Developing Drift Reduction Agents

NAICC Jan 19, 2018
Tucson, AZ

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Agenda

1. What is a DRA anyway?
2. Droplet Size and Why it Matters
3. Winfield United Spray Analysis
4. Using DRA’s to Manage Drift - 2 product examples
5. Future of DRA Development
What is a DRA anyway?
Importance of Drift Reduction Agents (DRAs)

- Dicamba buffer zones were developed incorporating spray drift modeling, a spray drift droplet deposition study, and raw data from field trials.
- Some dicamba tank-mix partners will increase the amount of fine droplets produced from a spray application – “driftable fines”.
- Any increase in driftable fines could lead to herbicide movement further away from the point of application than the buffer zone accounted for.
Importance of DRAs

It was the EPA’s determination that any dicamba tank-mix which **adversely affects** the spray droplet properties of dicamba **would not** be an approved, labeled application. When **included** in tank-mixes that adversely affect the spray droplet properties of dicamba, a **DRA** will overcome those adverse effects.
Importance of DRAs

• Xtendimax®/FeXapan® label language:
  “Certain products, as specified below, CANNOT be tank mixed with XtendiMax® With VaporGrip® Technology UNLESS those products are tank mixed with a DRA”
  • 23 herbicides require a DRA – including all glyphosates

• Engenia®
  “1 Must use a DRA on approved list”
  • 22 herbicides require a DRA
**WHAT’S A DRA?**

- **WHAT IS A DRA?**
  - Drift-Reduction Agent

- **What do DRA’s do?**
  - Most DRA’s affect viscosity

- **Viscosity:**
  - Measure of a fluid’s resistance to deformation by shear or tensile stress
  - For liquids, it corresponds to the informal concept of "thickness"
    - *Ex: honey has higher viscosity than water*

- **How do DRA’s work?**
  - DRA polymers “thicken” the spray solution in different ways, affecting the behavior of a flowing fluid

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A simulation of liquids with different viscosities. The liquid on the left has lower viscosity than the liquid on the right.

Although two fluids may look alike in appearance, they may behave very differently when set into motion.
WHAT’S A DRA? – VIDEOS

Dicamba alone

Dicamba + DRA (AG16098)
Droplet Size & Why it Matters
Droplet Size Makes a Difference
Advantages and Disadvantages of Different Droplet Sizes*

Equivalent droplet volume in each quadrant

+’s
- Very high air evaporation potential
- Quick drying time on leaf
- Very high drift potential
- Poor canopy penetration

-’s
- High air evaporation
- Fast drying time on leaf
- High drift potential
- Moderate canopy penetration

+’s
- Good coverage
- Medium evaporation
- Low drift potential
- Good canopy penetration
- Favorable drying time on leaf
- Good efficacy for systemic pesticides

-’s
- Some droplet bounce/spatter

+’s
- Very low evaporation
- Very low drift potential
- Good canopy penetration
- Long drying time on leaf

-’s
- Low coverage
- Hi droplet bounce/spatter
- Reduced efficacy for many pesticides

*Relative comparisons. Results vary depending on environment, products included, adjuvants, canopy characteristics, and other factors.
# Spray Quality & Applications

<table>
<thead>
<tr>
<th>Spray Quality</th>
<th>VMD (μm)</th>
<th>Drops per in²</th>
<th>Contact I &amp; F</th>
<th>Systemic I &amp; F</th>
<th>Contact Foliar H</th>
<th>Systemic Foliar H</th>
<th>Soil-Applied H</th>
<th>Incorp. Soil-Applied H</th>
<th>Drift Potential</th>
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Droplet size classifications: Spraying Systems TeeJet Technologies Catalog 51
Cumulative Volume – ‘% Fines’

- Cumulative Volume Percent
  - % fines or $V_n$
  - The percent of spray volume smaller than a given droplet size ($n$, in microns)
  - “Driftable Fines” are defined as % < 105 μm
    - Source: ASTM
  - Droplets < 210 μm are subject to drift
  - Droplets evaporate slower and travel farther in high humidity. Wind carries larger droplets farther.
Droplet Fate

Droplets slow down and shrink as they fall
Droplet fate is determined by droplet size, environmental conditions, and placement
• **Dry**: more droplets shrink and evaporate
• **Humid**: droplets hang in the air, more liable to drift
• **Windy**: droplets have greater potential for drift

<table>
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<th>*Droplet Diameter (μm)</th>
<th>Time to Evaporate (sec)</th>
<th>Vertical Deceleration Distance (in)</th>
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<td>16</td>
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<tr>
<td>200</td>
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*Conditions: 90°F, 36% RH, 25 psi, 3.75% pesticide solution.
From Wolf, Kansas State University. Strategies to Reduce Spray Drift.
Applying Spray Analysis Insights: Field Efficacy

Effect of nozzles on control of pigweed with Flexstar® herbicide

- TJ60 11003
- XR 11003
- AIXR 11004
- GA 11004
- Al 11004
- TTI 11004

Percent Control

Nozzle Type

LSD = 1.58
Droplet Size Affects Efficacy

**Medium Spray Quality**

**Coarse Spray Quality**

Incomplete control can lead to herbicide resistance

2,4-D Amine 28 DAT. Fargo, ND. Howatt and Lukach (2010), Proc NCWSS.
Winfield United Spray Analysis
Winfield United Drift Reduction Products

InterLock®

Lock down your spray investment
Versatile Drift Reduction and Deposition

InterLock® adjuvant is a crop-based adjuvant that improves spray deposition on intended targets and reduces spray drift. It is also a canopy-penetrating agent. The InterLock® adjuvant works effectively with herbicides, fungicides, insecticides, desiccants and defoliants.

Proprietary formula specifically designed to reduce oil-loving herbicides (category and activity),
- Drift Reduction: Exceptional drift reduction you expect
- Canopy Deposition: Increases depth of deposition and support usage of herbicides.
- High Oil Content: Continues to increased herbicide activity
- Improved Handling: Better leaving the tank

InterLock® adjuvant was specifically designed for water-based applications. When Agno® is added into the tank, it can dilute the InterLock® adjuvant. This increases the efficacy of the herbicides, along with other commonly used oil-loving herbicides.

Whether applying InterLock® adjuvant in a tank mix or an independent application, drift reduction is always important.

While InterLock® adjuvant is effective at low rates, it does not negatively affect spray patterns like other drift-control adjuvants, especially higher rates or air-assisted nozzles are used. For best product performance, select and use sprayer equipment properly, including boom height, nozzle type, size and pressure.

InterLock® adjuvant is CPOA (Council of Producers & Distributors of Agrotechnology)® certified, which assures product quality and reliability.

AccuDrop™

A Non-oil Based Adjuvant.

AccuDrop™ adjuvant is a surfactant based drift and deposition adjuvant designed to reduce drift, improve deposition and canopy penetration to optimize herbicide performance.

PRODUCT BULLETIN

AG16098

Approved DRA Adjuvant for Xtendimax™ with VaporGrip™ Technology

AG16098 adjuvant is a patent pending, drift and deposition aid for new disaccharide herbicide technologies and extra and ultra-coarse nozzles.

- This adjuvant system has been formulated to reduce drift below 0.25%.
- Acts with superior spreading and canopy deposition for improved herbicide efficacy.
- Includes anti-foam for added convenience.

As an approved DRA for Xtendimax™ with VaporGrip™ technology, AG16098 unlocks the use of many other key products to effectively manage the new Roundup Ready™ Xtral Crop System.

For more information, contact your local Winfield United retailer, or go to www.winfieldunitedag.com.

Learn more about our brands at WinfieldUnitedAg.com
Spray Analysis System

Original Spray Analysis System (SAS)
- Fully operational since 2012
- 50,000 + measurements since 2012
- Nozzle arm travels up and down equivalent to 5.8 miles per year
- Test an average of 25+ unique products each month
- Have tested almost 300 different nozzles
- Have directly contributed to the release of at least 15 new STAMPS and HIF products

Highlights:
- InterLock Market Expansion
- Class Act Ridion Release
- StrikeLock Release
- OnTarget (AG16098)
- AccuDrop Part of tank mix approval process with dicamba & 2,4-D POST technologies
Spray Analysis & Product Development

- New Product Ideas
- Field Study Treatments
- Existing Products
- DRTs
- Spray Analysis System
- Compare to Existing Products
  - Select Best Candidates
- Select Promising Treatments
  - Validate in the Field
- Improve Formulations
  - Quality Control
- Verify Drift Reduction Potential
  - Find Best Management Practices

WinField United
Winfield United Spray Analysis System

Five Components:
1. Fluid Delivery System
2. Laser Diffraction Analysis
3. Low Speed Wind Tunnel
4. Waste Disposal System
5. Expertise
How does it work?

Measures droplet size

Increases Knowledge About:

- Product Performance
- Spray Application Technology
- Spray Drift
- 615 µm: period at end of sentence, light rain
- 300 µm: toothbrush bristle, fine misty rain
- 2000 µm: #2 pencil lead, heavy thunderstorm rain
- 40 µm: limit of visibility to naked eye
- 17 µm: fog
- 105 µm: human hair, mist, driftable fines
- 210 µm: 2 sheets of paper
Volume Median Diameter

Half of the volume is made up with droplets smaller than the VMD.
Droplet Size Distributions: VMD

VMD ($X_{50}$) = 174 um

Half of spray volume is droplets larger than VMD
Half of spray volume is droplets smaller than VMD

Source: Winfield Spray Analysis System
Span

- Relative span of a spray
  - \( \frac{X_{90} - X_{10}}{X_{50}} \)
  - Where \( n \% \) of the volume is made up of droplets smaller than \( X_n \) (percentile)
  - Higher span \( \rightarrow \) more variable spray pattern
  - There is no ideal span, but a span of 1.0 would be very consistent and a span of 1.5 would be highly variable
Droplet Size Distributions: Span

$X_{10}$: 10% of spray volume is droplets smaller than 75 μm

$X_{90}$: 90% of spray volume is droplets smaller than 324 μm

Span: $X_{90} - X_{10} / VMD$

$VMD (X_{50}) = 174 \mu m$

Source: Winfield Spray Analysis System
Relative Span

Larger span $\rightarrow$ more variability within the spray.
Adjuvants can Affect Span

Source: Winfield Spray Analysis System
Applying Spray Analysis Insights: Tank Ingredients Matter

% Driftable Fines

Cumulative % Fines < 141 um

% Driftable fine droplets in 21 different tank mixtures
XR 11003 @ 43.5 psi

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Using DRA’s to Manage Drift
InterLock- Drift Reduction

Spray Comparison Wind - XR TeeJet®
©2009 Winfield Solutions, LLC

Herbicide Alone  Herbicide + InterLock®
InterLock- Drift Reduction

DRIFT REDUCTION- INTERLOCK®

High GPA 11-2-11

InterLock® @ 10 oz per 100 GAL - 3.5 mph
250 psi – 100 GPA
12-18 mph winds

No Drift Product – 3.5 mph
250 psi – 100 GPA
12-18 mph winds

From Erik Kellim: Winfield Solutions Sales, Boynton Beach, FLA
Off-Target Drift

River Falls, WI 2009 - Winds 5.4-8.6 mph
Drift: 24 ft – InterLock® reduced drift by 50%
Spray Quality Improvement

Cumulative reduction of fines with InterLock and low-drift tips

Source: Winfield Spray Analysis System
Finding the “Right” Droplet Size

Nozzles can reduce fines…
But may produce many coarse droplets

Source: Winfield Spray Analysis System
OnTarget™ Product Overview

DRA for Dicamba Chemistries with Ultra/Extra Coarse Nozzles

Approved DRA for use with Xtendimax™ herbicide

Approved DRA for use with Engertia™ herbicide

*Always read and follow label
What is OnTarget™
DRA, drift and deposition adjuvant

Primary Benefit:
• Improves efficacy of new dicamba based herbicides through the ultra and extra coarse nozzles by improving drift control, droplet spreading, and canopy deposition.

Product Attributes:
• Drift Reduction – reduces driftable fines for even less off-target movement
• Droplet spreading – improves contact angle for droplet spreading and leaf coverage
• Canopy Deposition – Increases depth of deposition for better coverage and uptake of herbicides
• Efficacy Improvement – surfactant contributes to greater herbicide activation or weed kill
• Anti-foam – for added convenience

Use Rate: 0.5% v/v
WHAT’S A DRA? – VIDEOS

Dicamba alone

Dicamba + DRA (AG16098)
Applying Spray Analysis Insights: Approval with Herbicides for New Traits

% Volume of Driftable Fine Droplets
<150 μm
TTi 100-04 at 63 psi

Volume Median Diameter (μm)
TTi 100-04 at 63 psi

Error bars represent the 95% confidence interval about the mean

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Shear Test Experimental Results

Evaluation of Shear Degradation of DRA Polymer Tank Mixes

- Dicamba + Glyphosate
- Dicamba (Benchmark)
- Dicamba + Glyphosate + PolyacrylamideA
- Dicamba + Glyphosate + PolyacrylamideB
- Dicamba + Glyphosate + AG16098

All DRA’s work at the start of the test!

Anything above this line is BAD!
Previous Shear Work

Repeated exposure to a high-shearing event will likely induce degradation of drift reduction performance of polymeric drift reduction adjuvants.

Future of DRA Development @ Winfield United
Winfield United Innovation Center
Infinity Lab: Next Gen Spray Analysis System

The most innovative and advanced droplet sizing wind tunnel in the world for testing ground application scenarios

**2-in-1 Wind Tunnel**
- ‘Closed Loop’ similar to current SAS
- ‘Open Return’ operation like EPA & UNL tunnel

**Safety**
- ‘Purge Mode’ evacuates all tunnel air in <30 sec.
- Increased automation reduces operator exposure

**Aerodynamic Flow Quality**
- 3:1 contraction ratio
- Greater flow conditioning elements
- Increased accuracy

**Climate control**
- Fix and maintain defined temperature
- Control relative humidity

**In-house Developed Spray Delivery System**
- Higher throughput: “fail faster”
- Improved process repeatability and traceability

**Enhanced Technology**
- State-of-the-art Laser-Based Spray Diagnostics
- Set up for multiple sensing and imaging techniques
- Top speed of 20 mph
- Allows testing of more different nozzle designs

*Installation: September 2017  
Fully operational: February 2018*
Come visit us at Booth #312

Acknowledgements:
All of the Winfield United Product Development Team

Special Recognition-
Lillian Magidow
Dan Bissell
Andrea Clark
Joe Gednalske
Eric Spandl
Greg Dahl
Ryan Edwards
Ray Pigati
Danny Brown

Thank You