Utilization of Synthetic Auxin Herbicides in Soybean

Travis Legleiter
Assistant Extension Professor – Weed Science
Research and Education Center at Princeton
New Soybean Traits

• Herbicide-resistant weeds a major threat in soybean
• Post emerge soybean herbicides restricted to 2-3 MOA’s with variable control
• Commercialization of 2,4-D, Dicamba, and HPPD tolerant soybean systems offer additional MOA’s
• Drift and volatilization of synthetic auxin and HPPD herbicides a major concern
Growth Regulator Resistant Soybean
A Potentially Treacherous Technology

- Summer of 2016
  - Dicamba resistant crop seed sold, but without herbicide approval
  - 18,000 Acres of dicamba drift complaints in Missouri
  - Arkansas and Tennessee also saw multiple cases

DICAMBA MOVEMENT PROMPTS ARKANSAS SHOOTING
ARGUMENT BETWEEN FARMERS RESULTS IN DEATH, SAYS AN ARKANSAS COUNTY SHERIFF.

Missouri's Largest Peach Farmer Sues Monsanto for Losses From Illegal Herbicide Use
Dec. 4, 2016 02:15PM EST
Growth Regulator Resistant Soybean
A Potentially Treacherous Technology

35,000 Acres of Soybean injured in Kentucky
Estimates of Dicamba-injured Soybean Acreage in the U.S. as Reported by State Extension Weed Scientists (*as of October 15, 2017)

*Total: ~3.6 million
In your estimation, what percent of the dicamba injury events in your county were due to the following:

- Vapor Drift: 65%
- Unsure: 20%
- Tank Contamination: 10%
- Droplet Drift: 10%
Influences on Drift
*Outside of Your Control*

- **Weather**
  - Wind Speed
    - *Increased speed = Increased drift*
  - Temperature & Humidity
    - *High temp & low humidity = Droplet evaporation & increased drift*
- Air Stability/Inversions
  - *Spraying into an inversion can suspend small droplets*
Influences on Drift

Within Your Control

• Droplet Size
  – Formulation
  – Nozzle pressure
  – Nozzle size
  – Nozzle type
• Height of Release

<table>
<thead>
<tr>
<th>Droplet Size (µm)</th>
<th>5 mph</th>
<th>10 mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>200</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>400</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>600</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>
Droplet Size and Nozzles

- Flat fan nozzles create a “sheet” of spray solution that breaks into droplets due to air resistance

- Factors that influence how the sheet breaks (In general)
  - Pressure: Increasing pressure = Quicker sheet break and smaller droplets
  - Nozzle (orifice) size: Small orifice = Smaller droplets
  - Nozzle design: Alters the magnitude of the above two factors
Droplet Size and Nozzles Design

- Two stage nozzles reduce pressure on exit orifice, thus reducing driftable fines
- Turbulence chambers further reduce pressure at the exit orifice
- Air induction nozzles create more consistent droplet spectrums and further reduce driftable fines

<table>
<thead>
<tr>
<th>Dritable Droplets*</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOZZLE TYPE (0.5 GPM FLOW)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>XR – Extended Range TeeJet (110°)</td>
</tr>
<tr>
<td>TT – Turbo TeeJet (110°)</td>
</tr>
<tr>
<td>TTJ60 – Turbo TwinJet (110°)</td>
</tr>
<tr>
<td>TF – Turbo FloodJet</td>
</tr>
<tr>
<td>AIKR – Air Induction XR (110°)</td>
</tr>
<tr>
<td>AIITJ60 – Air Induction Turbo TwinJet (110°)</td>
</tr>
<tr>
<td>AI – Air Induction TeeJet (110°)</td>
</tr>
<tr>
<td>TTI – Turbo TeeJet Induction (110°)</td>
</tr>
</tbody>
</table>

*Data obtained from Oxford VisiSizer system spraying water at 70°F (21°C) under laboratory conditions.
Broadcast Nozzle Requirements
A New EPA Label Requirement

• Nozzles with Pre-Orifice, Turbulence Chamber and Venturi Air Induction designs

• Reduce driftable fines and produce very coarse to ultra coarse droplets

• Larger droplets reach terminal velocity faster and less apt to move horizontally
Okay, But What About Coverage?
Herbicide Coverage

• Larger droplets applied at lower spray application volumes results in reduced herbicide coverage

• Reduction in coverage does not always correlate with absorption or efficacy

• Herbicide performance influenced by droplet size, carrier volume, weed species, herbicide, and interfering canopy

Ramsdale and Messersmith 2001
Knoche 1994
Evaluation of herbicide coverage in a soybean canopy
Spray Droplet Analysis
Roundup PowerMax plus 2,4-D Amine

% <200 μm

Nozzle Size: 025 Orifice

**XR**

- Dv50: 252 μm
- Category: Fine
- 34%

**TT**

- Dv50: 374 μm
- Category: Coarse
- 15%

**AIXR**

- Dv50: 510 μm
- Category: Ex. Coarse
- 5%

**TTI**

- Dv50: 919 μm
- Category: Ultra Coarse
- 0.5%

Nozzle Size: 015 Orifice

**XR**

- Dv50: 214 μm
- Category: Fine
- 45%

**TT**

- Dv50: 359 μm
- Category: Coarse
- 14%

**AIXR**

- Dv50: 543 μm
- Category: Ex. Coarse
- 5%

**TTI**

- Dv50: 945 μm
- Category: Ultra Coarse
- 0.5%

Spray Card Images for visual reference ONLY. Droplet sizes and categories analyzed using laser diffraction at the University of Nebraska PAT lab in accordance to ASAE S542.1.
Spray Card Coverage
Roundup PowerMax plus 2,4-D Amine

Table 7. Spray solution coverage of water sensitive cards placed at 12, 8, and 4-inch heights in 12-inch tall soybean, as influenced by spray volume.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>12 Inch</td>
<td>22 B</td>
<td>13 B</td>
<td></td>
<td>17 B</td>
<td>9 B</td>
<td></td>
<td>12 B</td>
<td>7 B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 Inch</td>
<td>17 B</td>
<td></td>
<td>9 B</td>
<td></td>
<td></td>
<td>17 A</td>
<td>28 A</td>
<td></td>
<td>11 A</td>
</tr>
<tr>
<td></td>
<td>4 Inch</td>
<td>12 B</td>
<td>7 B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>42 A</td>
<td>24 A</td>
<td>34 A</td>
<td>17 A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b Values followed by a different letter are significantly different. Tukey HSD (α =0.05)
Table 6. Spray solution coverage of water sensitive cards placed at 12, 8, and 12-inch heights in 12-inch tall soybean, as influenced by spray nozzle type.

<table>
<thead>
<tr>
<th>Nozzle Type</th>
<th>12 Inch</th>
<th>8 Inch</th>
<th>4 Inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>XR</td>
<td>35.9 A</td>
<td>28.2 A</td>
<td>18 A</td>
</tr>
<tr>
<td></td>
<td>17 A</td>
<td>10.4 B</td>
<td>7 A</td>
</tr>
<tr>
<td>TT</td>
<td>34 A</td>
<td>26 AB</td>
<td>21 A</td>
</tr>
<tr>
<td></td>
<td>19 A</td>
<td>15.1 A</td>
<td>9 A</td>
</tr>
<tr>
<td>AIXR</td>
<td>35.5 A</td>
<td>26.7 AB</td>
<td>22 A</td>
</tr>
<tr>
<td></td>
<td>19 A</td>
<td>12.2 AB</td>
<td>10 A</td>
</tr>
<tr>
<td>TTI</td>
<td>23.8 B</td>
<td>19.9 B</td>
<td>17 A</td>
</tr>
<tr>
<td></td>
<td>19 A</td>
<td>13.5 AB</td>
<td>9 A</td>
</tr>
</tbody>
</table>


Values followed by a different letter are significantly different. Tukey HSD (\(\alpha = 0.05\)).
Spray Card Coverage
Roundup PowerMax plus 2,4-D Amine

• Influence of Spray Nozzle Type on Coverage was Inconsistent
  - Inconsistency likely due to differences in Canopy development

• TTI and AIXR achieved equivalent coverage as the TT and XR in both years at the 4 inch height where target weed SHOULD exist

• Spray Volume had the largest Influence at all heights in both years.
  - 15 GPA achieved greater coverage than 10 GPA
Materials and Methods

• Trial Design
  – RCBD with 6 replications
  – 3 by 8 meter plots
  – Soybean planted in 38-cm rows

• Application Parameters
  – 2-m ATV mounted boom
  – 19 km h\(^{-1}\) travel speed
  – 276 kPa
  – 94 L ha\(^{-1}\) spray output
**Materials and Methods**

Broadcast spray nozzle designs evaluated for differences in spray deposition on glyphosate-resistant Palmer amaranth, giant ragweed, marestail, and common waterhemp.

<table>
<thead>
<tr>
<th>Nozzle Brand Name</th>
<th>Drift Reduction Design Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TeeJet® Extended Range XR 11004</td>
<td>None (Flat Fan Standard)</td>
</tr>
<tr>
<td>Turbo TeeJet® TT 11004</td>
<td>Pre-Orifice &amp; Turbulence Chamber</td>
</tr>
<tr>
<td>TeeJet® Air Induction Extended Range AIXR 11004</td>
<td>Pre-Orifice &amp; Air Induction</td>
</tr>
<tr>
<td>Turbo TeeJet® Induction TTI 11004</td>
<td>Pre-Orifice, Turbulence Chamber &amp; Air Induction</td>
</tr>
</tbody>
</table>

* In accordance to manufacture literature.
### Enlist Duo Droplet Size Classification @ 40 PSI

<table>
<thead>
<tr>
<th>Enlist Size</th>
<th>XR11004</th>
<th>TT11004</th>
<th>AIXR11004</th>
<th>TTI11004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine</td>
<td>76 fl oz</td>
<td>19 fl oz</td>
<td>76 fl oz</td>
<td>19 fl oz</td>
</tr>
<tr>
<td>Medium</td>
<td>76 fl oz</td>
<td>19 fl oz</td>
<td>76 fl oz</td>
<td>19 fl oz</td>
</tr>
<tr>
<td>Coarse</td>
<td>Very Coarse</td>
<td></td>
<td></td>
<td>Extremely Coarse</td>
</tr>
<tr>
<td>Very Coarse</td>
<td></td>
<td></td>
<td></td>
<td>Ultra Coarse</td>
</tr>
</tbody>
</table>

*Note: XR11004, TT11004, AIXR11004, TTI11004 are spray tip identifiers.*
### Engenia Plus Roundup PowerMax

**Droplet Size Classification @ 40 PSI**

<table>
<thead>
<tr>
<th>Fine</th>
<th>Medium</th>
<th>Coarse</th>
<th>Very Coarse</th>
<th>Extremely Coarse</th>
<th>Ultra Coarse</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 fl oz Engenia + 28 fl oz RUP</td>
<td>3 fl oz Engenia + 7 fl oz RUP</td>
<td>13 fl oz Engenia + 28 fl oz RUP</td>
<td>3 fl oz Engenia + 7 fl oz RUP</td>
<td>13 fl oz Engenia + 28 fl oz RUP</td>
<td>3 fl oz Engenia + 7 fl oz RUP</td>
</tr>
</tbody>
</table>
## Spray Solution Deposition on Kromekote Cards
### Enlist Duo

<table>
<thead>
<tr>
<th></th>
<th>XR 11004</th>
<th>TT 11004</th>
<th>AIXR 11004</th>
<th>TTI 11004</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deposition Density</strong>&lt;sup&gt;a&lt;/sup&gt; (Count cm&lt;sup&gt;-2&lt;/sup&gt;)</td>
<td>42 A</td>
<td>36 B</td>
<td>23 C</td>
<td>12 D</td>
</tr>
<tr>
<td><strong>Deposition Coverage</strong>&lt;sup&gt;a&lt;/sup&gt; (% area)</td>
<td>18.6 A</td>
<td>17.7 A</td>
<td>17.8 A</td>
<td>15 B</td>
</tr>
</tbody>
</table>

<sup>a</sup>Means with a different letter are significantly different based on Tukey HSD P<0.05

* Photos of Kromekote cards have been inverted for visual detail
## Spray Solution Deposition on Kromekote Cards

### Engenia plus Roundup PowerMax

<table>
<thead>
<tr>
<th></th>
<th>XR 11004</th>
<th>TT 11004</th>
<th>AIXR 11004</th>
<th>TTI 11004</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deposition Density</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Count cm&lt;sup&gt;-2&lt;/sup&gt;)</td>
<td>46 A</td>
<td>37 B</td>
<td>24 C</td>
<td>12 D</td>
</tr>
<tr>
<td><strong>Deposition Coverage</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(% area)</td>
<td>20.6 A</td>
<td>20.5 A</td>
<td>19 A</td>
<td>15.5 B</td>
</tr>
</tbody>
</table>

<sup>a</sup>Means with a different letter are significantly different based on Tukey HSD P<0.05

* Photos of Kromekote cards have been inverted for visual detail
Herbicide Spray Solution Deposition on Glyphosate-resistant Palmer Amaranth
Enlist Duo

Spray Solution Depositon (µl cm⁻²)

<table>
<thead>
<tr>
<th></th>
<th>XR 11004</th>
<th>TT 11004</th>
<th>AIXR 11004</th>
<th>TTI 11004</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 p=0.4426</td>
<td>0.5248</td>
<td>0.5687</td>
<td>0.5341</td>
<td>0.6111</td>
</tr>
<tr>
<td>2015 p=0.7723</td>
<td>0.4452</td>
<td>0.3566</td>
<td>0.2817</td>
<td>0.3837</td>
</tr>
</tbody>
</table>

Theoretical Maximum Deposition = 0.935 µl cm⁻²
Herbicide Spray Solution Deposition on Glyphosate-resistant Waterhemp

Enlist Duo

Theoretical Maximum Deposition = 0.935 µl cm\(^{-2}\)

**2014**
- XR 11004: 0.3956
- TT 11004: 0.378
- AIXR 11004: 0.4474
- TTI 11004: 0.4926

**2015**
- XR 11004: 0.5174
- TT 11004: 0.5625
- AIXR 11004: 0.5708
- TTI 11004: 0.5231

**p** = 0.3687 for 2014

**p** = 0.7176 for 2015
Herbicide Spray Solution Deposition on Glyphosate-resistant Giant Ragweed
Enlist Duo

Theoretical Maximum Deposition = 0.935 µl cm⁻²

\[ p = 0.3957 \]
Herbicide Spray Solution Deposition on Glyphosate-resistant Marestail Enlist Duo

Theoretical Maximum Deposition = 0.935 µl cm⁻²

$p=0.2085$
Herbicide Spray Solution Deposition on Glyphosate-resistant Palmer amaranth Engenia plus Roundup PowerMax

Spray Solution Depositon (µl cm⁻²)

Theoretical Maximum Deposition = 0.935 µl cm⁻²

\( p = 0.7158 \)
Herbicide Spray Solution Deposition on Glyphosate-resistant Waterhemp
Engenia plus Roundup PowerMax

Theoretical Maximum Deposition = 0.935 µl cm⁻²

$p = 0.8245$
Herbicide Spray Solution Deposition on Glyphosate-resistant Giant Ragweed Engenia plus Roundup PowerMax

Theoretical Maximum Deposition = 0.935 µl cm⁻²
Herbicide Spray Solution Deposition on Glyphosate-resistant Marestail Engenia plus Roundup PowerMax

Spray Solution Deposition (µl cm\(^{-2}\))

- XR 11004: 0.3978
- TT 11004: 0.4068
- AIXR 11004: 0.3625
- TTI 11004: 0.3666

Theoretical Maximum Deposition = 0.935 µl cm\(^{-2}\)

\(p = 0.7618\)
Herbicide Spray Solution Deposition on Glyphosate-resistant Weeds

No differences in herbicide solution deposition observed between nozzles on four weeds for either glyphosate plus dicamba or 2,4-D
Data Collection

• Herbicide Absorption into target weed leaves
  – One leaf per replication harvested at 0, 2, 4, 6, & 24 hr after application
  – Leaves washed in a 50ml 1:1 methanol & water solution
  – Leaves placed on dry ice and stored in freezer
  – Area and weight of leaves taken
  – 2,4-D and dicamba levels analyzed using GC/MS-MS both of leaves and washes
  – Final levels of 2,4-D and dicamba in wash and leaf converted using known leaf area and weight
2,4-D on Leaf Surface

Palmer amaranth

waterhemp

giant ragweed

horseweed
Dicamba on Leaf Surface

Palmer amaranth

AIXR  TT  TTI  XR

Waterhemp

AIXR  TT  TTI  XR

Giant ragweed

AIXR  TT  TTI  XR

Horseweed

AIXR  TT  TTI  XR
Herbicide Absorption by Glyphosate-resistant Weeds

No differences in herbicide absorption observed between nozzles on four weeds for either dicamba or 2,4-D
# Herbicide Efficacy

## 2,4-D plus glyphosate

<table>
<thead>
<tr>
<th>Broadcast nozzle</th>
<th>AMAPA&lt;sup&gt;ab&lt;/sup&gt;</th>
<th>AMATA&lt;sup&gt;ab&lt;/sup&gt;</th>
<th>AMBTR&lt;sup&gt;ab&lt;/sup&gt;</th>
<th>%c</th>
<th>ERICA&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>XR11004</td>
<td>12 A&lt;sup&gt;a&lt;/sup&gt;</td>
<td>22 A</td>
<td>88 A</td>
<td>18 A</td>
<td>26 A</td>
</tr>
<tr>
<td>TT11004</td>
<td>13 A</td>
<td>23 A</td>
<td>93 A</td>
<td>16 A</td>
<td>22 A</td>
</tr>
<tr>
<td>AIXR11004</td>
<td>11 A</td>
<td>22 A</td>
<td>90 A</td>
<td>13 A</td>
<td>20 AB</td>
</tr>
<tr>
<td>TTI11004</td>
<td>9 A</td>
<td>20 A</td>
<td>92 A</td>
<td>19 A</td>
<td>12 B</td>
</tr>
</tbody>
</table>

## Dicamba plus glyphosate

<table>
<thead>
<tr>
<th>Broadcast nozzle</th>
<th>AMAPA&lt;a&gt;</th>
<th>AMATA&lt;a&gt;</th>
<th>AMBTR&lt;a&gt;</th>
<th>%b</th>
<th>ERICA&lt;a&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>XR11004</td>
<td>16 A</td>
<td>22 A</td>
<td>77 A</td>
<td>37 A</td>
<td></td>
</tr>
<tr>
<td>TT11004</td>
<td>17 A</td>
<td>23 A</td>
<td>77 A</td>
<td>37 A</td>
<td></td>
</tr>
<tr>
<td>AIXR11004</td>
<td>17 A</td>
<td>24 A</td>
<td>85 A</td>
<td>40 A</td>
<td></td>
</tr>
<tr>
<td>TTI11004</td>
<td>16 A</td>
<td>24 A</td>
<td>83 A</td>
<td>38 A</td>
<td></td>
</tr>
</tbody>
</table>
Herbicide Efficacy on Glyphosate-resistant Weeds

Reduction in efficacy occurred when using TTI nozzle in dense stand of horseweed or Palmer that exceeded recommended height.
Summary of Results

• Herbicide deposition density onto Kromekote cards was reduced by the AIXR and TTI nozzles.

• Percent coverage of Kromekote cards was only reduced by the TTI nozzle.

• Herbicide deposition onto target weed species was equivalent among all nozzle types.
Conclusions

The use of drift reduction nozzles can provide equivalent deposition, absorption, and efficacy of a glyphosate plus 2,4-D or dicamba postemergence application as a standard flat fan nozzle when made with the following parameters:

- Spray volume of at least 10 GPA, preferably 15 GPA
- Applied to appropriately sized of weeds
- Following a PRE herbicide to reduce weed density
Further Thoughts

• This data is specific to mixtures of two systemic herbicides
• Future mixes of dicamba or 2,4-D with a contact herbicide such Liberty will be much more complex
• What about the POACEA species?
4 year evaluation of 2,4-D and dicamba use patterns in two tillage systems
<table>
<thead>
<tr>
<th>SEPAC</th>
<th>TPAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary 2 year Corn/Soy Rotation</strong></td>
<td><strong>Summary 2 year Corn/Soy Rotation</strong></td>
</tr>
<tr>
<td><strong>Int_Gly</strong></td>
<td><strong>Int_Gly</strong></td>
</tr>
<tr>
<td>7 Sites of Action</td>
<td>6 Sites of Action</td>
</tr>
<tr>
<td>0 Passes Glyphosate &amp; Dicamba/2,4-D</td>
<td>0 Passes Glyphosate &amp; Dicamba/2,4-D</td>
</tr>
<tr>
<td>Soil Residual in both Corn &amp; Soy</td>
<td>Soil Residual in both Corn &amp; Soy</td>
</tr>
<tr>
<td><strong>R_Dicamba/2,4-D</strong></td>
<td><strong>R_Dicamba/2,4-D</strong></td>
</tr>
<tr>
<td>3 Sites of Action</td>
<td>3 Sites of Action</td>
</tr>
<tr>
<td>5 Passes Glyphosate &amp; Dicamba/2,4-D</td>
<td>4 Passes Glyphosate &amp; Dicamba/2,4-D</td>
</tr>
<tr>
<td>Atrazine in Corn only</td>
<td>Atrazine in Corn only</td>
</tr>
<tr>
<td><strong>Int_Dicamba/2,4-D</strong></td>
<td><strong>Int_Dicamba/2,4-D</strong></td>
</tr>
<tr>
<td>6 Sites of Action</td>
<td>7 Sites of Action</td>
</tr>
<tr>
<td>3 Passes Glyphosate &amp; Dicamba/2,4-D</td>
<td>2 Passes Glyphosate &amp; Dicamba/2,4-D</td>
</tr>
<tr>
<td>Soil Residual in both Corn &amp; Soy</td>
<td>Soil Residual in both Corn &amp; Soy</td>
</tr>
<tr>
<td><strong>Full_Int</strong></td>
<td><strong>Full_Int</strong></td>
</tr>
<tr>
<td>8 Sites of Action</td>
<td>8 Sites of Action</td>
</tr>
<tr>
<td>2 Passes Glyphosate &amp; Dicamba/2,4-D</td>
<td>1 Passes Glyphosate &amp; Dicamba/2,4-D</td>
</tr>
<tr>
<td>Soil Residual in both Corn &amp; Soy</td>
<td>Soil Residual in both Corn &amp; Soy</td>
</tr>
</tbody>
</table>
Weed Species at Postemergence: SEPAC 2,4-D

Density

Total Weed Species

Dicot Weed Species

Monocot Weed Species

Richness

Total Weed Species

Dicot Weed Species

Monocot Weed Species

Legend:
- **Int_gly**
- **R_2,4-D**
- **Int_2,4-D**
- **Full_Int**
Weed Density and Richness at POST

2,4-D and Dicamba reliant programs had increased densities and species, indicating increased selection pressure

Failure of 2,4-D and Dicamba reliant programs to reduce monocot species, indicating potential shift towards monocots
Soil Seed Banks

• SEPAC
  – Diverse and Rich seed bank
  – Decrease in both density and richness for all programs
  – No shifts in predominate species

• TPAC
  – Low diversity and richness
Conclusions

The continuous and repeated use of 2,4-D or dicamba as primary herbicides and a lack of soil residual herbicides increased selection pressure at postemergence herbicide applications over a four year period.

Potential shifts toward predominate monocot species was observed in the TPAC seed bank and at SEPAC at post applications.
Overall Conclusions

- Dicamba and 2,4-D resistant soybean bring a new tool to farmers for control of dicot weeds.
- Use of air induction nozzles will reduce drift potential while achieving acceptable delivery to target dicot weeds when used in appropriate system.
- Use of an integrated programs with soil residuals will reduce selection pressure of further resistance and reduce potential shifts towards monocot species.
Questions?

Travis Legleiter
Assistant Extension Professor – Weed Science

Travis.Legleiter@uky.edu