Learnings from 2018 on Off-target Movement of Auxin Herbicides

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• **Objective:** Assess the likely causes for off-target movement of Enlist One with a commercial application

• **Cotton:** XtendFlex

• **Application:** 1 qt/A Enlist One + 1 qt/A Liberty

• **Date:** August 6, 2018 (1:55 to 2:05 PM)

• **Sprayer setup**
  – 25 ft boom; 8 mph; 10 GPA, 24 inch height
  – AIXR 11003 nozzles

• **Environmental conditions during application**
  – Avg. 8.0 mph; Range of 7.0 to 9.5 mph
  – 89 F and 54% RH
Injury to Cotton

29 days after application

Injured

Treated
Injury from Enlist One

- Covered
- Uncovered

Distance from treated area (ft)

Injury (%)
0.5 to 72 hours after application
Objective: Assess the ability of the See-and-Spray system to control weeds and reduce off-target movement of dicamba.
• **Objective:** Assess the ability of the See-and-Spray system to reduce off-target movement of dicamba

• **Location:** Keiser, AR

• **Treatments:**
  – Open boom broadcast vs. See-and-Spray hooded boom broadcast
  – Open boom broadcast vs. See-and-Spray

• **Engenia + Roundup PowerMax + Intact**
See & Spray vs. Open Boom
(15 days after application)
See & Spray (Broadcast) vs. Open Boom (Broadcast)
(15 days after application)
Goal: Determine the movement of dicamba resulting from commercial field application.

Location: Proctor, AR

Trial size: 240 acres (360 ft x 660 ft)

Cooperators: Mike & Sherry

Treatment: XtendiMax + Roundup

From July 9 at 1:00 PM – July 16 at 2:58 PM there were no sustained wind speeds above 3 mph for a sufficient period to spray

Application made July 16 at 2:58 PM

ER 0823
An Example Temperature Inversion in Southeast Missouri in 2016

Air Temperatures on June 7, 2016

- Warmer (near surface)
- Cooler (near surface)

Temperature (F)

Time of Day

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Temperature During and After Application

Temperature (°F)

7/16/18 12:00 AM 7/17/18 12:00 PM

74 76 78 80 82 84 86 88 90 92 94
Wind Direction and Speed During Application at Boom Height
Wind direction during application (min)

0-15

15-30

30-45
Wind Direction Following Application at Boom Height

Date and Time

ER 0829
Wind Speed Following Application at Boom Height

Date and Time

ER 0830
Wind Direction at Two Heights During Application

![Graph showing wind direction at two heights](chart.png)
Injury to Soybean Adjacent to and Beneath Tarps

22 days after application

- Not covered
- Covered (tarp)

Injury (%)

<table>
<thead>
<tr>
<th>Direction</th>
<th>Not Covered</th>
<th>Covered (tarp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>40%</td>
<td>50%</td>
</tr>
<tr>
<td>East</td>
<td>40%</td>
<td>50%</td>
</tr>
<tr>
<td>South</td>
<td>50%</td>
<td>60%</td>
</tr>
<tr>
<td>West</td>
<td>30%</td>
<td>40%</td>
</tr>
</tbody>
</table>

ER 0834
17 days after application

Roundup Ready

Xtend
Contribution of Secondary Movement to Overall Soybean Injury

22 days after treatment (East Transect 2)

- Not covered
- Covered (bucket)

Injury (%) vs. Distance from treated field (ft)
Injury to Soybean on East of Treated Field

29 days after treatment

Distance from treated field (ft)

Injury (%)
Injury to Soybean on South Side of Treated Field

Distance from treated field (ft)

- South

29 days after treatment
Injury to Soybean on West Side of Treated Field

29 days after treatment

- West

Injury (%)

Distance from treated field (ft)
Injury to Soybean on North Side of Treated Field

29 days after treatment

Distance from treated field (ft)

Injury (%)
Injury to Soybean on Each Side of Treated Field

29 days after treatment

- North
- East
- South
- West

Distance from treated field (ft)

Injury (%)
Irrigation Schedule

Plot sprayed July 16

26 DAT
23 DAT
25 DAT
25 DAT
24 DAT
24 DAT
Rainfall, Irrigation, & Field Visits

![Graph showing rainfall, irrigation, and field visits over a period.]
Takeaways from Trial

• Symptomology observed on all four sides of field

• Secondary movement contributed greatly to observed damage
  – Volatility
  – Irrigation and possibly rainfall

• Damaged area from dicamba exceeded size of treated area
Irrigation with Contaminated Tailwater

• Dicamba dissolved in irrigation water at five known concentrations

• Applied as 1 acre inch of water via furrow irrigation
  – Held water on field with in-furrow soil dams to facilitate timely application of all treatments

• Ratings collected from zones within a furrow
  – Mid-furrow ratings represent “average” impact
  – Bottom of furrow ratings represent max impact
Damage from dicamba in irrigation water applied at V3 stage

<table>
<thead>
<tr>
<th>Condition</th>
<th>None</th>
<th>0.1 ppm</th>
<th>0.5 ppm</th>
<th>5 ppm</th>
</tr>
</thead>
</table>

ER 0849
Dicamba in irrigation water applied at V3 and R1 growth stages

V3  0.1 ppm  R1
Symptoms following irrigation with dicamba contaminated water
September 18, 2018
• **Objective:** Assess relative differences in volatility of auxin products in the field inside of low tunnels

• **Location:** Fayetteville, Lonoke, & Tillar

• **Growth stage:** V2 to V6

• Tunnels and treated soil removed 48 hours after application
Low Tunnel Volatility Setup

- Air sampler
- Flats of treated soil
- Soybean rows
- Tunnel

Diagram with numbered sections: 1, 2, 3, 4, 5, 6, 7, 8
Low Tunnel Volatility Evaluation of Dicamba Formulations

26 days after application

- Maximum

<table>
<thead>
<tr>
<th>Injury (%)</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>Engenia + Roundup PowerMax</td>
</tr>
<tr>
<td>25</td>
<td>Engenia Pro</td>
</tr>
<tr>
<td>20</td>
<td>XtendiMax + Roundup PowerMax</td>
</tr>
<tr>
<td>15</td>
<td>XtendiMax + Roundup PowerMax (sterilized soil)</td>
</tr>
<tr>
<td>10</td>
<td>Experimental Dicamba + Glyphosate</td>
</tr>
<tr>
<td>5</td>
<td>Untreated</td>
</tr>
</tbody>
</table>

ER 0857
Low Tunnel Volatility Evaluation
(Surface and Timing)

18 days after application

Maximum

XtendiMax + Liberty + Roundup PowerMax

a

b

c

Untreated

XtendFlex Cotton

XtendFlex Cotton

Bareground

Bareground

0 days

0 days

4 days

4 days

(%) Injury

Surface

Timing
Low Tunnel Volatility Evaluation (Surface and Timing)

22 days after application

XtendiMax + Liberty + Roundup PowerMax II

A: Untreated
B: XtendFlex Cotton
C: Bareground Cotton

Timing

Surface → Bareround

Distance to 5% (ft)

35 30 25 20 15 10 5 0
2018 Lonoke Low Tunnel Study
14 Days After Treatment

Injury (%)

Xtendimax + Roundup + AMS: 29
Xtendimax + Liberty: 21
Clarity + Roundup: 13
Engenia + Roundup: 12
Xtendimax + Roundup: 19
Tavium + Roundup: 16
Loyant: 10

LSD = 10
2018 Tillar Low Tunnel Study
14 Days After Treatment

Injury (%)

- Xtendimax + Roundup + AMS: 45%
- Xtendimax + Liberty: 34%
- Clarity + Roundup: 36%
- Engenia + Roundup: 28%
- Engenia + Outlook + Roundup: 32%
- Xtendimax + Roundup: 20%
- Tavium + Roundup: 9%
- Loyant: 0%

ER 0864
pH of XtendiMax Spray Solutions

Solution pH

- Before application
- After application

Water source  | XtendiMax  | XtendiMax + SelectMax  | XtendiMax + Roundup PMax  | XtendiMax + Roundup PMax + Warrant  | XtendiMax + Roundup PMax + Warrant (4 days)

4 | 5 | 5.5 | 6 | 6.5 | 7 | 7.5 | 8 | 8.5

Treatment

ER 0866
- **Objectives:** Determine if Roundup PowerMax increases off-target movement of XtendiMax
- **Soybean:** LibertyLink
- **Applications:**
  1. XtendiMax + Roundup PowerMax + *Quadris* + Intact
  2. XtendiMax + *Quadris* + Intact
- **Date:** August 13, 2018
- **Sprayer setup:**
  - 25 ft boom; 6 mph; 15 GPA, 24 inch height
  - TTI 11003 nozzles
- **Environmental conditions:**
  - Avg. 3.2 mph; range 0 to 5.7 mph
  - Daily max. 93 F
14 days after treatment
• **Objective:** Determine if non-Xtend soybean varieties differ in tolerance to drift rates of dicamba

• **Location:** Fayetteville, AR

• **Rate:** 1/250X
  (0.002 lb/A or 0.088 fl oz/A XtendiMax)

• **Growth stage:** V3 & R1
Relationship between environmental conditions and XtendiMax volatility
Inversion Frequency

Mississippi County

Crittenden County

Lee County

Washington County
Conclusions thus far from 2018

- Damaged to soybean caused by Loyant was not a result of volatility
- Off-target damage caused by Enlist One is a result of physical drift or tank contamination
- Addition of Roundup PowerMax to dicamba products increases volatility and off-target movement
- Irrigation from tailwater recovery systems in areas where dicamba is used should be a concern
- Volatility continues to be a significant contributor to off-target movement of dicamba during the summer months
Additional On-going Projects

- Can SelectMax substitute for Roundup PowerMax as a dicamba tank-mix partner without increasing volatility?
- Does length of time in spray tank influence volatility?
- Does soil pH influence volatility of dicamba?
- Relationship between dicamba air concentration and symptomology on soybean?
- Influence of rainfall or irrigation on XtendiMax volatility
Encouragement through research

- Experimental dicamba is superior to XtendiMax & Engenia (Is this good enough?)

- The relationship between XtendiMax volatility and temperature in the field soon be better understood
  - Complicated by interaction with other factors

- Removing Roundup PowerMax from the spray and replacing with SelectMax

- Use of See-and-Spray will reduce off-target movement from physical drift and volatility
2018 Support

• Direct or indirect support
  – Mike & Dusty Carlson
  – U of A Systems Division of Agriculture
  – Arkansas State Plant Board
  – Northeast Research and Extension Center
  – Lon Mann Cotton Branch Station
  – Arkansas Agricultural Research Center
  – BASF, Corteva, & Bayer CropScience
  – United Soybean Board

• $350,000 spent on volatility research