Impact of water stress on dicamba dissipation in susceptible soybean

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Recent Dicamba Events

• 2016
  – Dicamba-resistant Xtend® soybean and cotton cultivars released
    • Response to multiple-herbicide resistant weeds
    • No dicamba use approved for row crops
  – 32 drift complaint cases in AR
    • Off-label applications

3,6-dichloro-2-methoxybenzoic acid (Dicamba)
Recent Dicamba Events

• 2016
  – Engenia® (Dec) approved for cotton and soybeans

• 2017
  – 40% AR soybean Xtend®
  – 924 drift complaint cases
  – July 11th temporary ban for rest of season
Impact of Dicamba Drift

• Non-Xtend soybeans are highly sensitive
• Dicamba drift is a deep concern
  – How will it effect my crop?
• Impact of abiotic factors unknown

Cupping of leaves
Epinasty of stems
Stacking of nodes
Pod malformation
Objective

• Determine the impact of soil moisture on dicamba dissipation in sensitive soybean exposed to simulated drift
  – Physical difference = biochemical difference
Materials and Methods

- Greenhouse study
  - Grown to V1-V2
  - Simulated dicamba drift
  - Soil moisture:
    - wet or dry
  - Physical Data
    - Injury and height
    - Day 0, 1, 2,3 Weekly, 63 days
Materials and Methods

• Plant Collection
  – Shoots, roots, and soil
  – Stored -20°C

• Extraction
  – QuEChERS EN 15662

• Analysis
  – U of A Statewide Mass Spectrometry Facility
  – Shimadzu 8040 TQ MS with Shimadzu Nexera UPLC
# Materials and Methods

<table>
<thead>
<tr>
<th>Common name</th>
<th>Chemical name</th>
<th>m/z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dicamba</td>
<td>3,6-dichloro-2-methoxy-benzoic acid</td>
<td>219.0 → 175.0</td>
</tr>
<tr>
<td>5-OH dicamba</td>
<td>2,5-dichloro-3-hydroxy-6-methoxy-benzoic acid</td>
<td>235</td>
</tr>
<tr>
<td>5-OH glucoside</td>
<td>Glucoside of 2,5-dichloro-3-hydroxy-6-methoxy-benzoic acid</td>
<td>397</td>
</tr>
<tr>
<td>DCSA</td>
<td>3,6-dichloro-2-hydroxy-benzoic acid</td>
<td>204.9 → 160.9</td>
</tr>
<tr>
<td>DCSA glucuronide</td>
<td>Glucuronide of 3,6-dichloro-2-hydroxy-benzoic acid</td>
<td>367</td>
</tr>
<tr>
<td>DCGA</td>
<td>2,5-dichloro-3,6-dihydroxy-benzoic acid</td>
<td>221</td>
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<tr>
<td>DCGA glucoside</td>
<td>Glucoside of 2,5-dichloro-3,6-dihydroxy-benzoic acid</td>
<td>383</td>
</tr>
</tbody>
</table>
Results

12 days after dicamba drift
Results

Days After Application

% Plant Injury

Dry

Wet

Days After Application

% Plant Injury
Results

![Graph showing height reduction over days after application, comparing dry and wet conditions. The graph displays data points for Days 0, 10, 20, 30, 40, 50, and 60, with height reduction in centimeters ranging from 0 to 140. The graph indicates a significant increase in height reduction for wet conditions compared to dry conditions.](image-url)
## Results

**Preliminary LC/MS/MS results**

<table>
<thead>
<tr>
<th>Sample Day</th>
<th>Dicamba (mg kg⁻¹)</th>
<th>DCSA (mg kg⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6.1</td>
<td>0.09</td>
</tr>
<tr>
<td>0</td>
<td>3.2</td>
<td>0.04</td>
</tr>
<tr>
<td>3</td>
<td>5.7</td>
<td>ND</td>
</tr>
<tr>
<td>3</td>
<td>1.4</td>
<td>ND</td>
</tr>
<tr>
<td>14</td>
<td>0.63</td>
<td>ND</td>
</tr>
<tr>
<td>14</td>
<td>0.27</td>
<td>ND</td>
</tr>
<tr>
<td>63</td>
<td>0.04</td>
<td>ND</td>
</tr>
<tr>
<td>63</td>
<td>0.02</td>
<td>ND</td>
</tr>
<tr>
<td>63</td>
<td>0.02</td>
<td>ND</td>
</tr>
</tbody>
</table>

**Dicamba**

![Dicamba](https://via.placeholder.com/150)

**DCSA**

![DCSA](https://via.placeholder.com/150)
Results

• Preliminary LC/MS/MS results
  – Additional metabolite data collected
    • Suggests glucosides increase over time
    • Need standards to verify retention time and peak ID
      – Synthesis of glucosides is underway!
Conclusion

• Water stress impacts expression of dicamba injury in soybean
  – More accurate crop damage estimates
  – Effective drift mitigation measures
  – Better estimate of drift event timing