Adjuvant Research

Industry Collaborations

- Commercial product evaluation
  - Full or slightly reduced (sub-lethal) herbicide rates
  - “As long as the product is similar to the commercial standard.”

- New product development
  - Typically reduced (sub-lethal) herbicide rates
  - “We want a better mousetrap.”

- Almost all confidential or experimental codes
Adjuvant Research

Academic Collaborations

- Addressing regional commercial challenges
  - Adjuvant requirements for mixtures
  - Product evaluation
  - Nozzle interactions

- New herbicide active characterization
  - Optimization with adjuvants
General Areas of Research

- Water conditioners and DRAs 56%
  - Dicamba +/- glyphosate
  - 2,4-D +/- glyphosate
- HPPD herbicides 18%
  - Mesotrione and tembotrione
- Water conditioners and NIS 15%
  - Glyphosate
- Glufosinate 5%
- NIS replacements for oil-based adjuvant 2.5%
- Soil adjuvant 2.5%

Summary from 2017 and 2018 field trials (n=39).
Types of Experiments

Research Methods

Field

Greenhouse

Lab Complement
Not Just Squirt and Look Research!
Leaf Fluorescence
Herbicide Volatility

*Vapor chamber incubation (24-h)*

- Growth chamber set to 35 C, 40% RH, 14-h day light cycle

- Dicamba captured in air sampler containing filter paper, XAD-2 sorbent, and polyurethane foam

- Vacuum manifold calibrated to pull 2 L min\(^{-1}\) through vapor chamber
  - Full exchange of air every 20 min
Laser Ablation Electrospray Ionization Mass Spectrometry (LAESI-MS)

- Concept: Mid-infrared laser with wavelength (2940 nm) that corresponds with absorption of the energy by the O-H bonds in water
  - Gas phase particles created from sample ablation. Particles are then ionized with electrospray ionization (ESI)
- Ions introduced to mass spectrometer
Influence of Adjuvant on Paraquat Absorption by Common Lambsquarters
Ammonium Thiosulfate (ATS)

- Sulfur (S) deficient soils
  - Product of Clean Air Act
  - Up to 20 lb/acre of S recommended

- ATS
  - 12-0-0-26S; pH 7 to 8.5
  - Identified as cheap and effective product
  - Rates up to 7 gal ATS per acre (~20 lb/acre target)
  - “Ammonium Thiosulfate should not be mixed with acids or other acidic materials below a pH of 6.”
Effect of ATS on Glyphosate Activity

Wheat - Control at 14 Days after Treatment

Glyphosate: Roundup Powermax @ 22 oz/A
2,4-D: Shredder LV4 @ 16 oz/A
Dry AMS @ 8.5 lb/100 gal

LSD_{(0.05)} = 13

Study code: 19-GH-ATS
Effect of ATS on Glyphosate Activity

*Velvetleaf* - Control at 14 Days after Treatment

- **Glyphosate**: Roundup Powermax @ 22 oz/A
- **2,4-D**: Shredder LV4 @ 16 oz/A
- **Dry AMS**: 8.5 lb/100 gal

<table>
<thead>
<tr>
<th>Spray pH</th>
<th>Glyphosate Alone</th>
<th>Glyphosate + AMS</th>
<th>Glyphosate + 2,4-D</th>
<th>Glyphosate + 2,4-D + AMS</th>
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<td>6.3</td>
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<td>93</td>
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</table>

LSD\(_{(0.05)}\) = 4.8

Study code: 19-GH-ATS
### Effect of ATS on Glyphosate Activity

**C. Lambsquarters** - Control at 14 Days after Treatment

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<tr>
<th>Spray pH</th>
<th>Glyphosate Alone</th>
<th>Glyphosate + AMS</th>
<th>Glyphosate + 2,4-D</th>
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<td>6.3</td>
<td>75</td>
<td>64</td>
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<td>97</td>
</tr>
</tbody>
</table>

LSD\(_{0.05}\) = 9.9

Glyphosate: Roundup Powermax @ 22 oz/A
2,4-D: Shredder LV4 @ 16 oz/A
Dry AMS @ 8.5 lb/100 gal

Study code: 19-GH-ATS
Valent Observations and Research

- Reducing the spray pH helped overcome antagonism. However, not all acidifiers worked the same.
  - LI-700 and FS Transform worked well. Jackhammer did not.
  - No extensive testing of all acidifying agents to date.
- Recommendation for Select Max + Warrant:
  - Use AMS
  - Increase the Select Max rate by 33%
  - Add crop oil
  - Add LI-700 or FS Transform
- Recommendation for the Select Max + Warrant + Xtendimax or Engenia:
  - No tank-mix. Applications separated by 3 days.
  - If tank-mixed:
    - Increase Select Max rate 33%
    - Use crop oil
    - Limit Warrant rate to 2 pt/A
Technologies for Battling Weeds

“$7 Per Acre Per Pass”

LibertyLink® GT27

Enlist

LibertyLink®

Roundup Ready® XTEND® Crop System

NEW BioDirect Technology

Monsanto Research Lab Trials

| Glyphosate-Resistant Weeds Sprayed with Glyphosate Alone | Glyphosate-Resistant Weeds Sprayed with BioDirect + Glyphosate |

Example: Glyphosate-Resistant Weed Control
Early testing indicates that BioDirect technology can be used with Glyphosate to target resistant weeds and provide more effective spectrum of control of problem weeds.
# Herbicide Strategies and Combinations for Weed Management

## Corn
- ACCase (1)
- ALS (2)
- Dinitroanalines (3)
- Auxins (4)
- Triazines (5)
- Glyphosate (9)
- Gufosinate (10)
- PPO (14)
- Acetamides (15)
- Paraquat (22)
- HPPD (27)

## Soybean
- ACCase (1)
- ALS (2)
- Dinitroanalines (3)
- Auxins (4)
- Triazines (5)
- Glyphosate (9)
- Gufosinate (10)
- PPO (14)
- Acetamides (15)
- Paraquat (22)
- HPPD (27)*

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*Pending regulatory approval.

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Optimizing oil-soluble herbicides in a surfactant market
See & Spray from Blue River (John Deere)

More tools. Less herbicide. Lower costs.

http://www.bluerivertechnology.com
See & Spray
from Blue River (John Deere)

http://www.bluerivertechnology.com
Automated Drone Spraying from Rantizo

WHAT IS RANTIZO?

Delivering Agricultural Solutions

Drone Based Agrichemical Spraying

Integrated Software and Hardware

Cost Effective Solutions. In a $36 Billion global chemical and application market, chemical effectiveness is decreasing, leading to increasing application costs. Rantizo strives to deliver solutions through automation to recognize field issues, diagnosing the problems, and aerially spraying agrichemicals via drone.

Cutting Edge Innovation. Agrichemicals are delivered precisely where they are needed using an electrostatic sprayer mounted on a drone. Drones are loaded with cartridges only containing the active chemical ingredient.

More Than Diagnostics. Existing drone companies are primarily diagnostic, gathering data to help farmers make decisions.

https://rantizo.com
Automated Drone Spraying from Rantizo

WHAT IS ELECTROSTATIC SPRAYING?

**Electrostatics.** Electrostatic spraying is a method that can reduce problems with uneven coverage and over spray that result from using a regular sprayer. Spraying creates a strong bond, and covers crops evenly with wrap-around coverage. Because of this high transfer efficiency, it uses less chemicals to cover a field.

https://rantizo.com

www.aliexpress.com
Spray Like You Mean It!

- “Adjuvants 101” training is lacking at the retail and customer level
- “Application 101” training is better, but less than optimal

Challenges
- One or two adjuvants per customer doesn’t address all application needs
- Label requirements/restrictions
- Profit opportunity and/or cutting costs are driving inputs.
Trends in Adjuvant Research

- Activator Adjuvants - *More than just glyphosate*
  - Glufosinate
  - Mesotrione
  - Saflufenacil
  - ACCase herbicides

- Optimizing Herbicide Combinations
  - Most commonly oil and water soluble herbicides
  - Product mixtures
    - Premix
    - Tank-side
Thank You!

Questions?

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