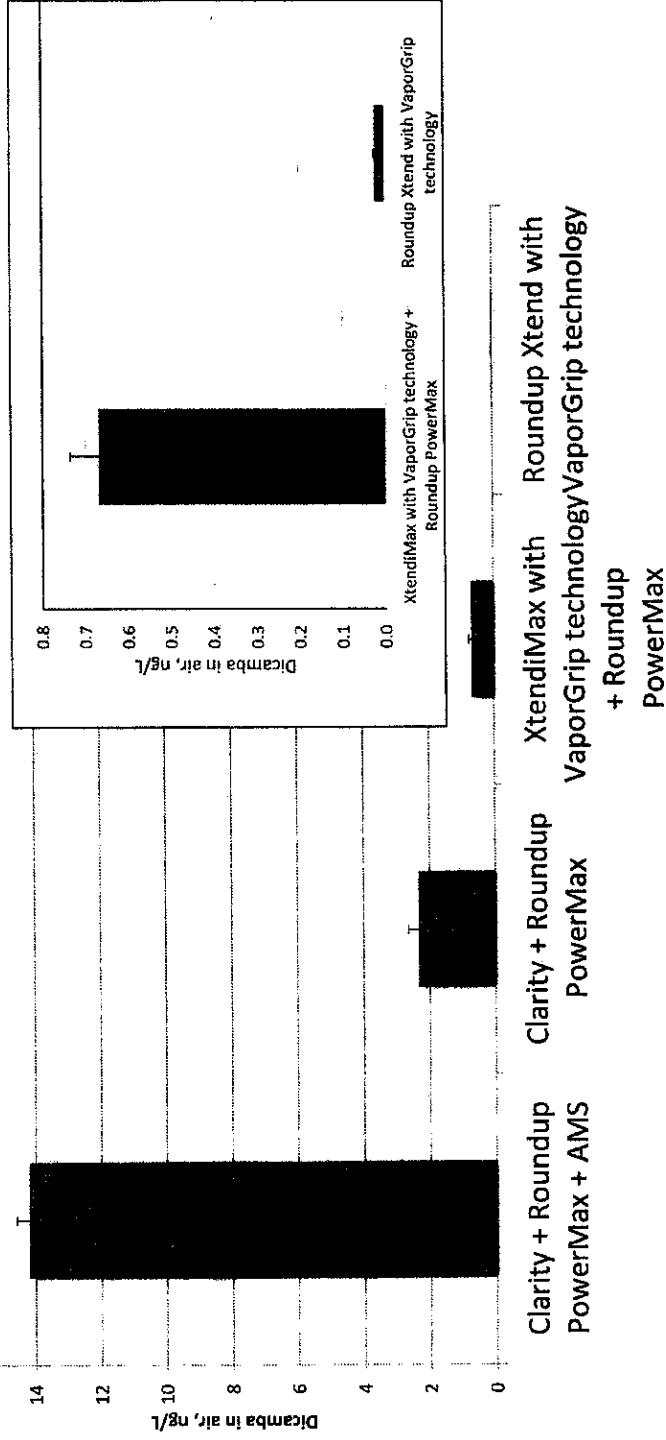
RR2Y soybean + AMS show injury and the stems thicken
RR2Y soybean XtendiMax technology at 14 DAT



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VaporGrip™ technology significantly reduces dicamba volatility in combinations with glyphosate

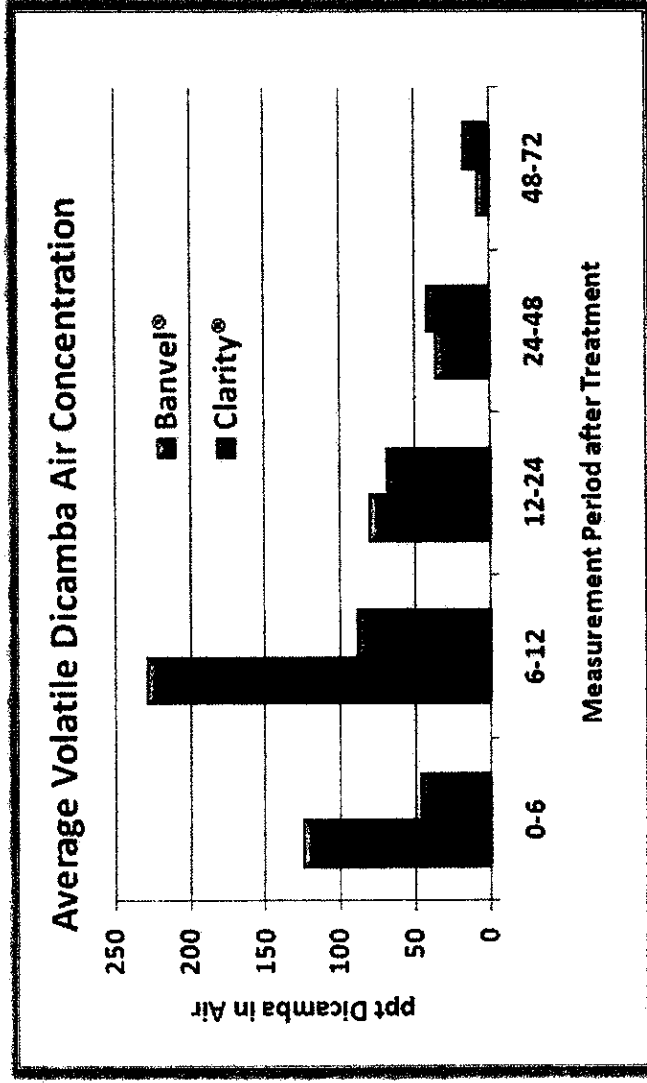
When used in combination with glyphosate, dicamba formulations with VaporGrip™ technology reduce volatility potential compared to Clarity® in combination with glyphosate



Source: Monsanto Internal Testing; DCV 1173

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2009 Field Volatility Results Suggest Majority of Volatility Occurs within 24 hours of Application after Spraying

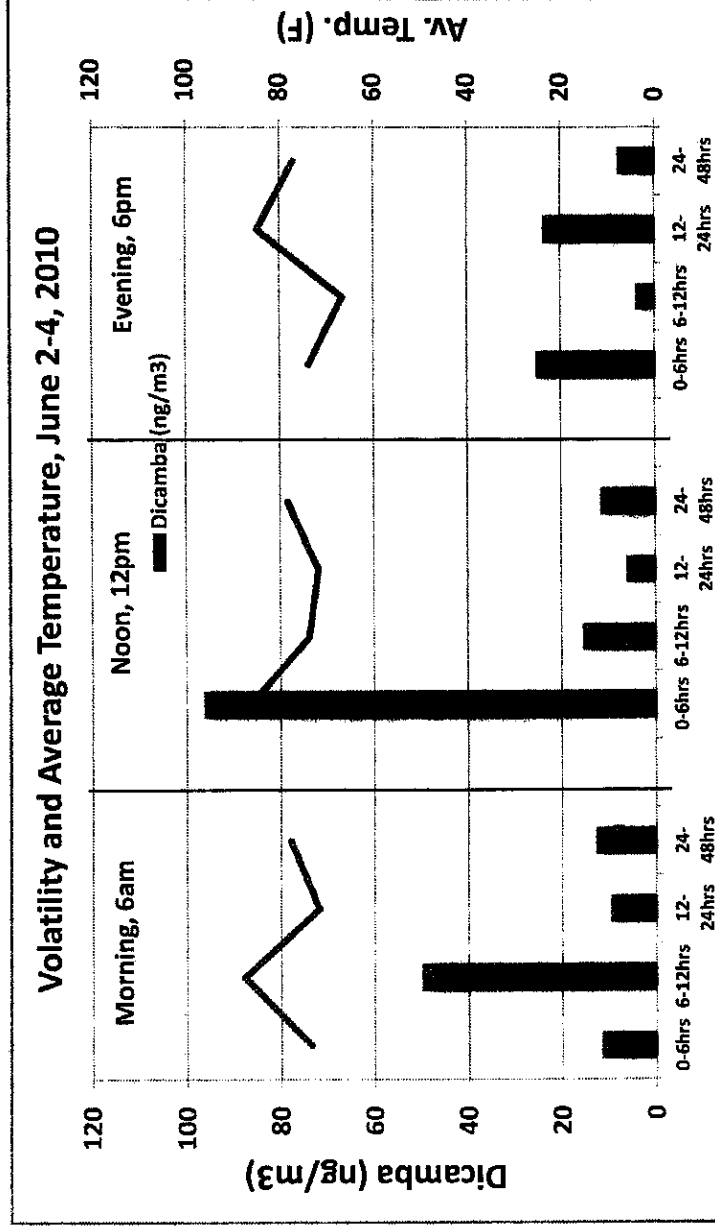


1 lb/A ae (32 oz/A) Application Rate, on No Till RR Soy
 Calm winds at application
 Temp 60 – 95 °F
 Detection in the Center of 50 X 50 plot

Average Results from Three Trials
 1 ppt = 1 ng/m³

Thomas C. Mueller, Daniel R. Wright, and Kirk M. Remund (2013) Effect of Formulation and Application Time of Day on Detecting Dicamba in the Air under Field Conditions. Weed Science: October-December 2013, Vol. 61, No. 4, pp. 586-593

Effect the Time of Day Spraying Application Occurs and the Amount of Volatile Dicamba Measured

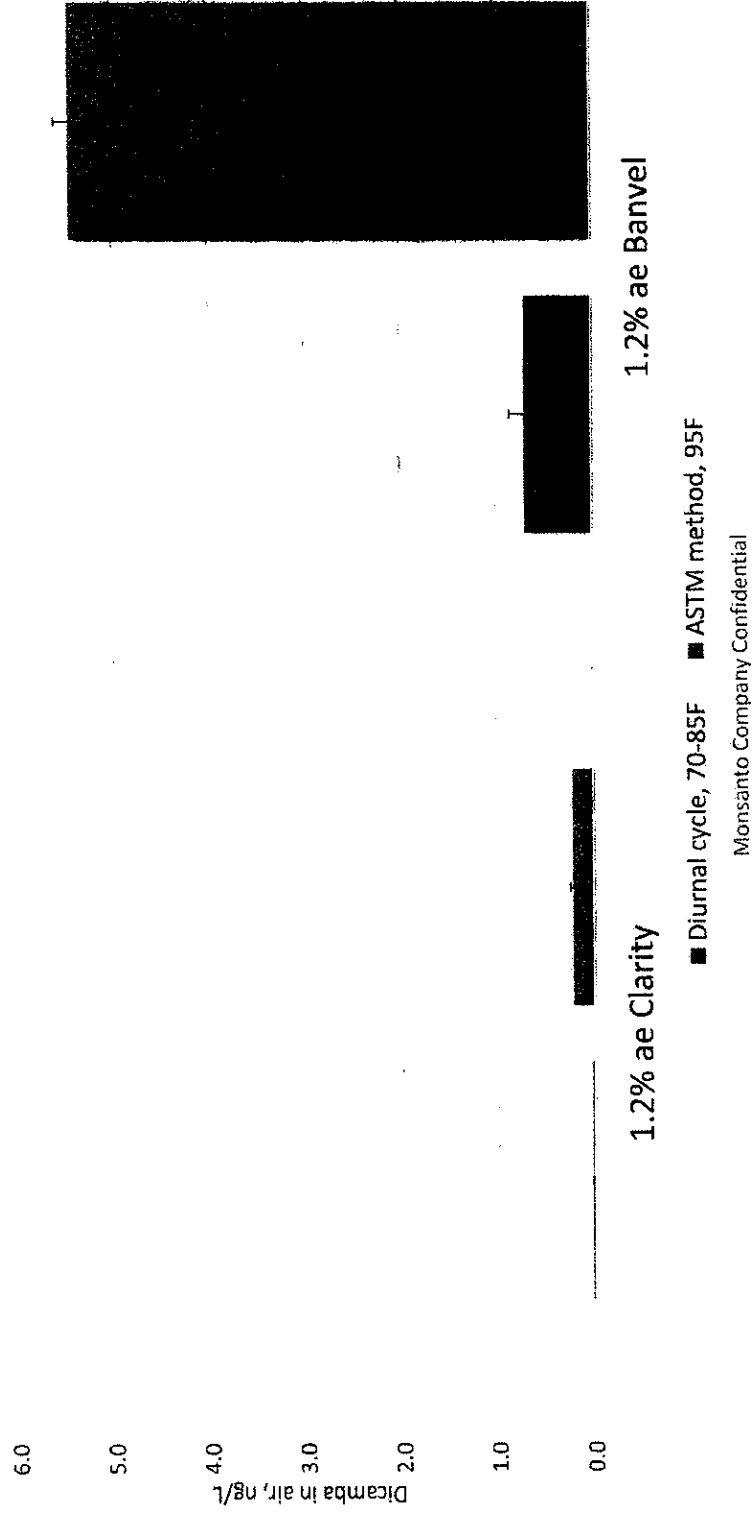


The highest amount of dicamba measured was during the hottest part of the day no matter the time of day of application

- For 6am application the highest amount of dicamba was measured at 6-12 hours after application, noon-6pm
- For noon application the highest amount was measured in the first 6 hours, noon-6pm
- For the evening application some dicamba was detected in the first 6 hours, 6pm-midnight. More was measured at 12-24 hours after application, 6am-6pm the following day

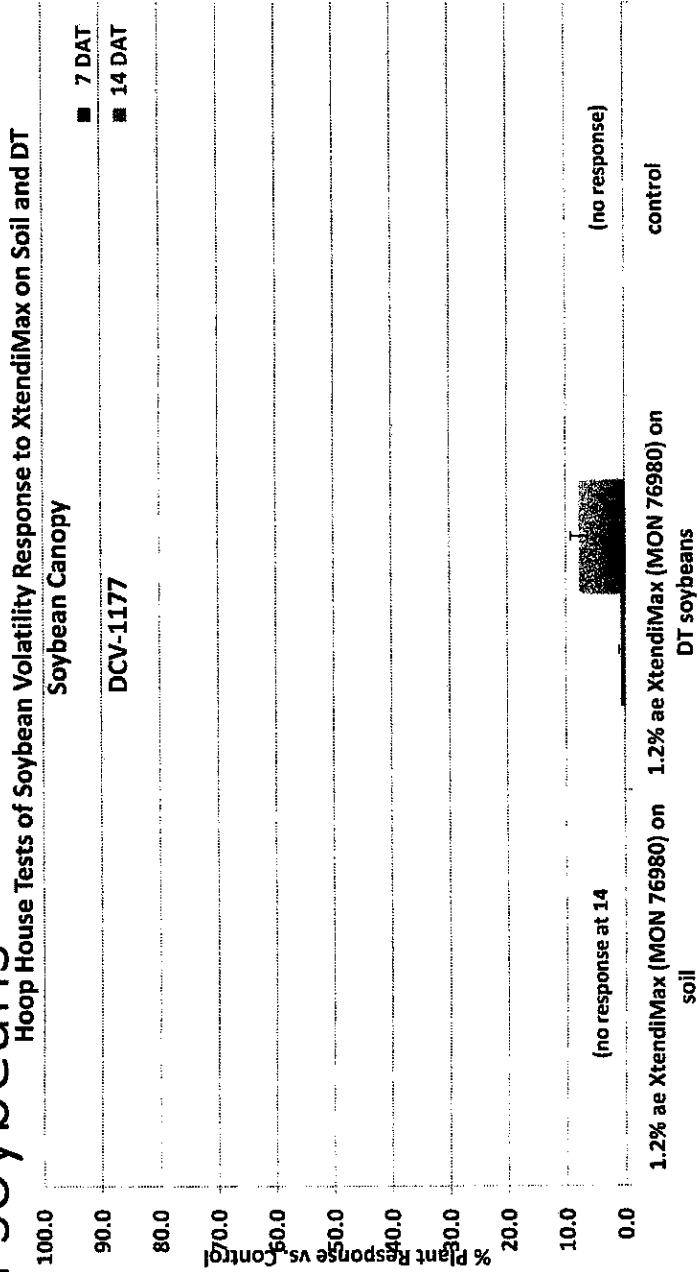
Thomas C. Mueller, Daniel R. Wright, and Kirk M. Remund (2013) Effect of Formulation and Application Time of Day on Detecting Dicamba in the Air under Field Conditions. Weed Science: October-December 2013, Vol. 61, No. 4, pp. 586-593

Dicamba Volatility Potential Increases with Higher Temperatures, humidome data



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Hoop house data RR2Y soybeans exposed for 24 hours to XtendiMax sprayed on soil or canopy of Xtend soybeans

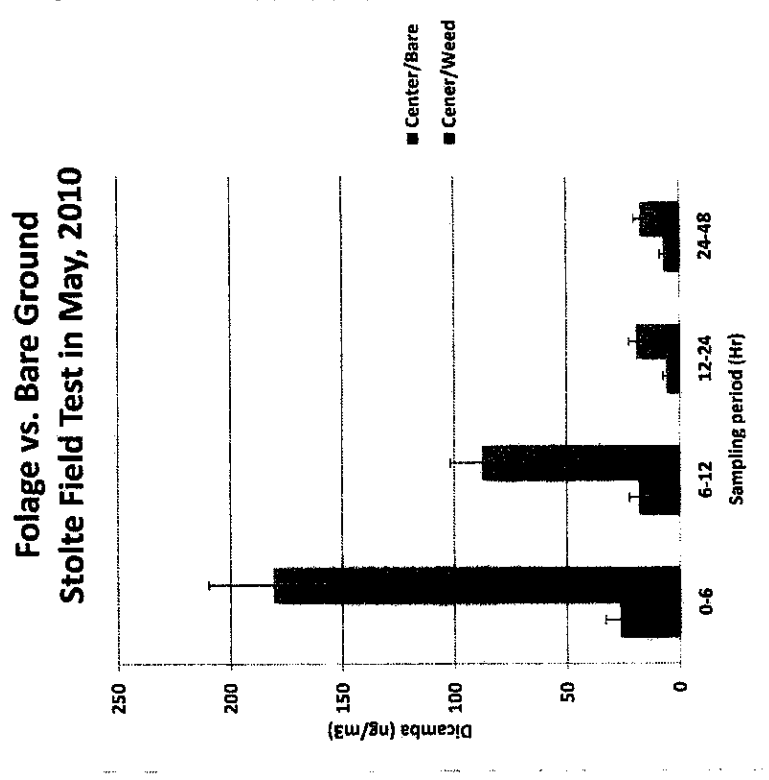


No injury on RR2Y soybeans in the hoop house where XtendiMax was sprayed on soil, some injury response in RR2Y soybeans exposed to XtendiMax sprayed on a canopy of Xtend soybeans. Injury response <10% at 14 DAT

Field volatility test detected more dicamba off weed canopy than bare ground

Plant Canopy vs. Bare Soil

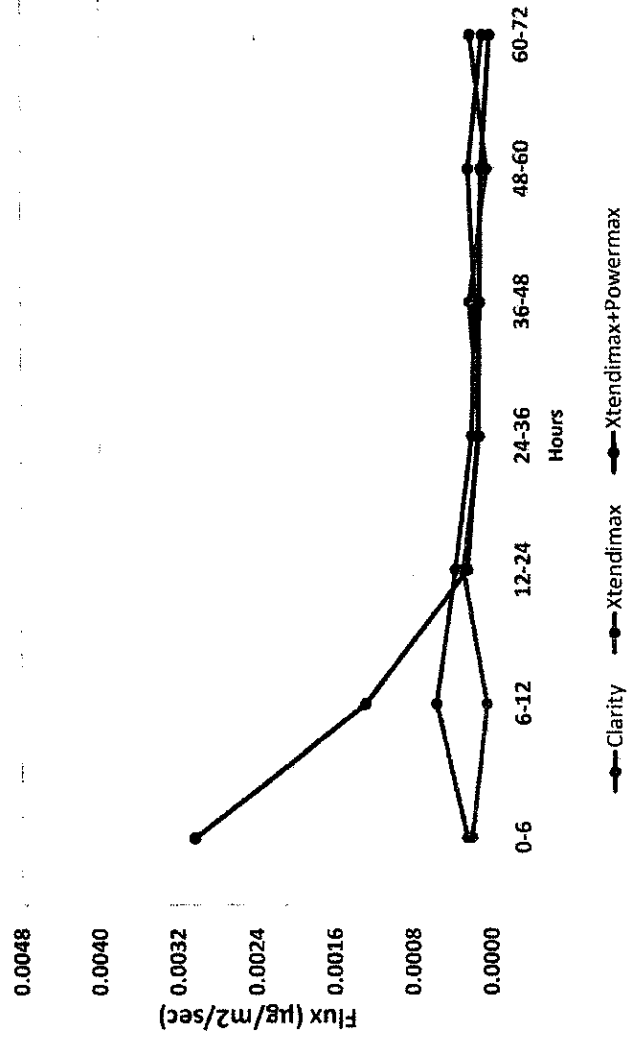
- 50' X 50' Plot
- 1lb/A dicamba + .75 lb glyphosate
- Temp. 70 -- 93 °F
- Test 48 hours
- Results
 - Amount of dicamba detected over 48 hour period is small percentage of total amount sprayed
 - 0.00037% for weed canopy
 - 0.00010% for bare ground
 - Four samplers 10' outside the sprayed area detected low levels during 48 hour period
 - Canopy <15% total outside plot than detected in center
 - Bare ground <3% total outside the plot than detected in center



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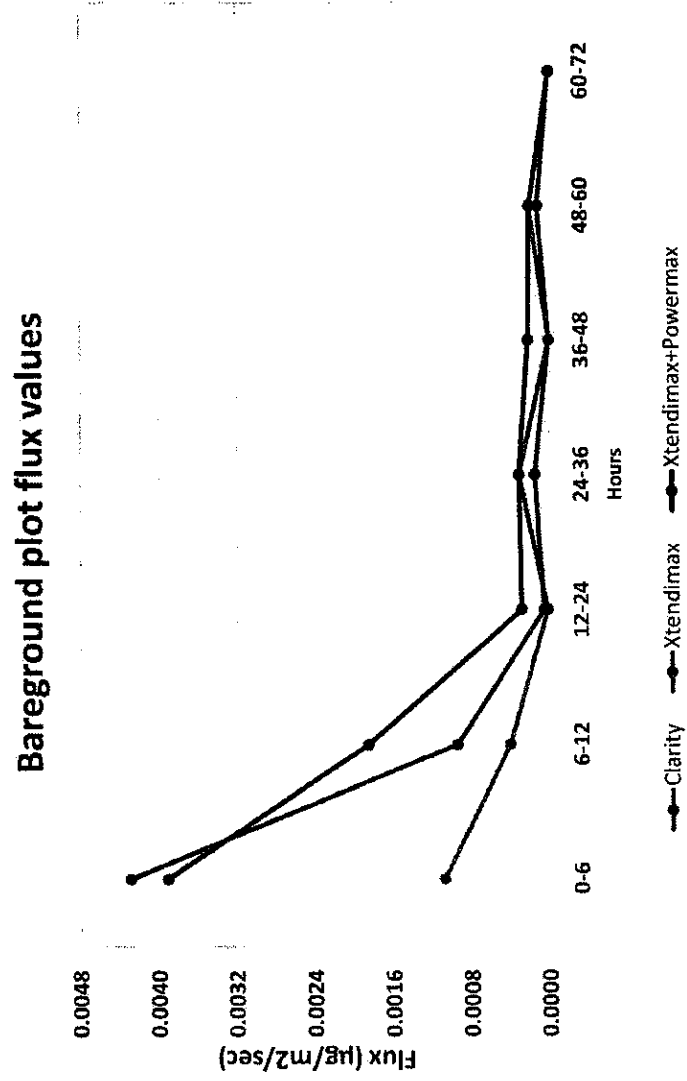
Flux results from REG studies

Cropped plot flux values



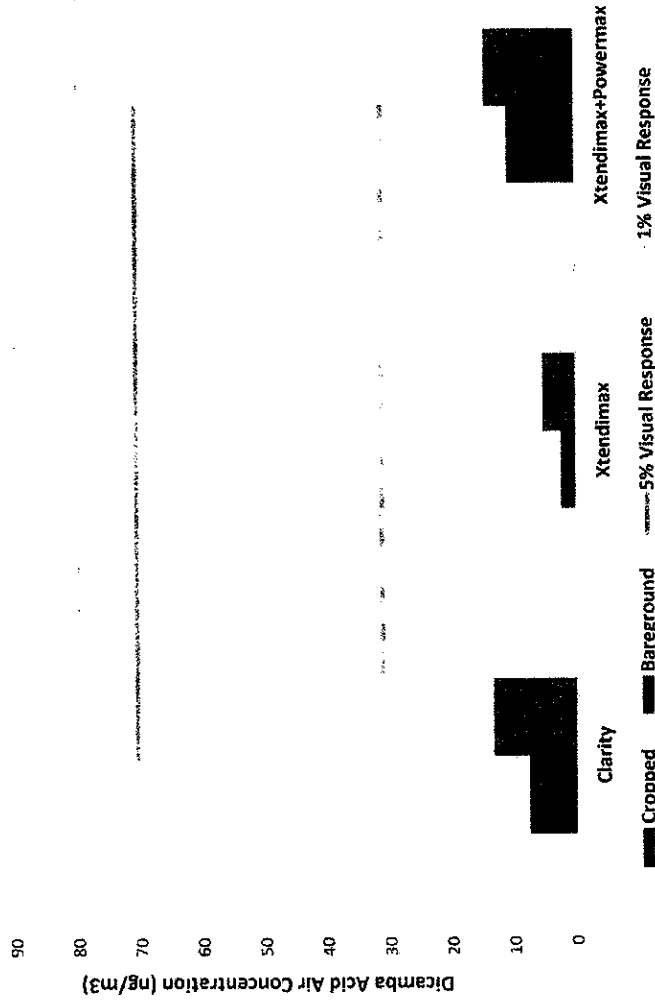
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Flux results from REG studies



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Modeled air concentration 5m from edge of field relative to air concentrations associated with visual response



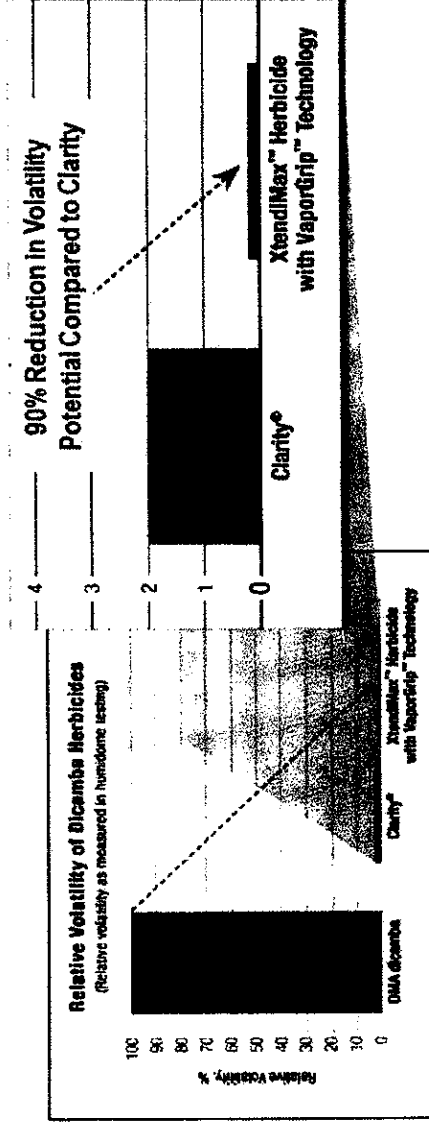
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Back up

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XtendiMax™ Herbicide with VaporGrip™ Technology

- Significant reduction in volatility potential compared to currently available dicamba formulations
 - Designed to be the industry's lowest volatility dicamba formulation through our exclusive VaporGrip™ Technology
 - Designed specifically for the Roundup Ready® Xtend Crop System



DIMA or acid formulations of dicamba will NOT be authorized by Monsanto

THIS PRESENTATION ON APPLICATION REQUIREMENTS IS NOT A SUBSTITUTE FOR THE PRODUCT LABELING ALWAYS READ AND FOLLOW ALL PRODUCT LABELING.

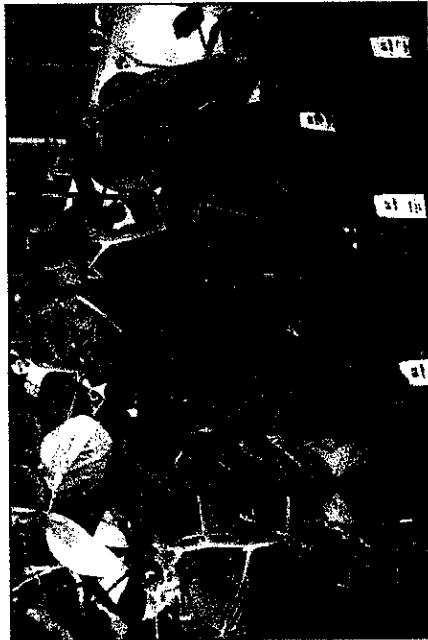
V1 - 11/2016

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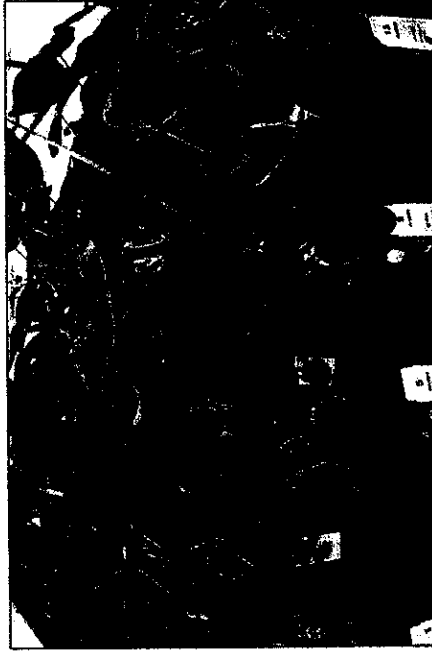
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XtendiMax™ Herbicide Low Volatility Response



Soybeans exposed for 24 hours to XtendiMax show low injury response at 14 DAT

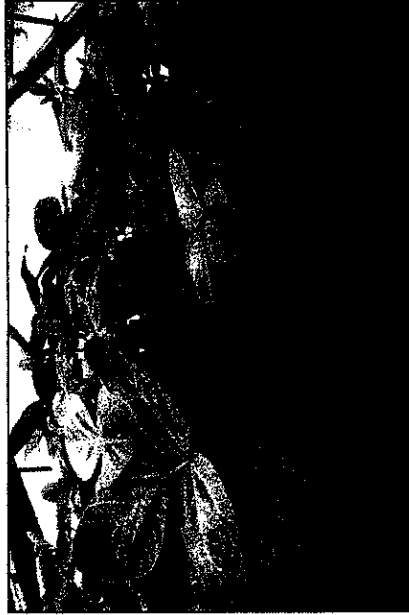
Soybeans exposed for 24 hours to DMA dicamba show injury response at 14 DAT



This information is for educational purposes only and is not an offer to sell Roundup Xtendi™, XtendiMax™, or Roundup Ready 2 Xtend™. These products are not yet registered or approved for sale or use anywhere in the United States.

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Roundup® Xtend™ with VaporGrip™ Technology Low Volatility Response in the Hoop House



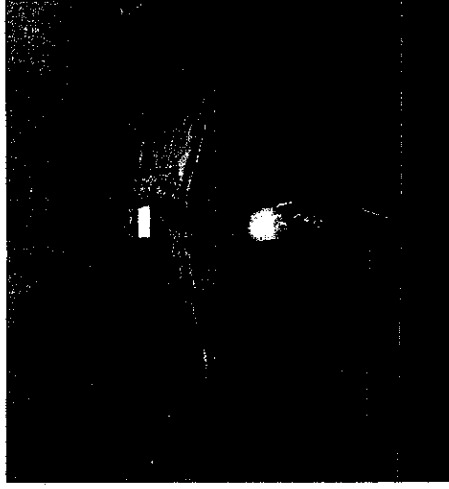
Soybeans exposed for 24 hours to Roundup® Xtend™ with VaporGrip™ Technology* show low injury response at 14 DAT
*pending regulatory approvals

Soybeans exposed for 24 hours to DMA dicamba + Roundup PowerMAX® Herbicide show injury response at 14 DAT



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Humidome Assay Determines Air Concentration of Dicamba



- Developed by Monsanto after years of researching methods
- Studies conducted at 95°F and high humidity
- Formulations and tank mixes are tested at 2X field rates and applied to soil
- Determines concentration of dicamba vapor
- Method presented to ASTM and published
- Results consistent with field studies
- Enabled other companies and labs to use the method

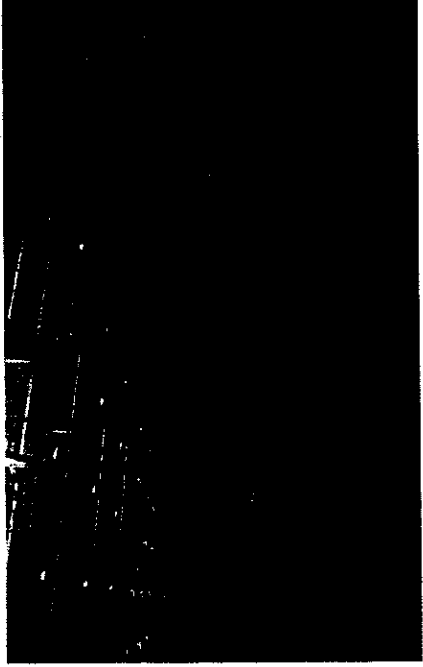
*Gavlick, W. K., Wright, D. R., MacInnes, A., Hemminghaus, J. W., Webb, J. K., Yermolenka, V. I., Su, W., "A Method to Determine the Relative Volatility of Auxin Herbicide Formulations," *Pesticide Formulation and Delivery Systems: 35th Volume, ASTM STP1587*, G. R. Goss, Ed., ASTM International, West Conshohocken, PA, 2016, pp. 24-32, doi:10.1520/STP158720150006

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Hoop House Volatility Assay Measures the Plant Effects of Dicamba



- 32 plants placed in each hoop house.
- Formulations tested at 2X field rates and sprayed onto glass Petri dishes which are placed in the middle of the hoop house.



- Hoop houses covered with plastic and sealed for minimum of 24 hours
- Plants removed and rated for injury response at 7 and 14 days after exposure

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vol·a·tile (völl'ə-tl, -tīl')adj.

- Chemistry
 - Evaporating readily at normal temperatures and pressures
 - Capable of being readily vaporized
- Analytical Chemistry
 - The compound can be analyzed by gas chromatography
 - High vapor pressure
 - Acetone = $3.0 \times 10^{+4}$ Pa
 - Dicamba acid = 4.5×10^{-3} Pa
 - 2,4-D acid = 1.9×10^{-5} Pa

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Humidome Based Test – Method Basics

- Method to assess relative volatility
- Track sprayer used to dose substrate
- Dosed substrate placed in a closed dome system
 - Controlled growth chamber environmental conditions
- Air drawn out of the closed dome system for 24 hours
 - Volatile analyte trapped on polyurethane foam (PUF)
- Solvent extraction of the PUF
 - Quantitation of analyte in extract by liquid chromatography mass spectrometry (LC-MS/MS)

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Humidome Environment

- Typical humidome chamber conditions
 - 35 C (95 F) & 40% Relative Humidity
 - Light cycle is based on a 14 hour day
- Inside humidome
 - Humidity goes up to 90% RH during the 24 hour time period
 - Soil moisture decreases during 24 hour time period
 - For example: 18% to 8%
 - Temperature 35 +/- 2 C during the 24 hour time period

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Lab Volatility Testing Notes

- Over 1230 lab volatility tests conducted since Jan 2008
- Soil vs Petri dish comparisons are not valid since surface area that is dosed is different
- If the relative humidity setting for the growth chamber that is used for the humidome testing is too high, then condensation can occur in the vacuum lines

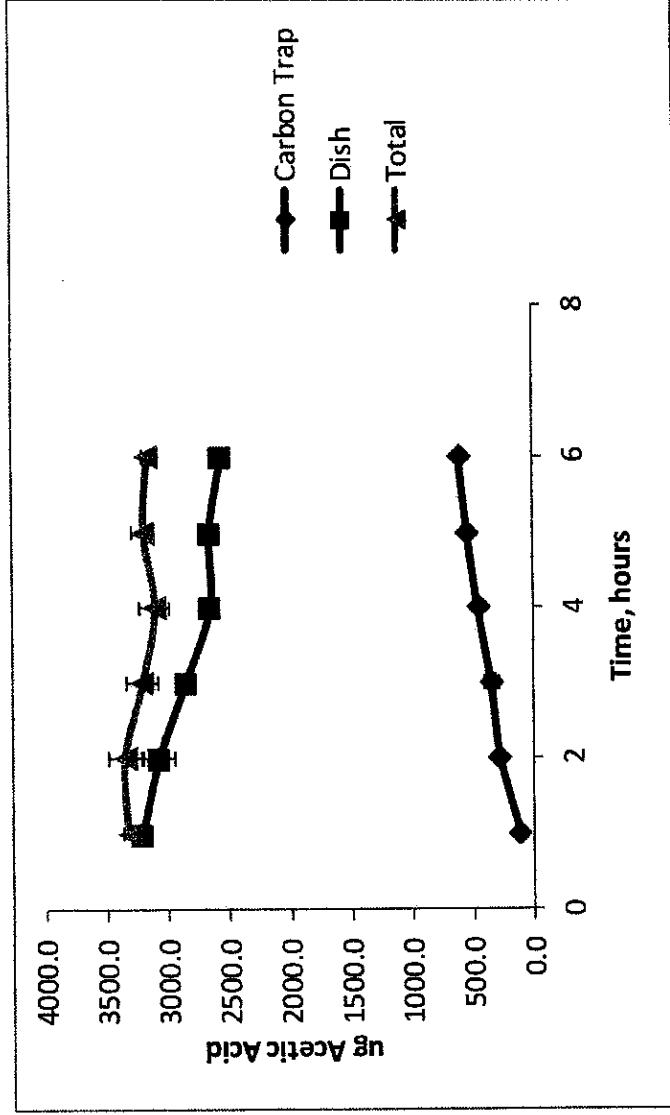
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Method to Generate Relative Volatility Data

- **Method Presented**
 - 35th ASTM International Symposium on Pesticide Formulation and Delivery Systems: Pesticides and Adjuvant Formulations, **October 2014**
- **Method Published**
 - “A Method to Determine the Relative Volatility of Auxin Herbicide Formulations,” *Pesticide Formulation and Delivery Systems: 35th Volume, ASTM STP1587*, G. R. Goss, Ed., ASTM International, West Conshohocken, PA, **2016**, pp. 24-32, doi:10.1520/STP158720150006.

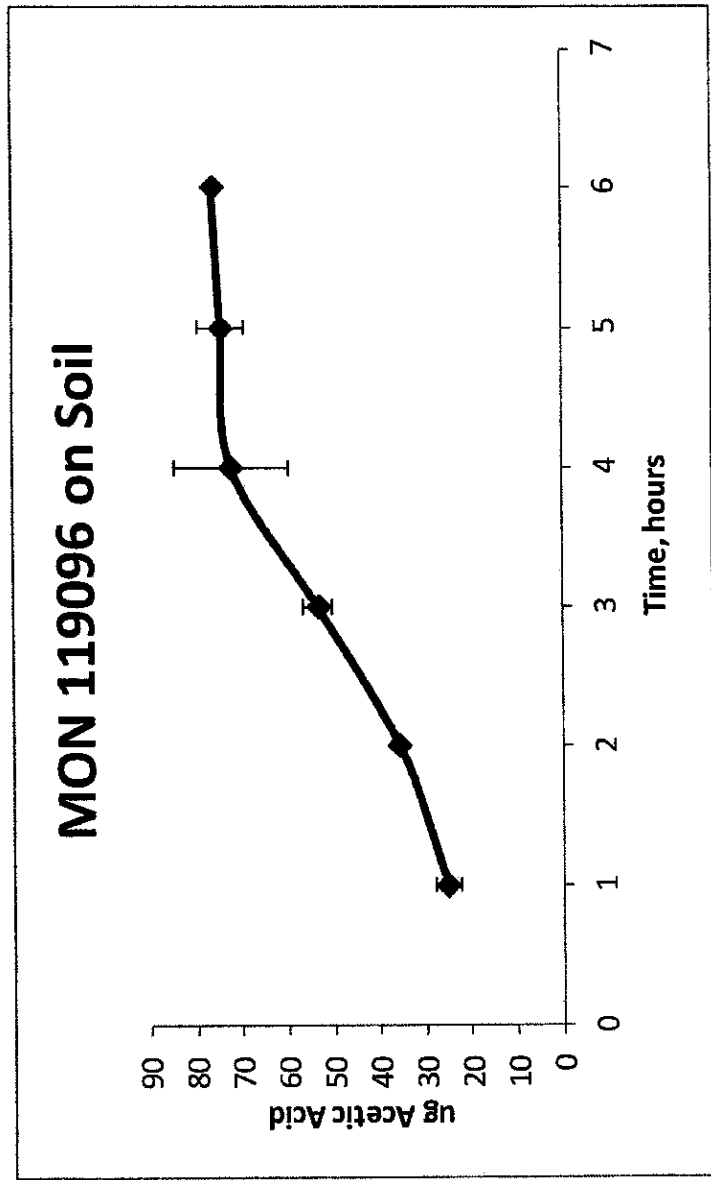
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Fate of Acetic Acid – MON 119096 on Petri Dish in Humidome



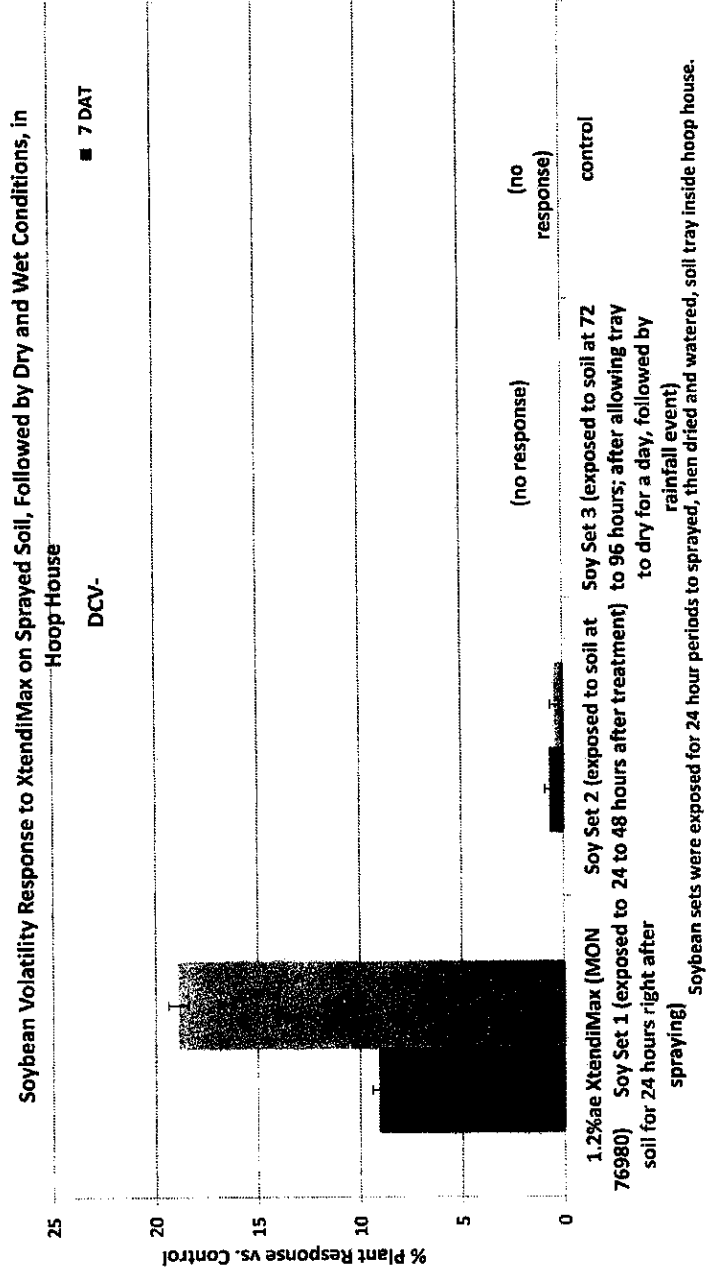
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Fate of Acetic Acid on Soil in Humidome



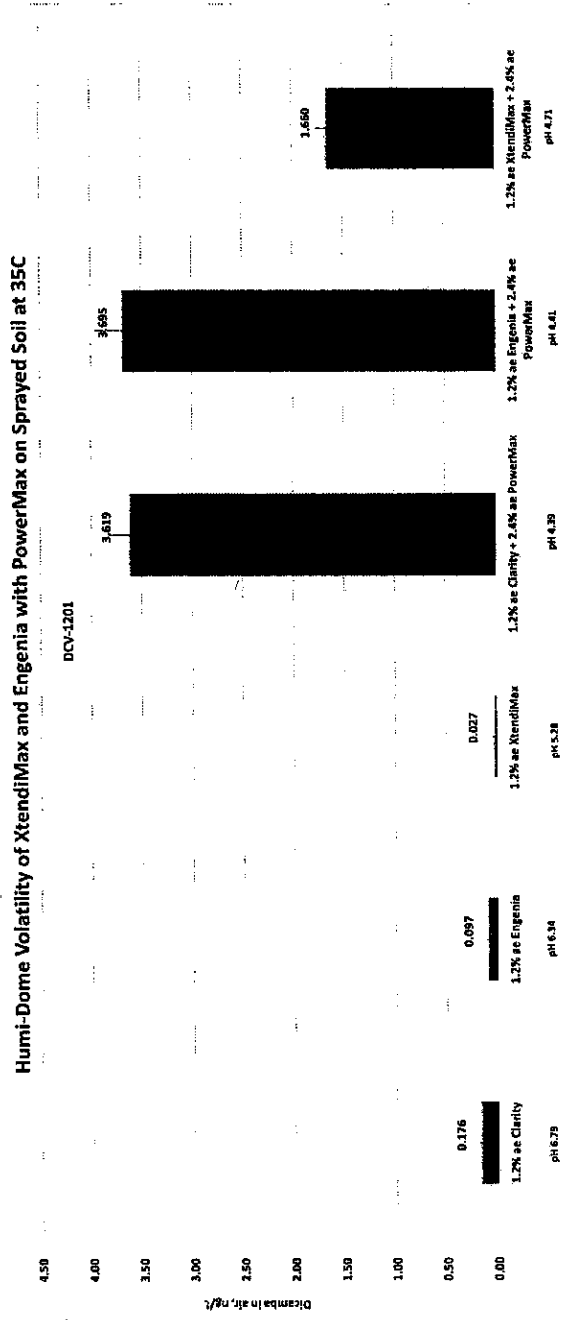
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Longer than 24 hour exposure in hoop house DCV-1167

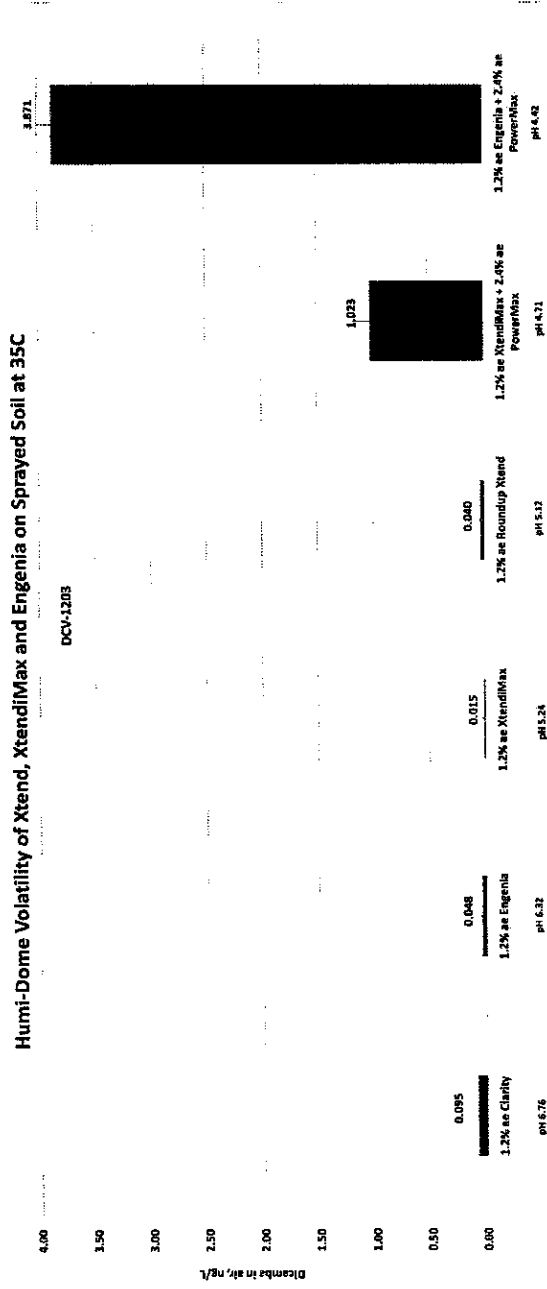


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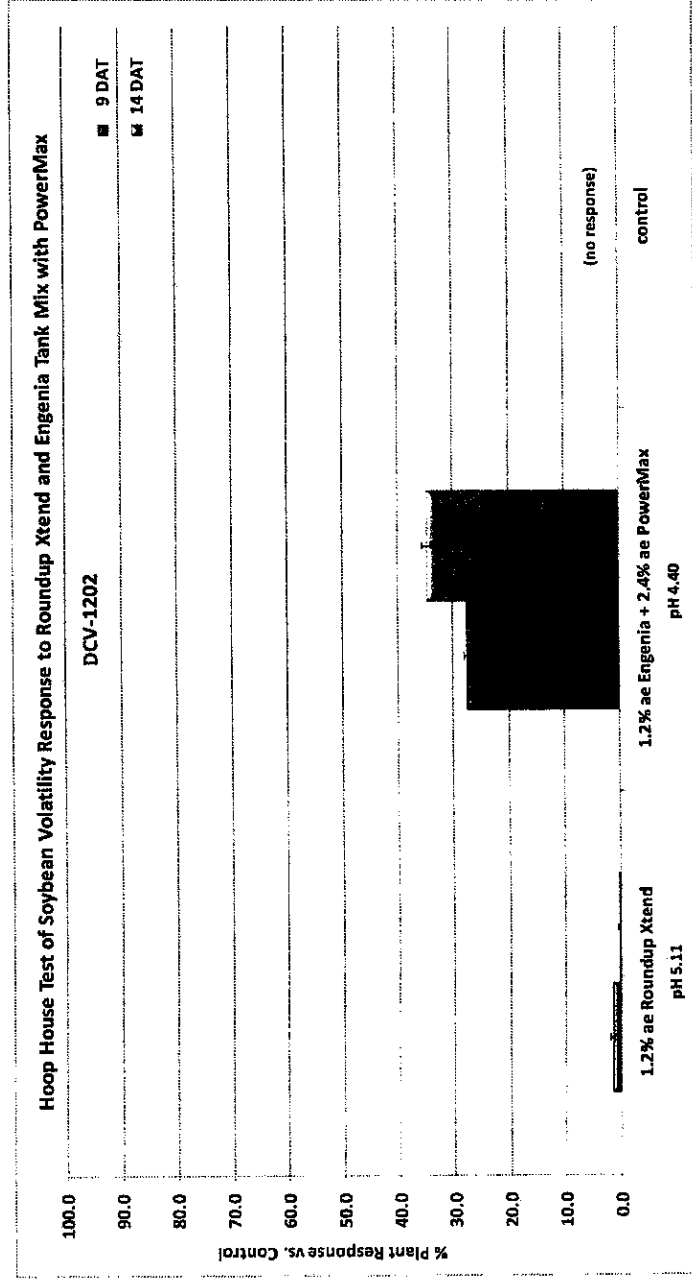
Engenia Humidome Data



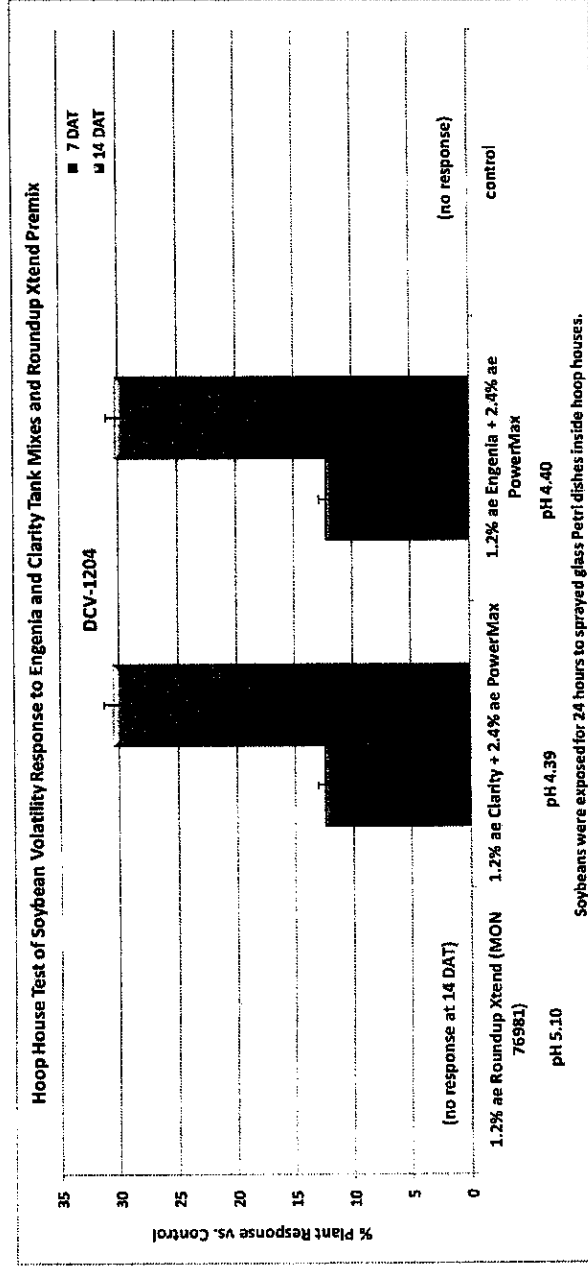
Engenia Humidome Data



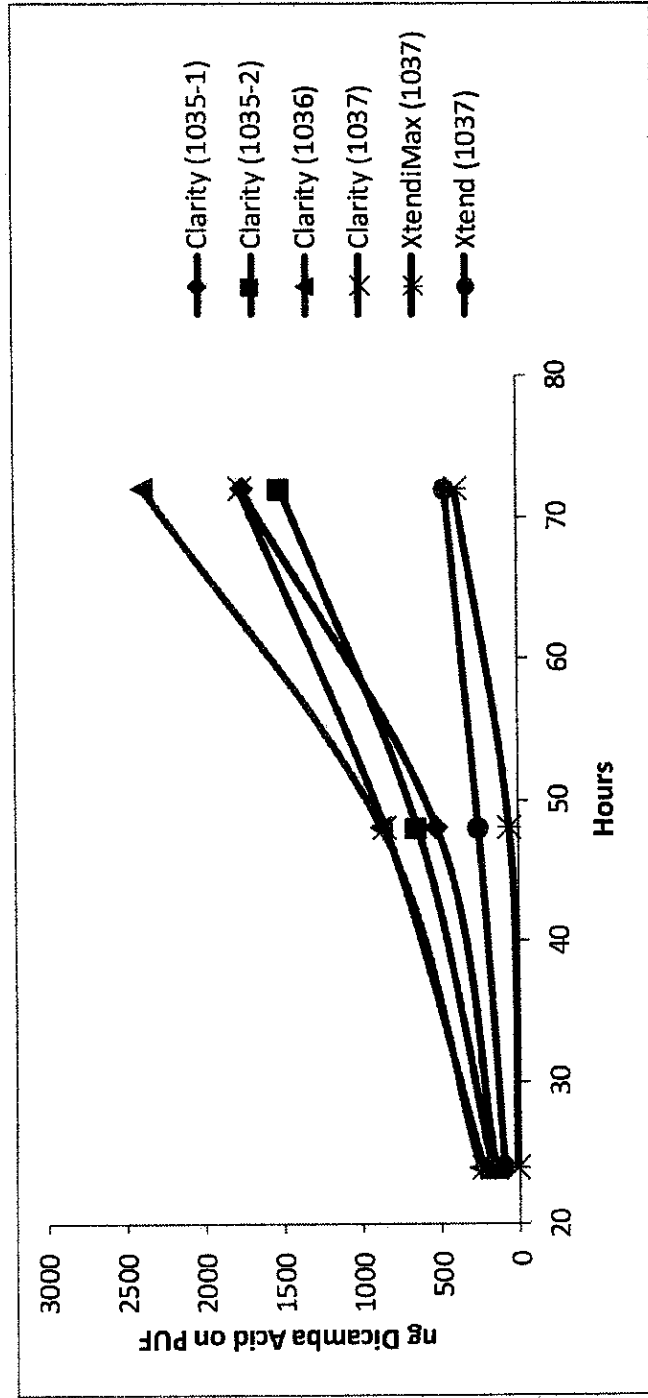
Engenia Hoop House Data



Engenia Hoop House Data



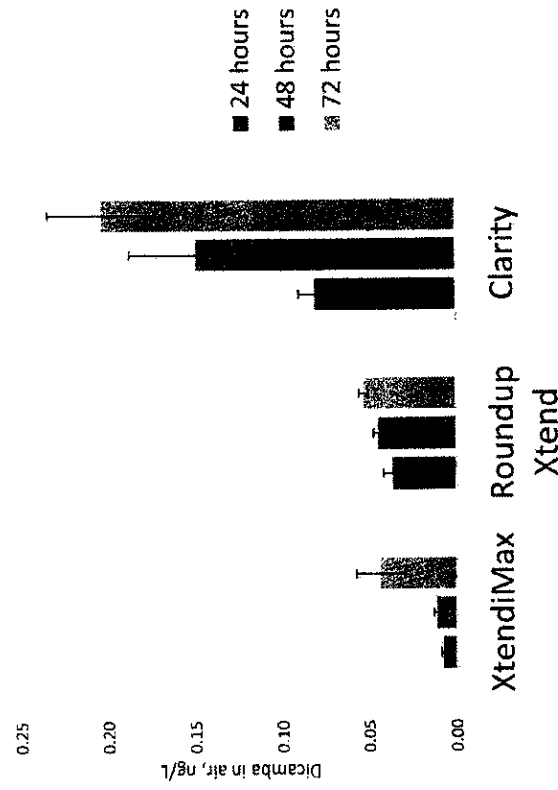
Total Dicamba Trapped on PUF @ 72 Hours Confirm Low VOL Profile of Xtendimax and Xtend



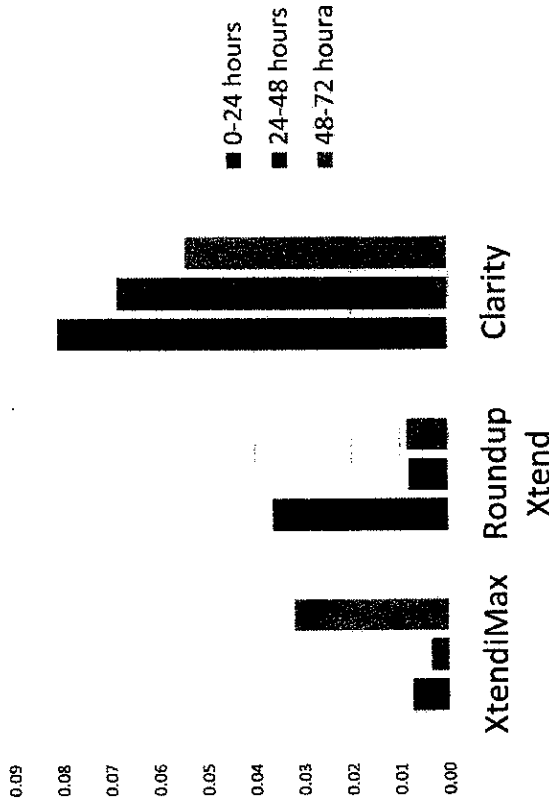
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Total Dicamba Trapped on PUF @ 72 Hours Confirm Low VOL Profile of Xtendimax and Xtend

Total dicamba measured at 24, 48 and 72 hours DCV-1037



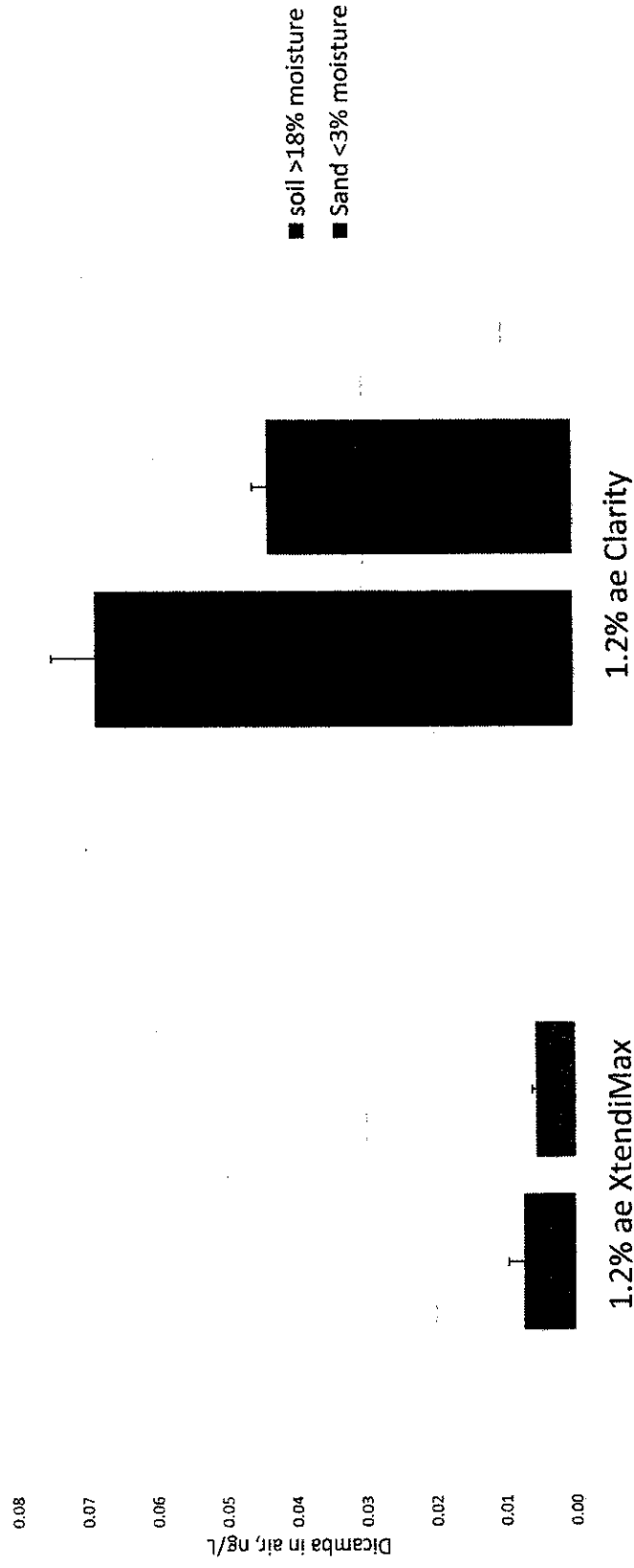
Dicamba measured in the individual 24 hour periods, calculated



Total amount of dicamba measured much lower for the VaporGrip formulations than Clarity

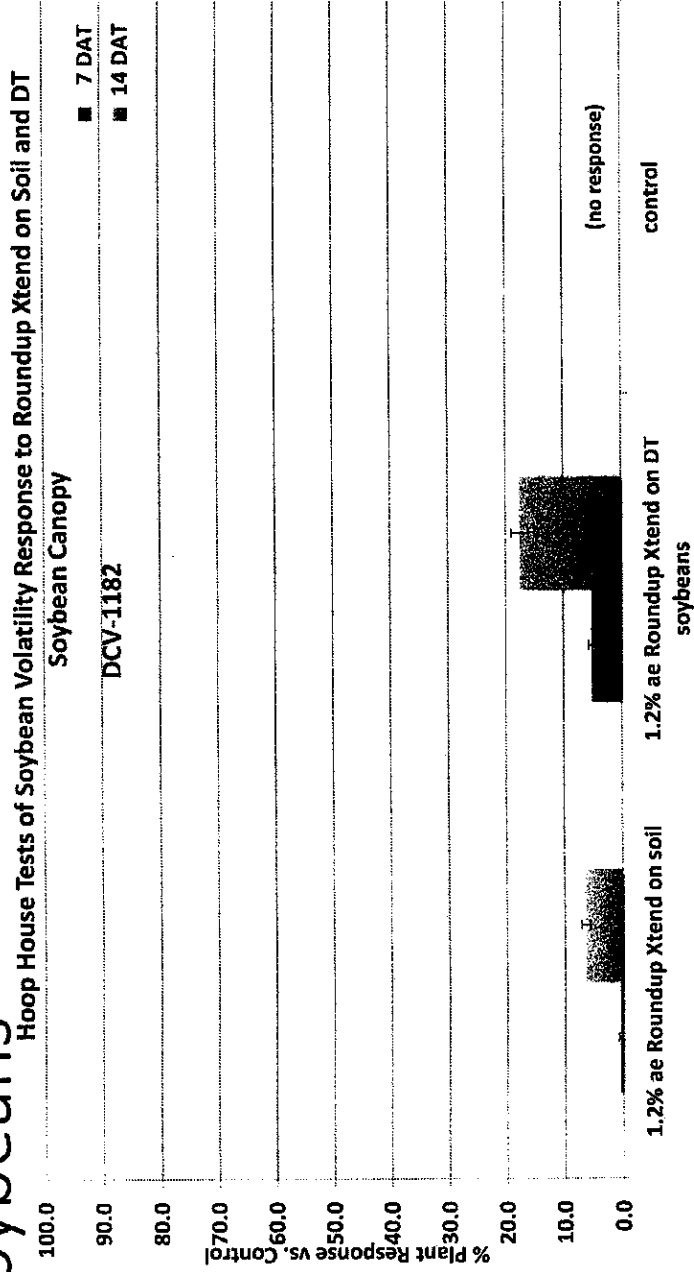
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Humidome data for XtendiMax and Clarity sprayed on soil or sand, more dicamba measured off soil but moisture may have an effect



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Hoop house data RR2Y soybeans exposed for 24 hours to Roundup Xtend sprayed on soil or canopy of Xtend soybeans



Higher levels of injury response seen in RR2Y soybeans exposed to Roundup Xtend sprayed on a canopy of Xtend soybeans than sprayed on soil

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