WINFIELD® UNITED

Developing Drift Reduction Agents

NAICC Jan 19, 2018

Tucson, AZ

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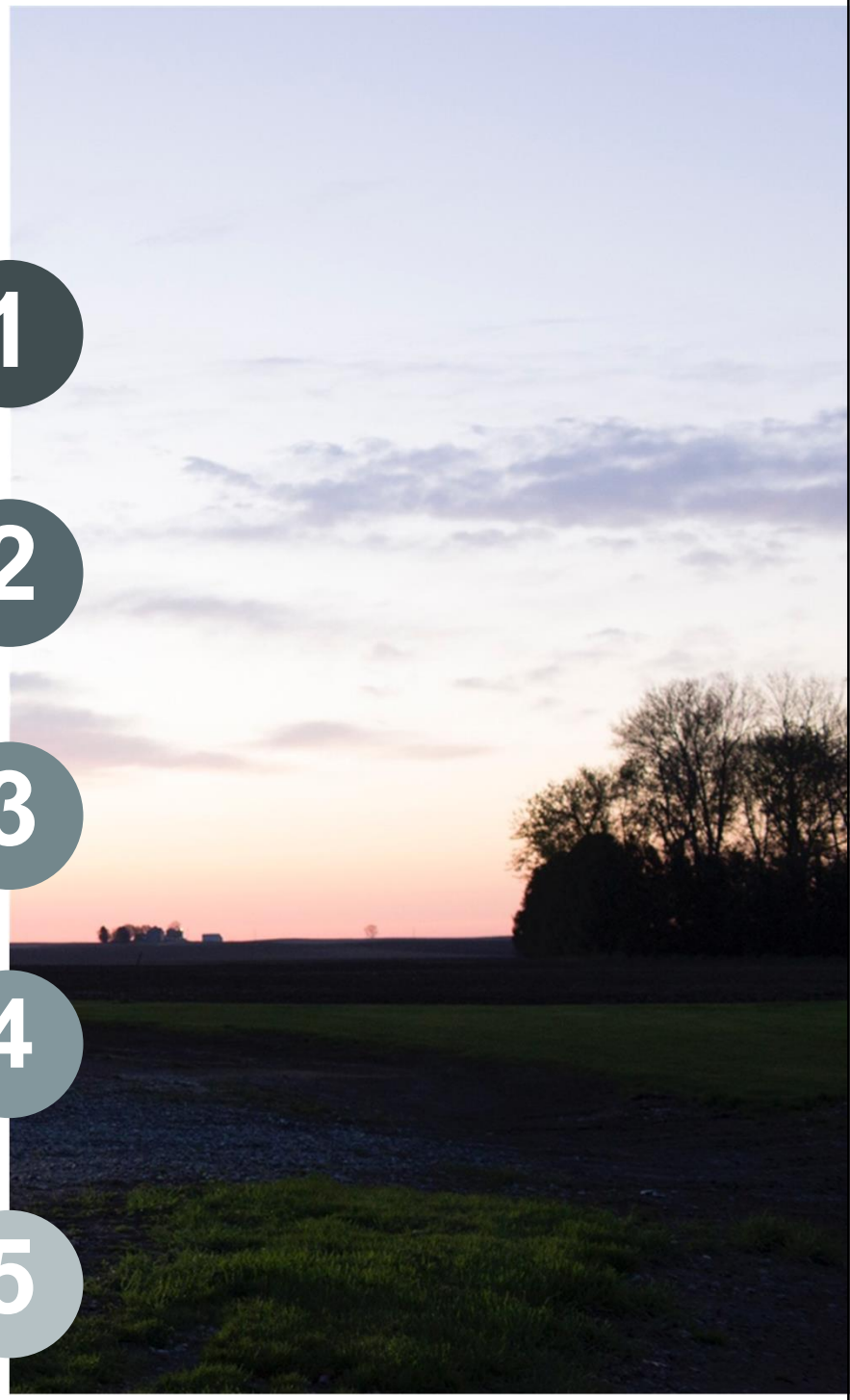
Jo Gillilan, Ph.D., Southern research manager

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



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What is a DRA anyway?

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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

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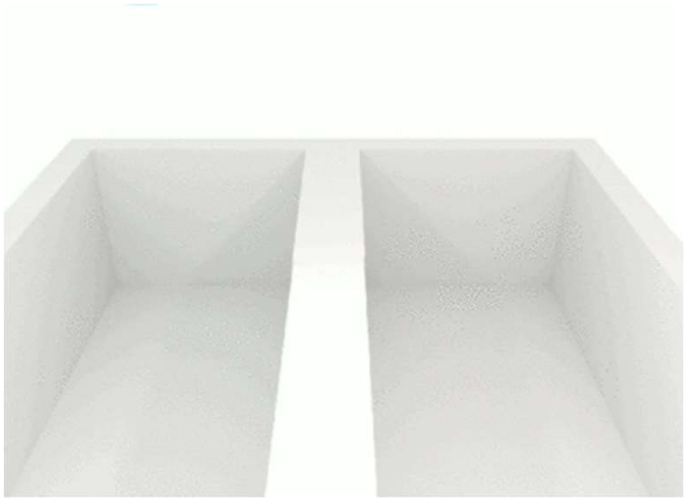
WHAT'S A DRA?

- **WHAT IS A DRA?**
  - Drift-Reduction Agent
- **What do DRA's do?**
  - Most DRA's affect viscosity
- **Viscosity:**
  - Measure of a fluids 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



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.

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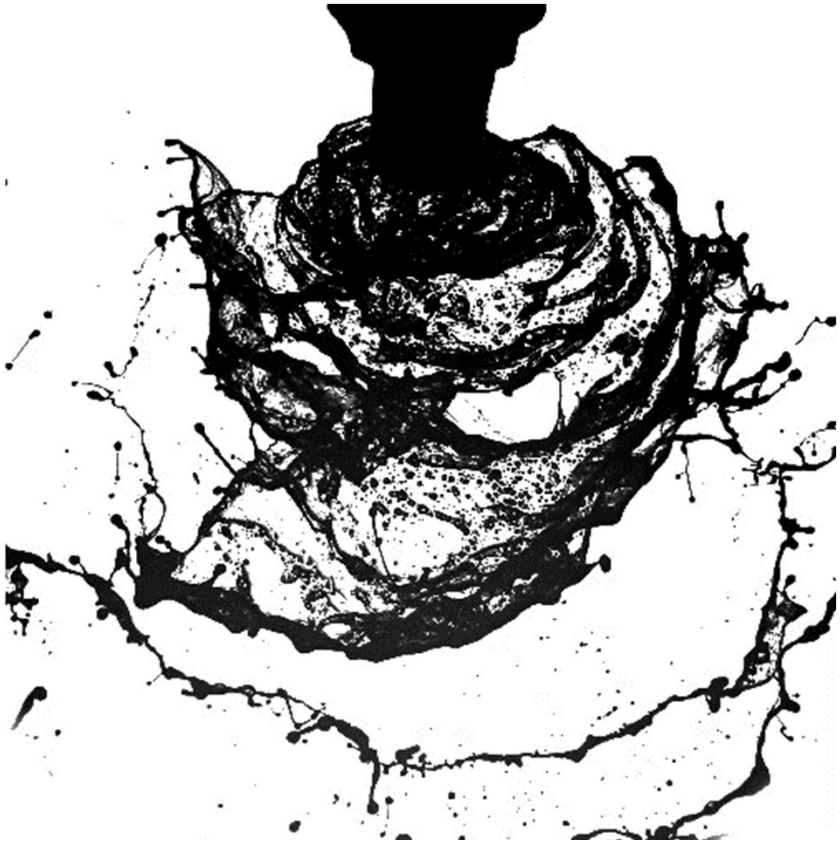
TTI11004
63 psi

WHAT'S A DRA? – VIDEOS

Dicamba alone



Dicamba + DRA (AG16098)

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Droplet Size & Why it Matters

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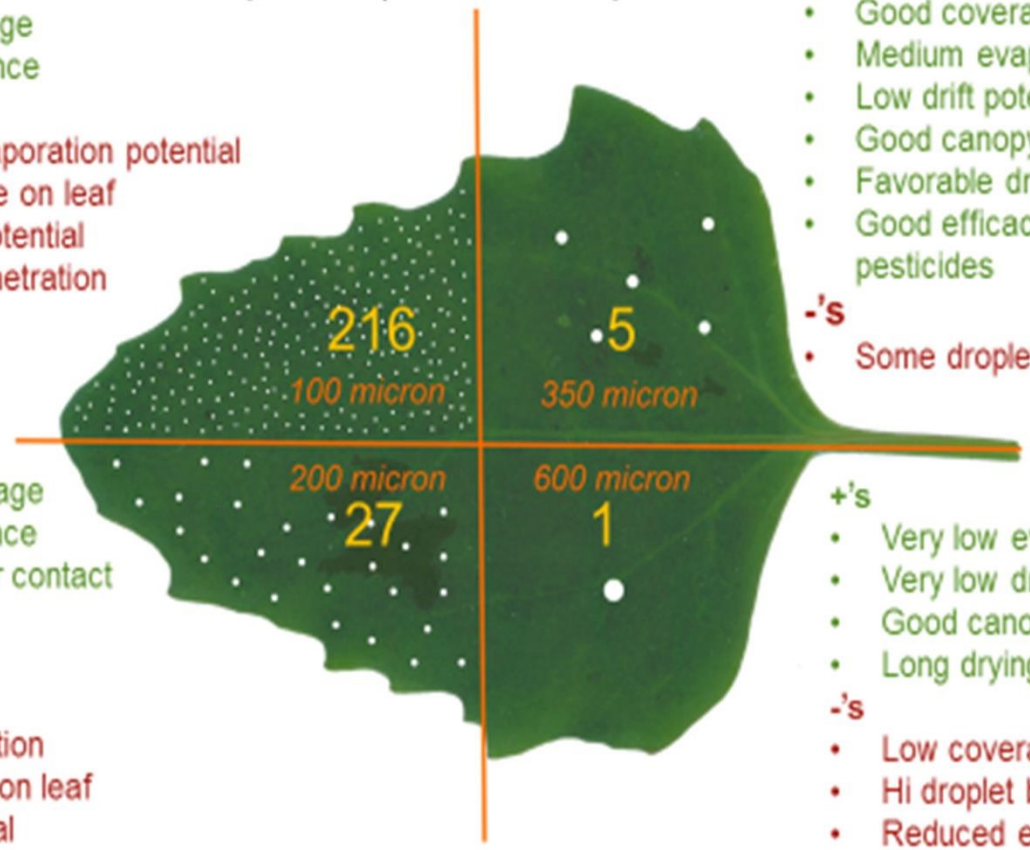
Droplet Size Makes a Difference

Advantages and Disadvantages of Different Droplet Sizes*

Equivalent droplet volume in each quadrant



+'s
- Excellent coverage
- Low droplet bounce

-'s
- Very high air evaporation potential
- Quick drying time on leaf
- Very high drift potential
- Poor 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 good coverage
- Low droplet bounce
- Good efficacy for contact pesticides

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

+'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.

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Spray Quality & Applications

Spray Quality	VMD (µm)	Drops per in^2	Contact I & F	Systemic I & F	Contact Foliar H	Systemic Foliar H	Soil-Applied H	Incorp. Soil-Applied H	Drift Poten-tial
VF	<136	>4582							High
F	136-177	2078	✓						
M	177-218	1112	✓	✓	✓	✓			
C	218-349	271		✓	✓	✓	✓	✓	
VC	349-428	147				✓	✓	✓	
XC	428-622	48						✓	
UC	> 622	<48						✓	Low

Droplet size classifications: Spraying Systems TeeJet Technologies Catalog 51
Applications: Kansas State Extension Publication MF2869, *Droplet Size Calibration: a New Approach to Effective Spraying,* March 2009
Droplets/in^2: E. Spandl, Winfield Solutions (2009). At 10 GPA, for upper limit of size class.

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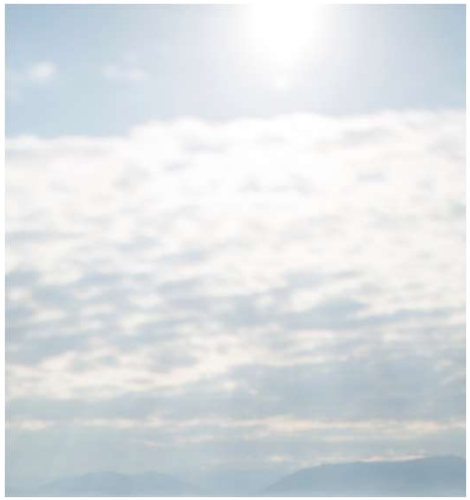

Cumulative Volume – '% Fines'

- 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.

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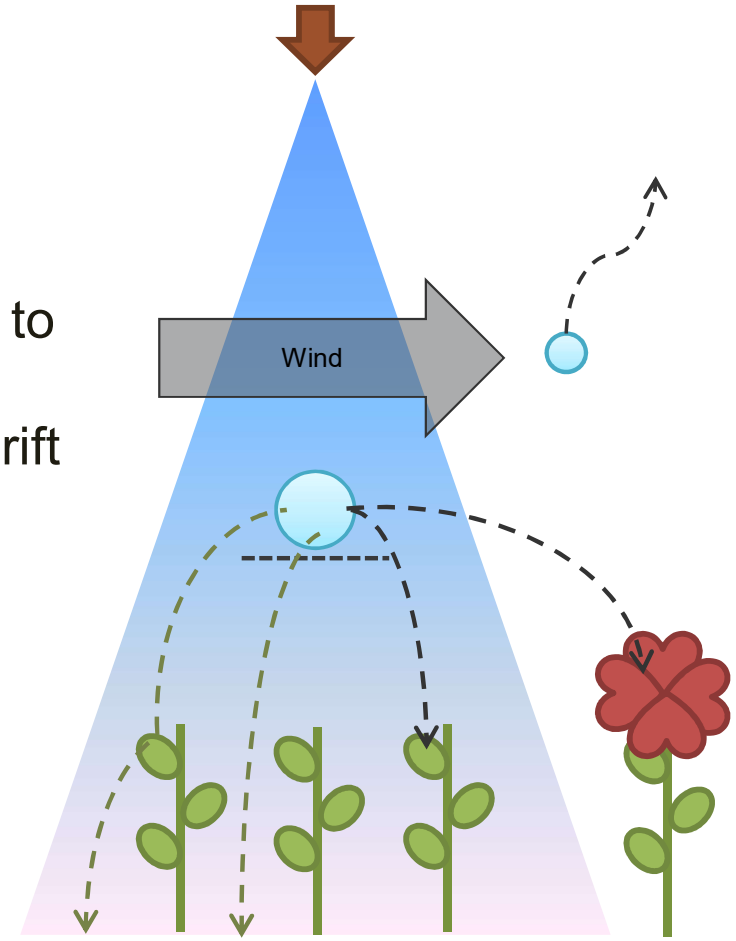
Droplet Fate

Droplets slow down and shrink as they fall

Droplet fate is determined 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

*Droplet Diameter (µm)	Time to Evaporate (sec)	Vertical Deceleration Distance (in)
20	0.3	< 1
50	1.5	3
100	7	9
150	16	16
200	29	25



*Conditions : 90°F, 36% RH, 25 psi, 3.75% pesticide solution.
From Wolf, Kansas State University. Strategies to Reduce Spray Drift.

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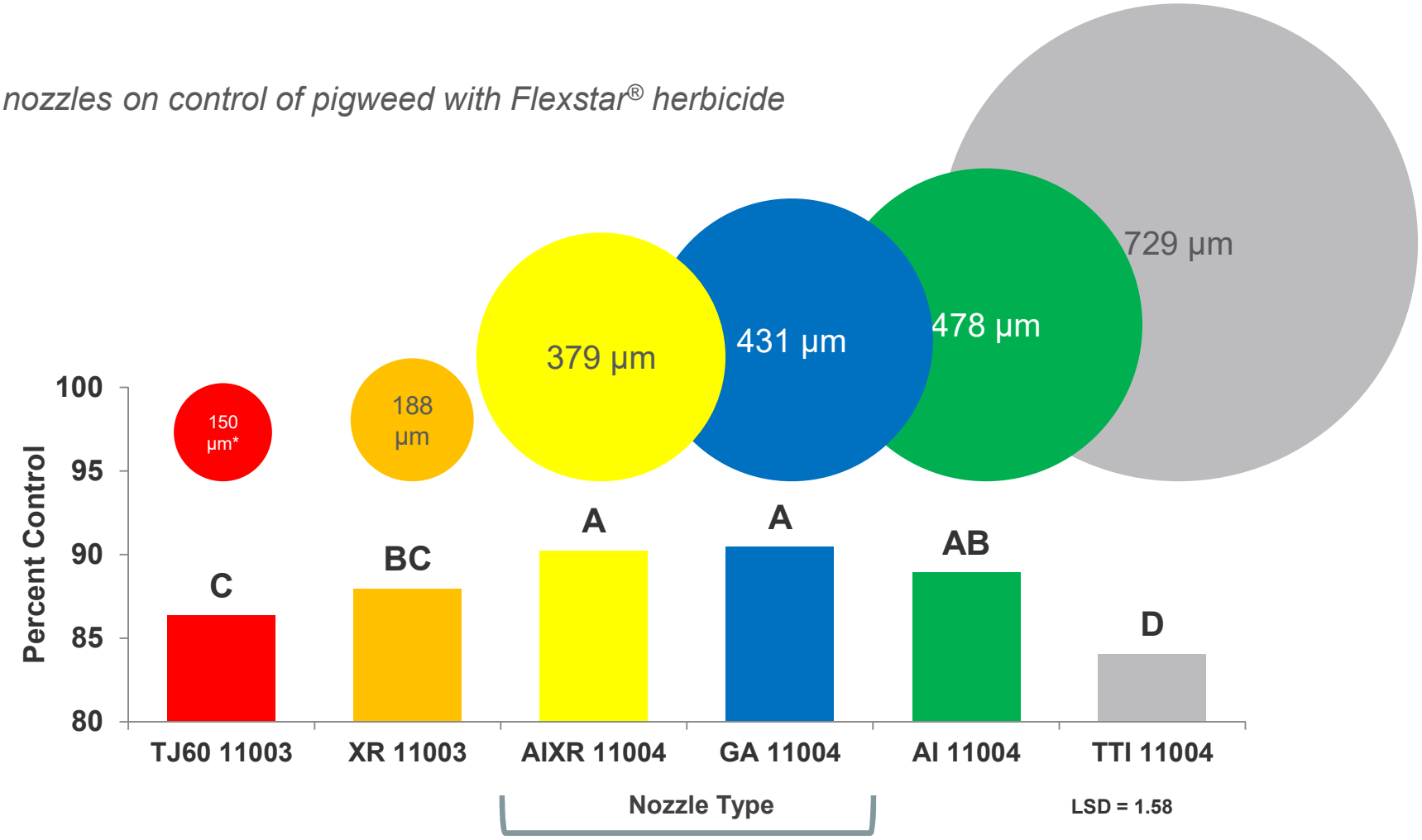
Applying Spray Analysis Insights: Field Efficacy

Effect of nozzles on control of pigweed with Flexstar® herbicide



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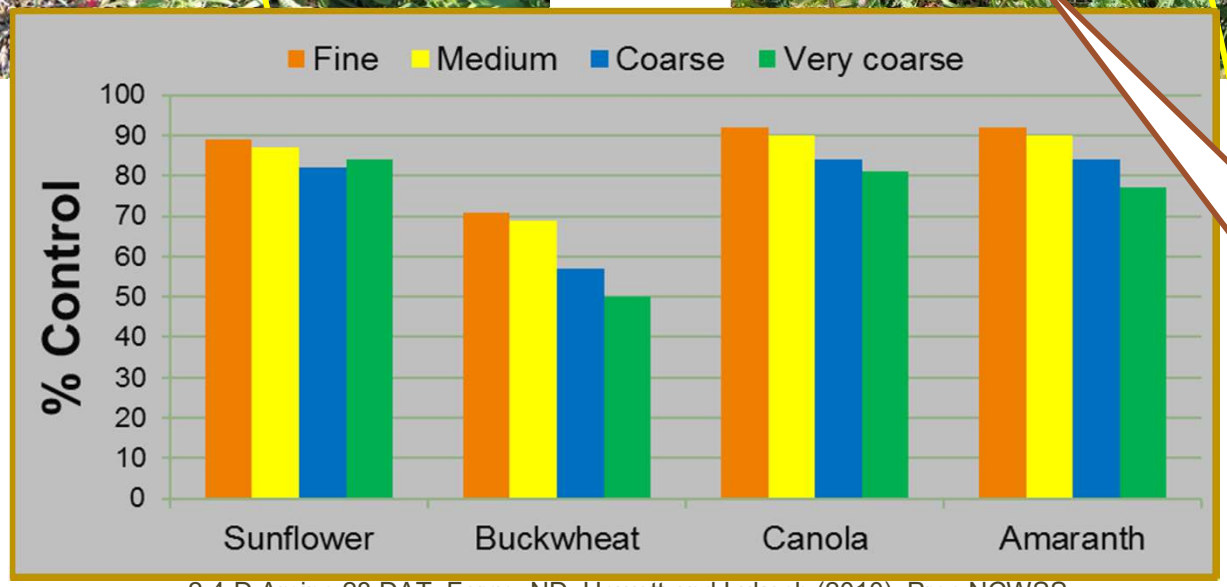
Droplet Size Affects Efficacy



Incomplete control can lead to herbicide resistance

2,4-D Amine 28 DAT. Fargo, ND. Howatt and Lukach (2010), Proc NCWSS.

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Winfield United Spray Analysis

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Winfield United Drift Reduction Products

InterLock® By WinField

Lock down your spray investment

Versatile Drift Reduction and Deposition

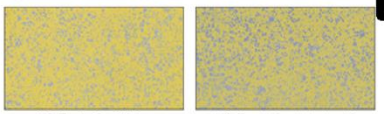
InterLock® adjuvant is a crop-based adjuvant that improve spray deposition on intended targets and reduces spray drift. It is also a canopy-penetrating agent. InterLock® adjuvant works effectively with herbicides, fungicides, insecticides, desiccants and defoliants.

Derived from vegetable oil, InterLock® adjuvant considera reduces the amount of fine particles in the spray pattern without thickening the spray (see Figure 1). By keeping more spray droplets within the most effective size range, InterLock® adjuvant helps improve coverage, increases canopy penetration, and reduces drift and evaporation of pesticides, whether they are applied by ground or air.

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

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

Figure 1.



XR TeeJet® – Water XR TeeJet® – InterLock®

Ingredients

Modified vegetable oil, polyoxyethylene sorbitan fatty acid ester, vegetable oil

Learn more abou

StrikeLock™ By WinField United

Adjuvant
DRIFT AND DEPOSITION AID PLUS A HSOC-MSO

Drift and deposition aid with a highly concentrated MSO for use with oil-loving herbicides.

Designed for use with oil loving herbicides, StrikeLock™ adjuvant is an oil-based drift and deposition aid, high surfactant oil concentrate, and includes WinField® United's newly developed surfactant designed to improve herbicide performance.

FEATURES AND BENEFITS

Proprietary formula specifically designed to ta oil-loving herbicides (coverage and activity):

- **Drift Reduction** – exceptional drift reduction you expec
- **Canopy Deposition** – increases depth of deposition an support uptake of herbicides.
- **High Oil Content** – contributes to increased herbicide a
- **Improved Handling** – better flowing oil vs. traditional h

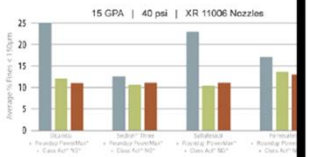
StrikeLock™ adjuvant was specifically designed for use wit are more efficacious when an MSO is added into the tank. been extensively tested with WinField® United's Avalanche herbicides, along with other common oil loving chemistries.

Whether applying StrikeLock™ adjuvant in a burndown or i optimizing deposition and limiting drift is always important f

Application Rate Guidelines

StrikeLock™ adjuvant may be used at rates that are similar rates. Suggested use rate for StrikeLock™ adjuvant is 0.5% ounces per acre, but no less than 6.4 ounces per acre. Con agronomist to determine the best agronomic use rate for yo

WinField® United's Spray Analysis System Dat



1 Always read and follow product labels directions.
Always read and follow label directions. StrikeLock is a trademark of and Avalanche, InterLock. See Winfield Solutions, LLC. © 2017 Winfield Solutions, LLC
* Because of factors outside of WinField's control, such as weather, application factors, etc., results performance, or profits, cannot be predicted or guaranteed by Winfield Solutions, LLC. Actual resu

AccuDrop™ By WinField United

Adjuvant
Drift and Deposition Agent with Surfactant Canopy Penetrant

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 pesticide performance.

USE RATE[1]
3 ounces/acre

ACTIVE INGREDIENTS[1]
98% Blend of high content of unsaturated fatty acid and low content of rosin acids, mixture of glycerol polyethylene glycol ricinolate with fatty acid esters of polyethylene glycol, and alcohol ethoxylate

PACKAGING
2 x 2.5 gallon cases
bulk

Ultra-Lite®
Ultra-Lite®+ AccuDrop™

rademarks of Monsanto Technology LLC.
Solutions, LLC. WF082217

winfieldunited.com

PRODUCT BULLETIN — WinField United

AG16098 XTENDIMAX™ with VaporGrip™ Technology

Approved DRA Adjuvant for XtendiMax™ with VaporGrip™ Technology

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

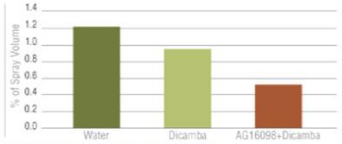
- This adjuvant system has been formulated to reduce driftable fines up to 50%.
- Aids with droplet spreading and canopy deposition for improved herbicide efficacy.
- Includes anti-foam for added convenience.

As an approved DRA for XtendiMax™ herbicide with VaporGrip™ technology, AG16098 unlocks the use of many other key products to effectively manage the new Roundup Ready® Xtend™ Cropping System.

Application Rate with XtendiMax™ herbicide:

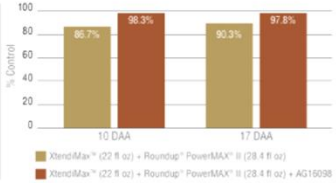
	AG16098	XtendiMax™
Pre	0.5% v/v	22 – 44 fl. oz./A
Post	0.5% v/v	22 fl. oz. /A

Average % Fines < 150µm: TTI 11004



Source: WinField United Spray Analysis System 2016

Control of Common Lambsquarters



Source: WinField United, 2016

To learn more, contact your local WinField® United retailer, or go to winfieldunitedag.com

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*Because of factors outside of WinField's control, such as weather, application factors, etc., results to be obtained, including but not limited to yields, financial performance, or profits, cannot be predicted or guaranteed by WinField. Actual results may vary.

Learn more about our brands at
WinFieldUnitedAg.com

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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

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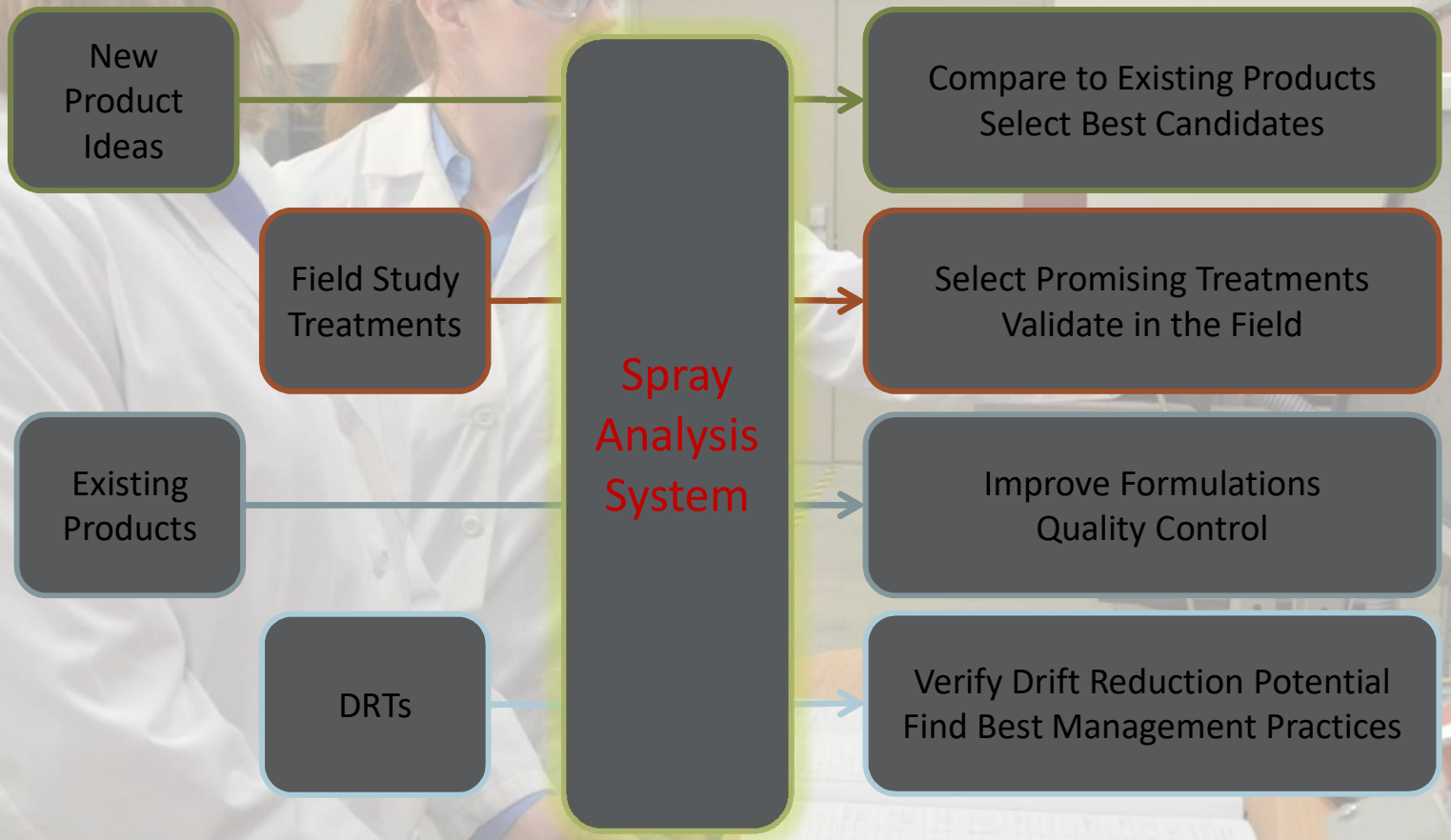
Spray Analysis & Product Development



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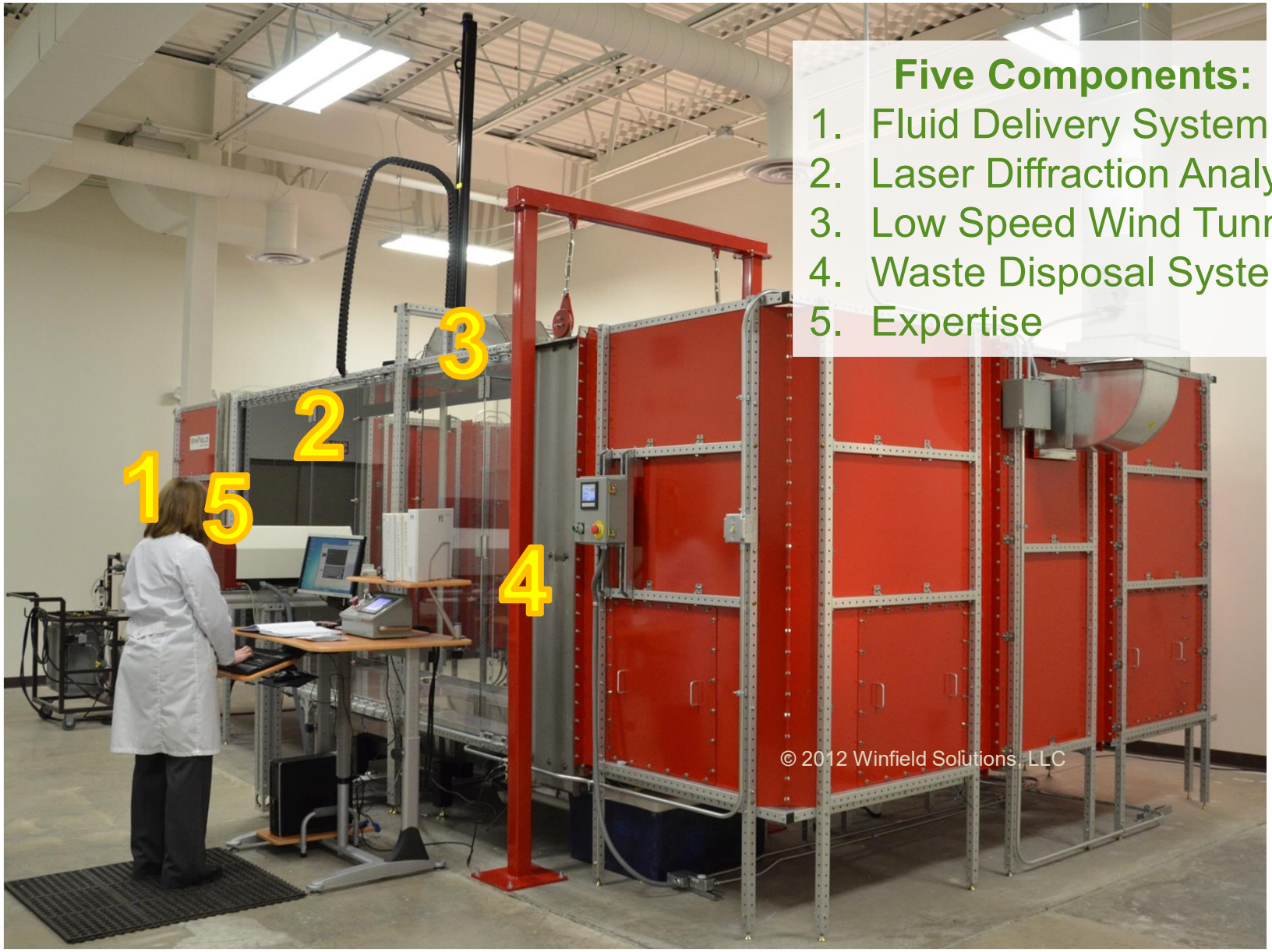
Winfield United Spray Analysis System



Five Components:

1. Fluid Delivery System
2. Laser Diffraction Analysis
3. Low Speed Wind Tunnel
4. Waste Disposal System
5. Expertise

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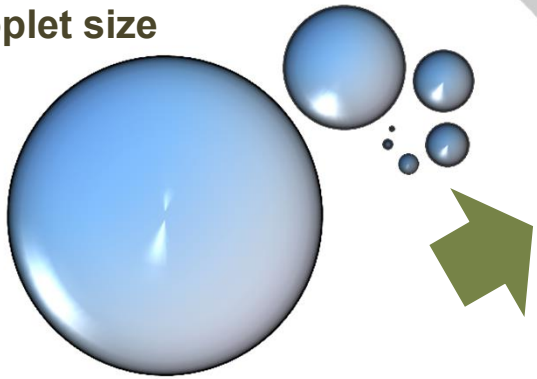
How does it work?

Measures droplet size



Increases Knowledge About:

- Product Performance
- Spray Application Technology
- Spray Drift

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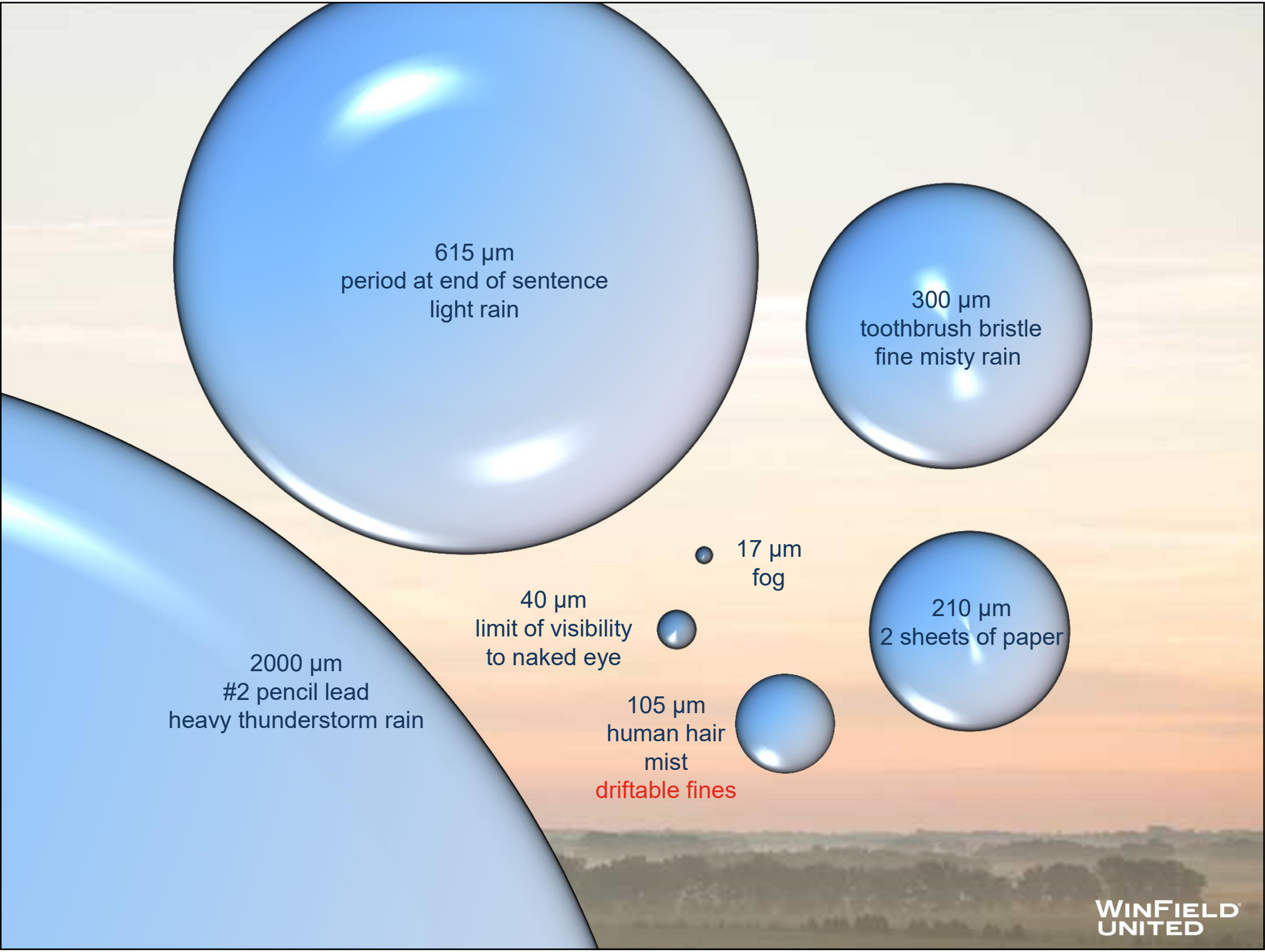
615 µm
period at end of sentence
light rain
300 µm
toothbrush bristle
fine misty rain
17 µm
fog
40 µm
limit of visibility
to naked eye
210 µm
2 sheets of paper
2000 µm
#2 pencil lead
heavy thunderstorm rain
105 µm
human hair
mist
driftable fines
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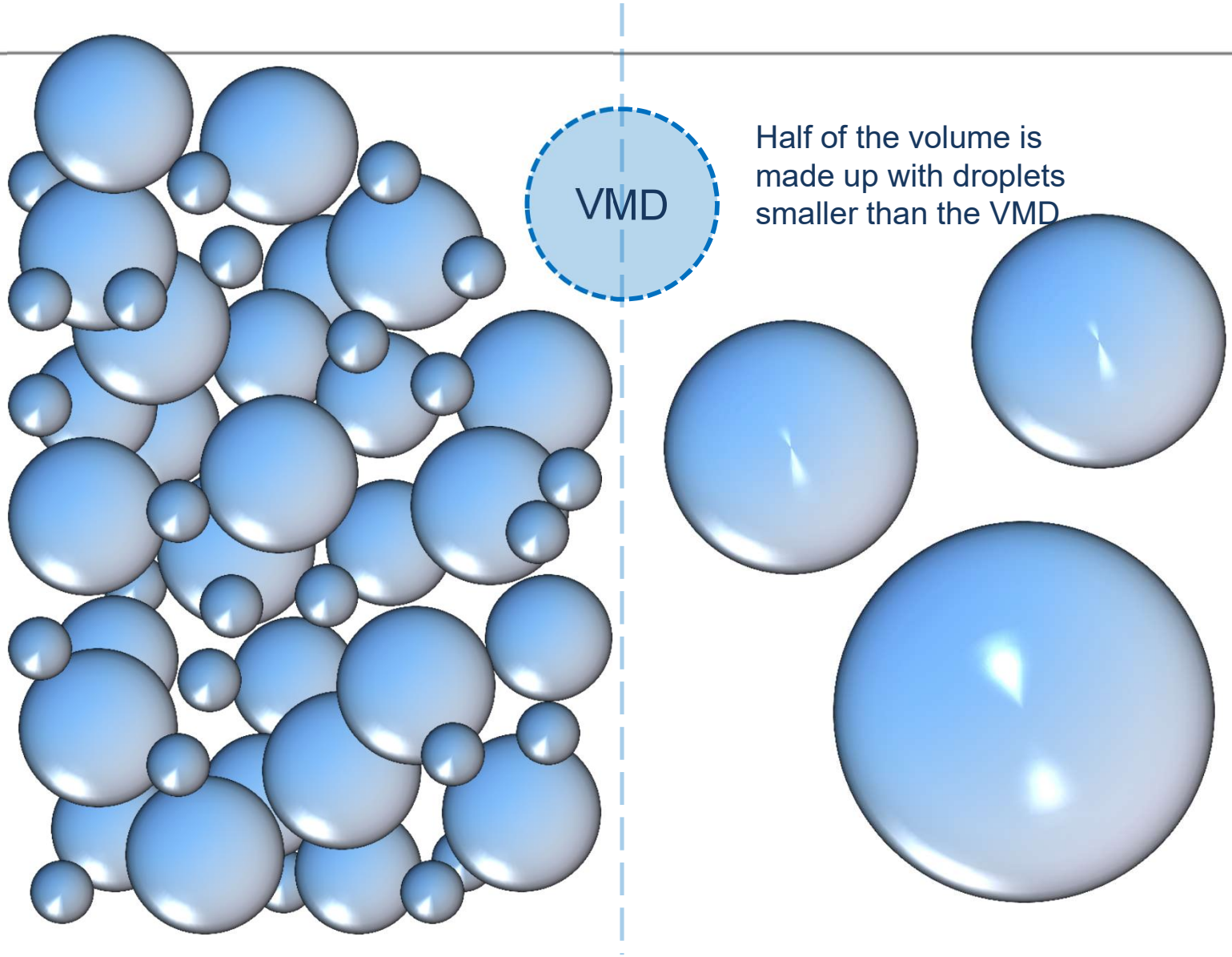
Volume Median Diameter



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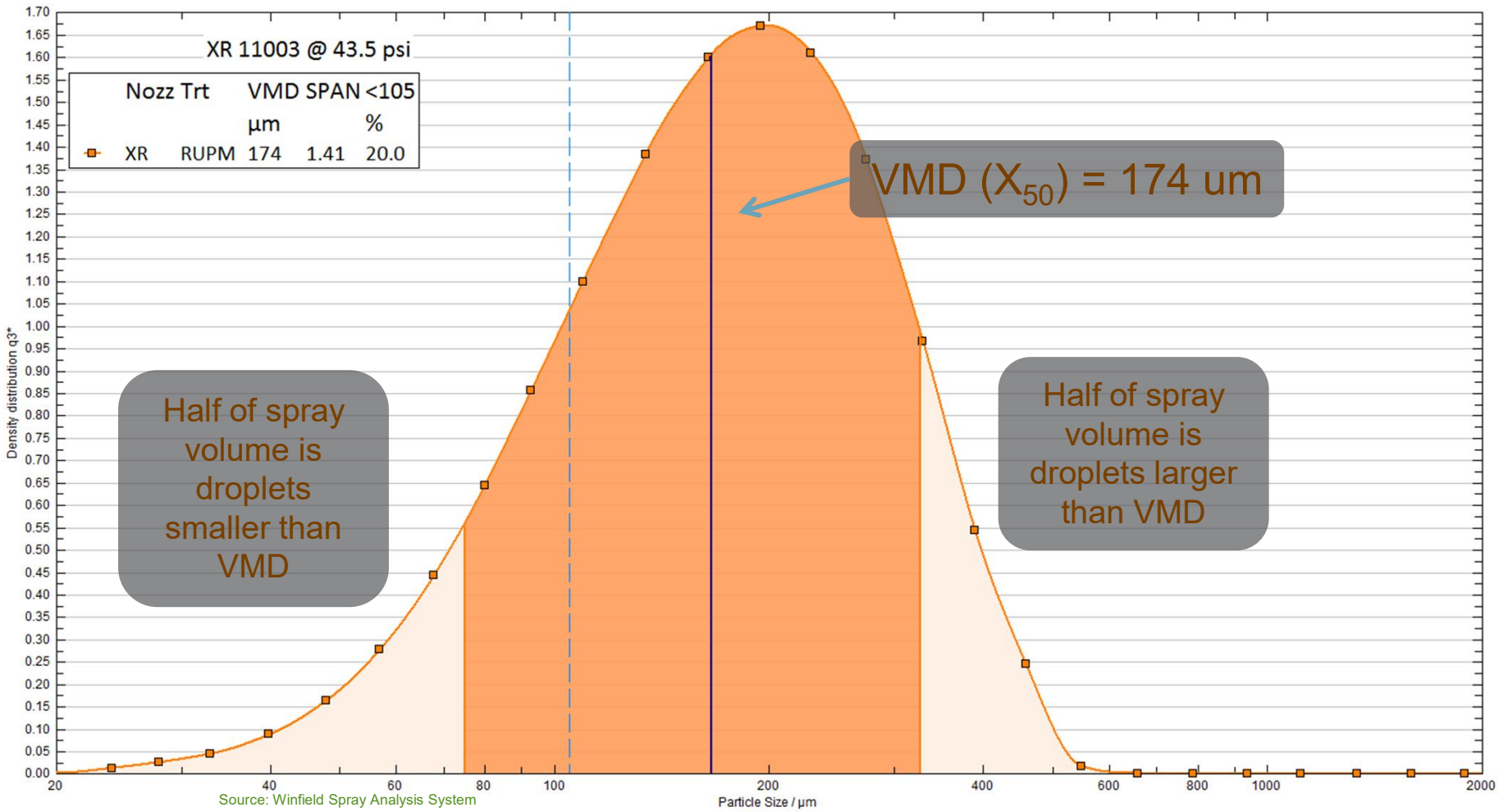
Droplet Size Distributions: VMD



Source: Winfield Spray Analysis System

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Span

- Relative span of a spray
  - $(X_{90} - X_{10})/X_{50}$
  - Where *n*% of the volume is made up of droplets smaller than X_n (percentile)
  - Higher span → 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

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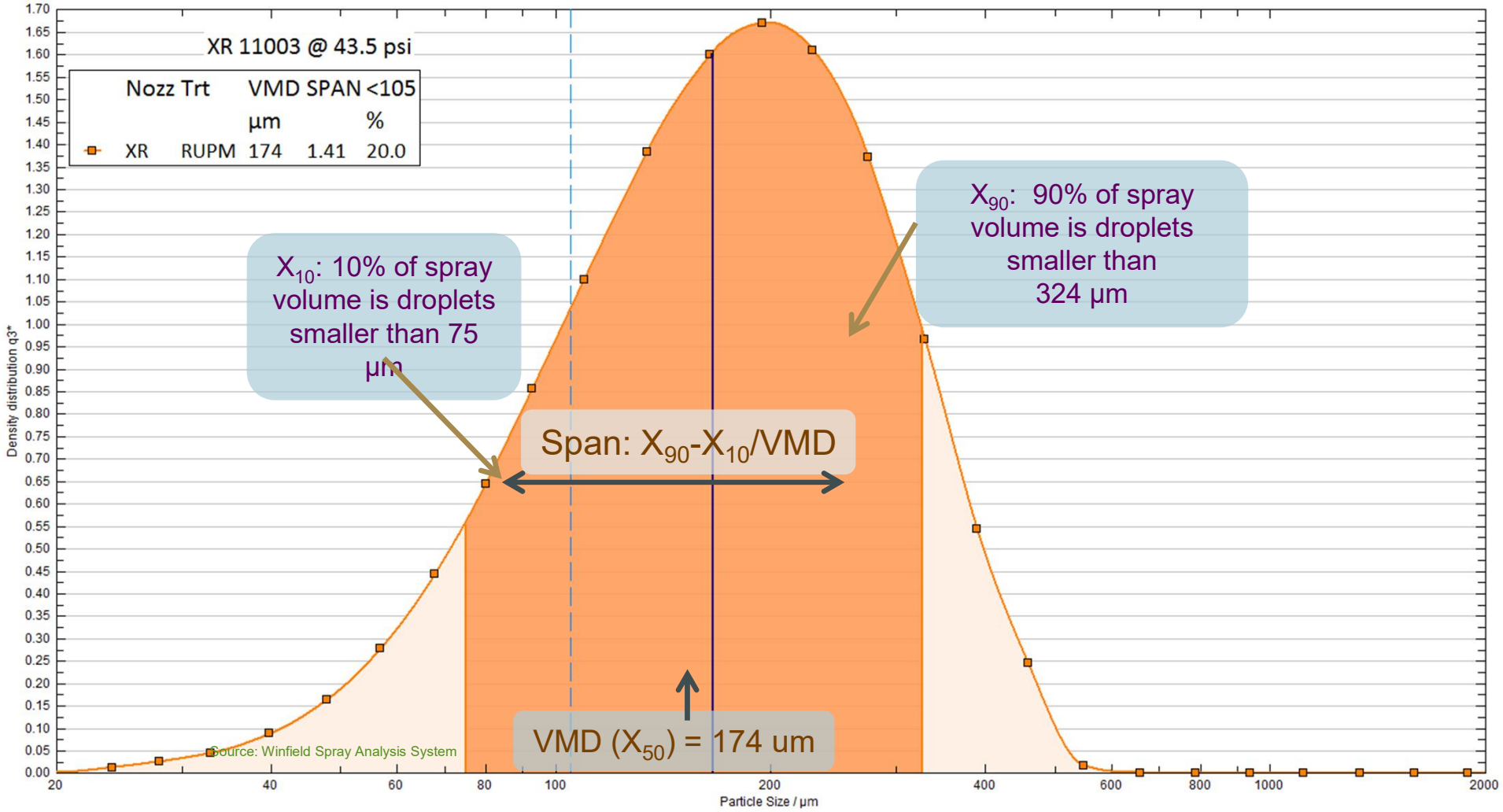
Droplet Size Distributions: Span



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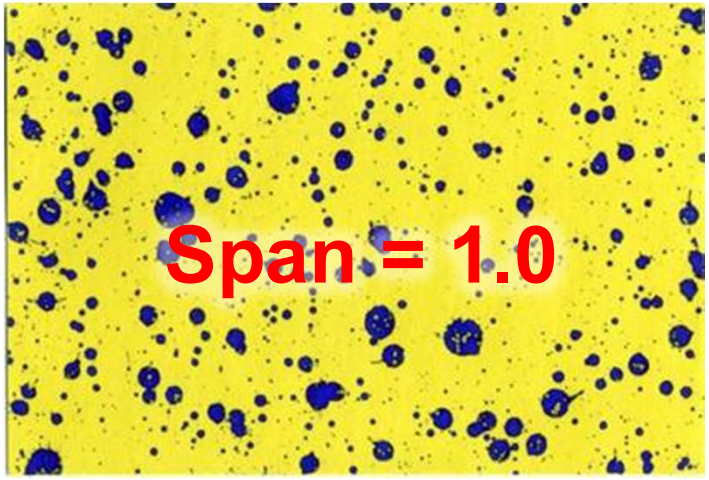
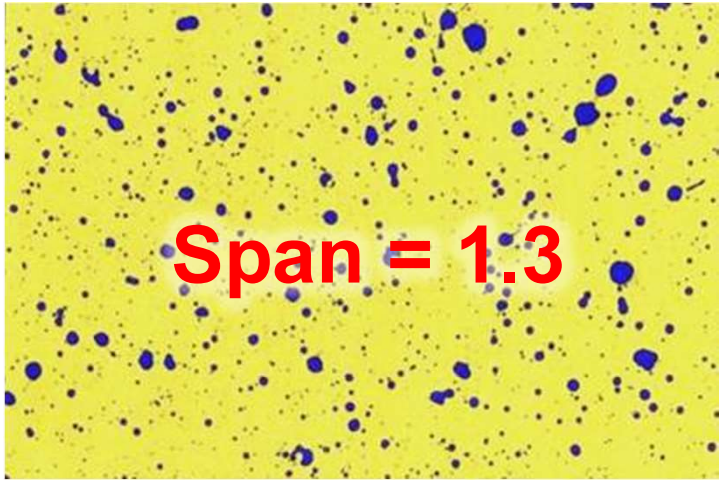
Relative Span



AI 11003 with InterLock
12.4% Coverage
VMD = 556, Fines = 0.36%



AI 11003
6.9% Coverage
VMD = 473, Fines = 2.2%

Larger span → more variability within the spray.

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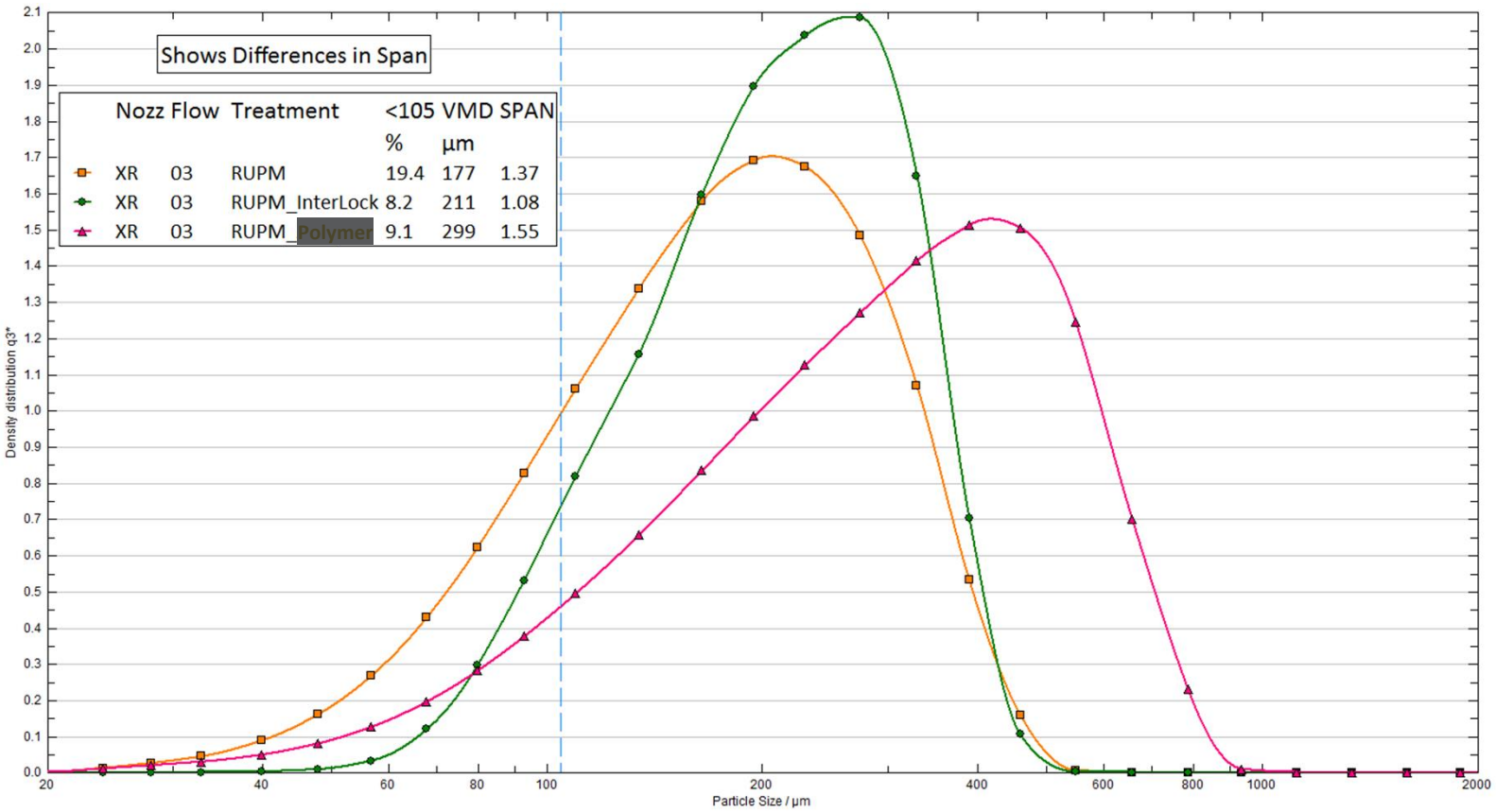
Adjuvants can Affect Span



Source: Winfield Spray Analysis System

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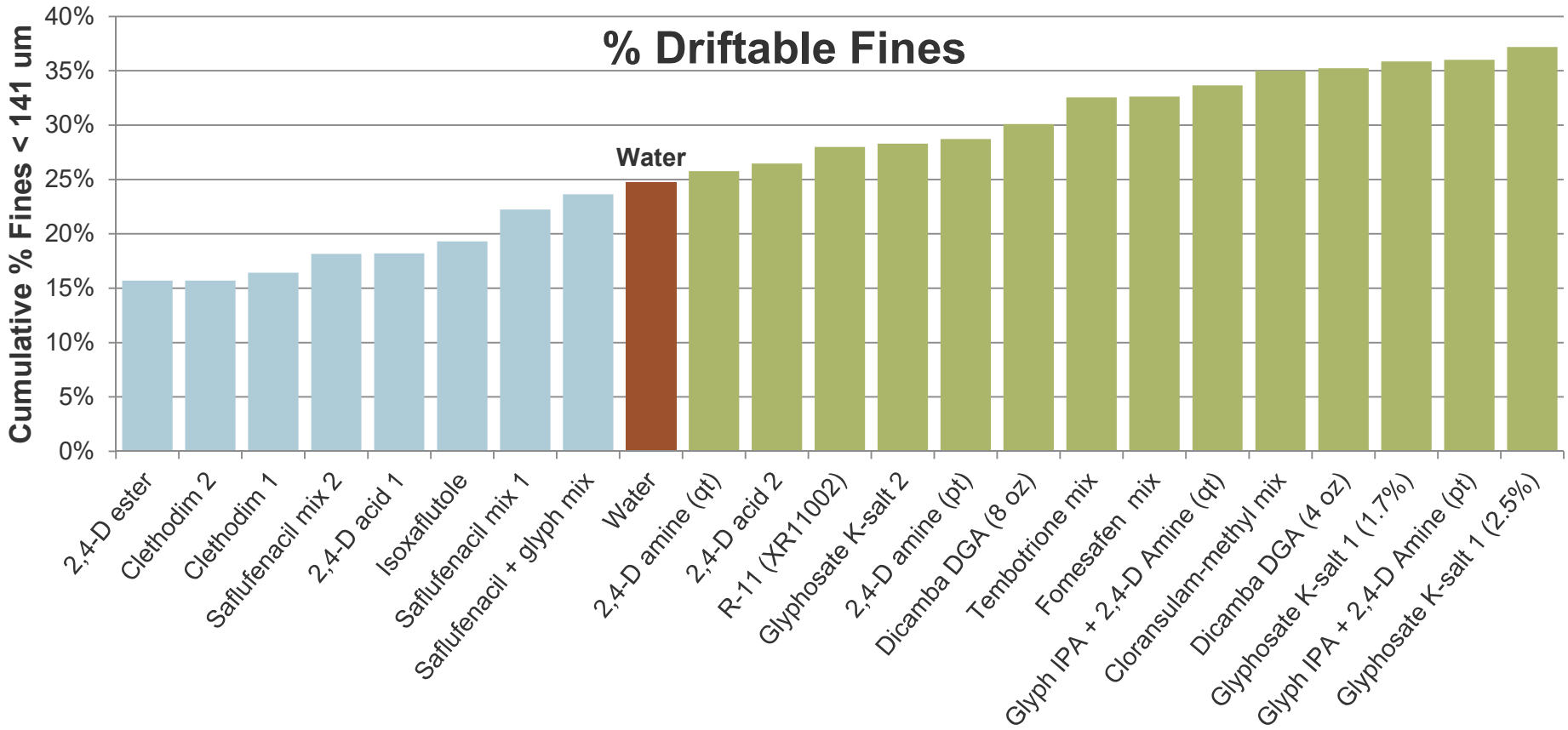
Applying Spray Analysis Insights: Tank Ingredients Matter



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

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Using DRA's to Manage Drift

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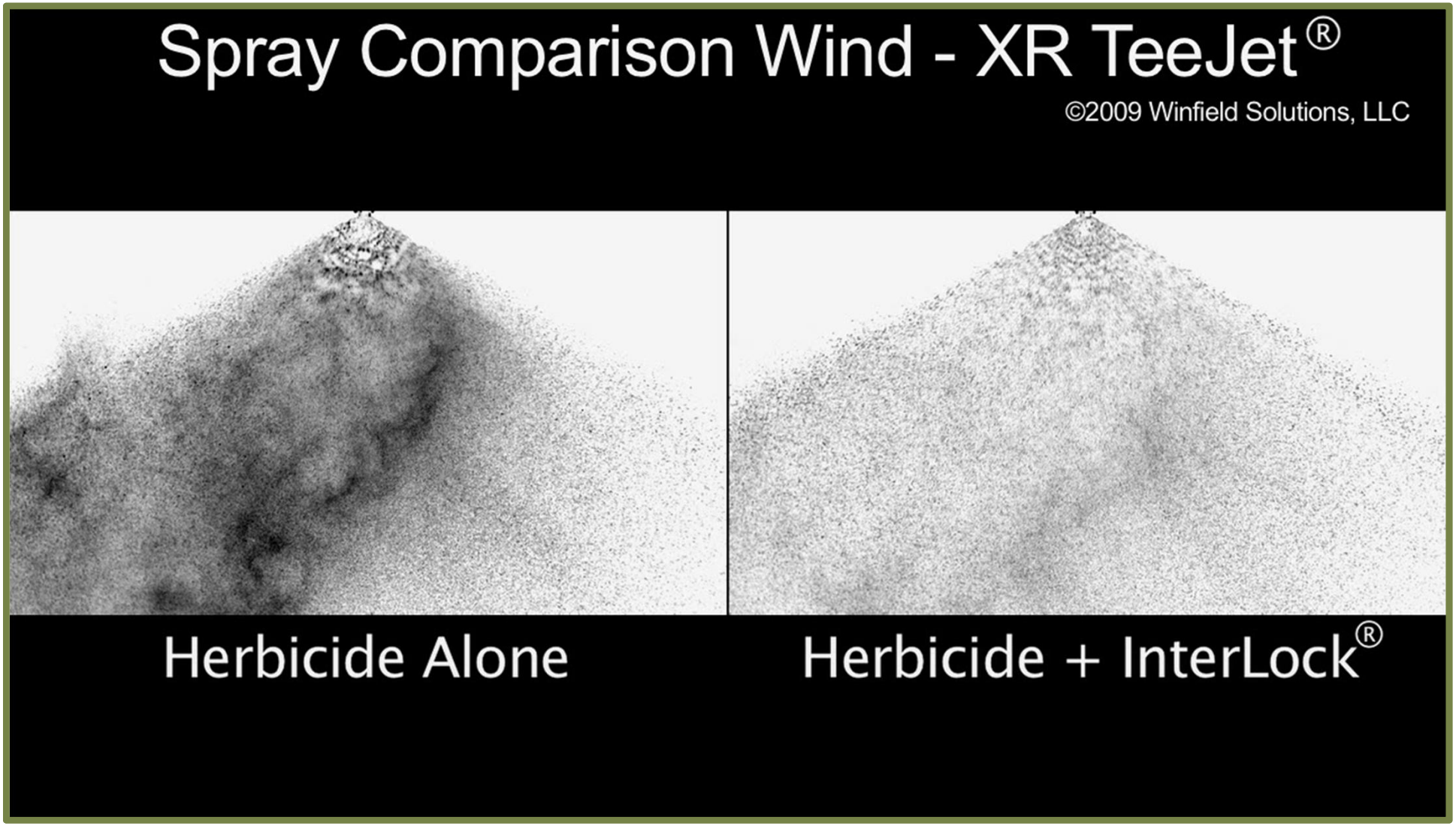
InterLock- Drift Reduction



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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

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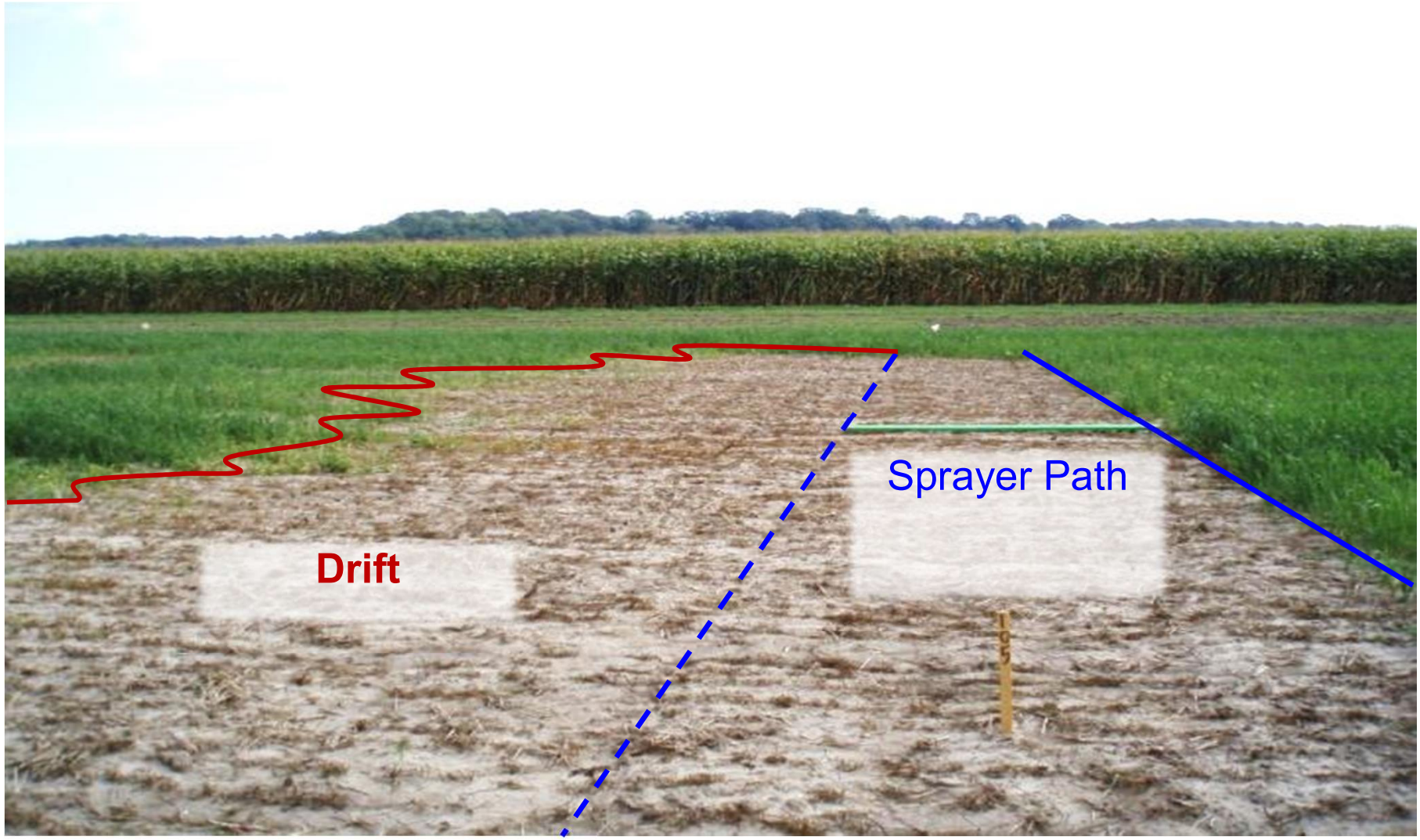
Off-Target Drift



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

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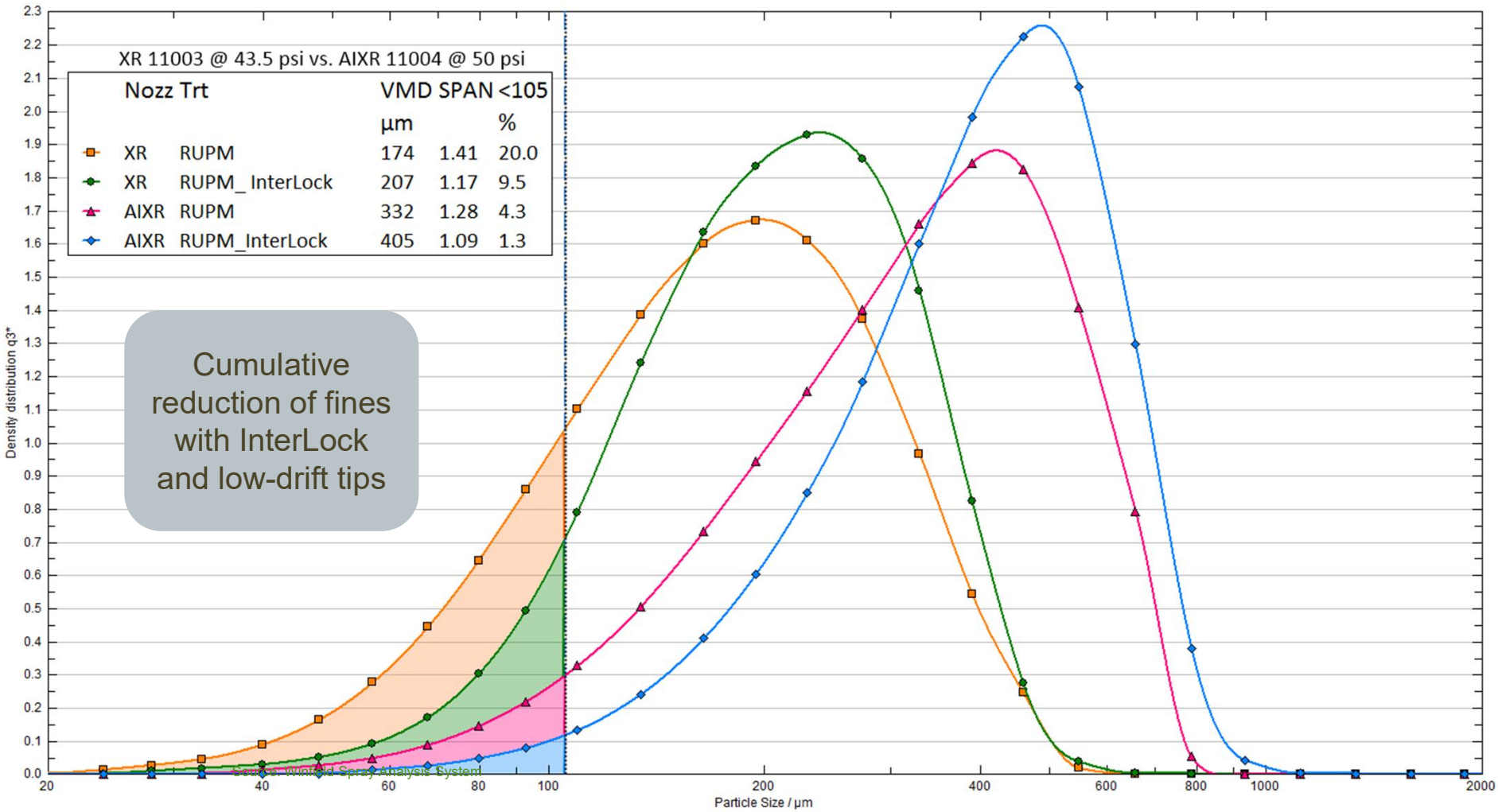
Spray Quality Improvement



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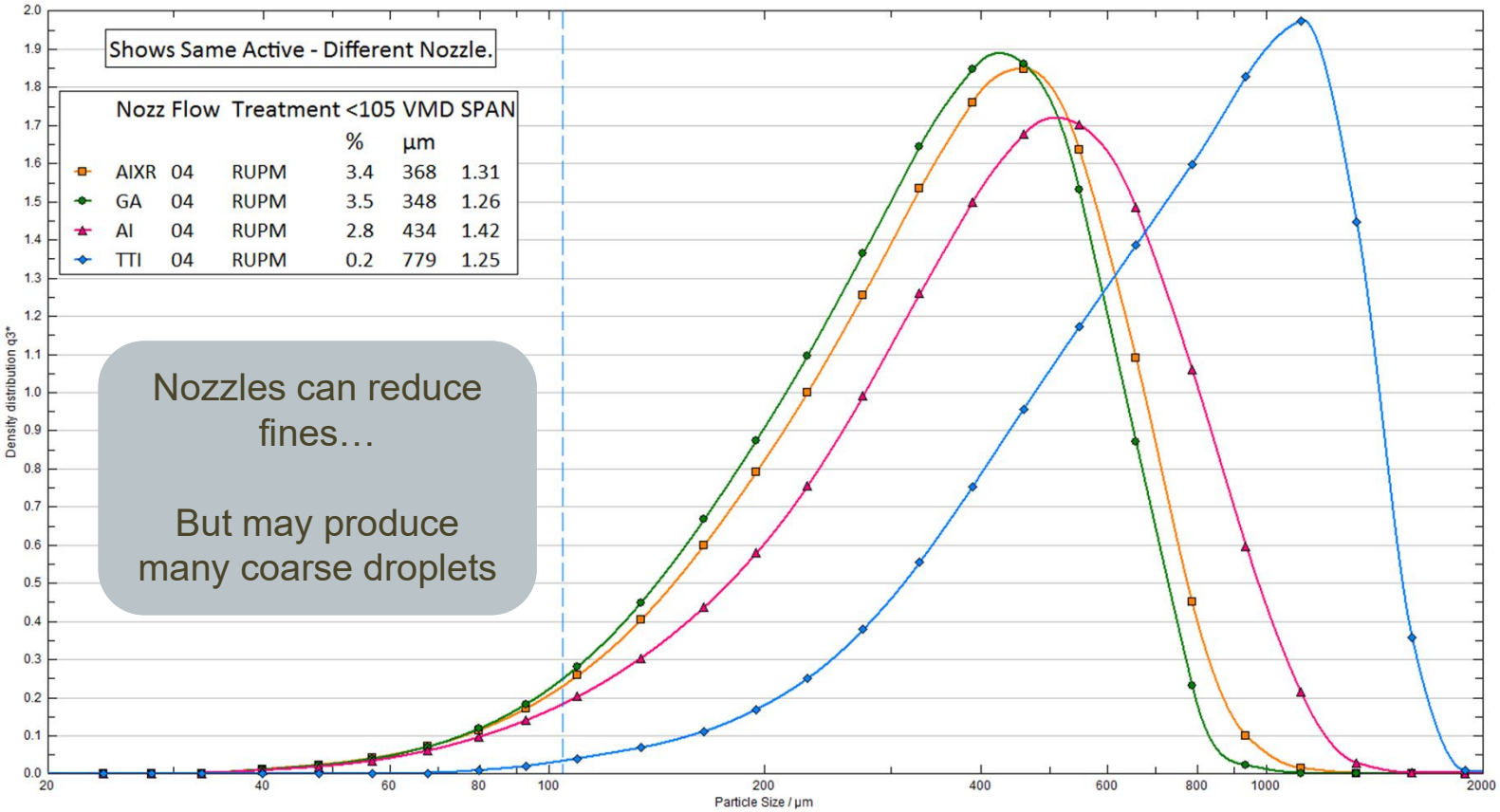
Finding the "Right" Droplet Size



Source: Winfield Spray Analysis System

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Approved DRA for use with Xtendimax™ herbicide

Approved DRA for use with Engenia™ herbicide

*Always read and follow label

OnTarget™ Product Overview

DRA for Dicamba Chemistries with Ultra/Extra Coarse Nozzles

August 2017

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OnTarget™ By WINFIELD UNITED

Drift and Deposition

What is OnTarget™

DRA, drift and deposition adjuvant **Use Rate: 0.5% v/v**

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

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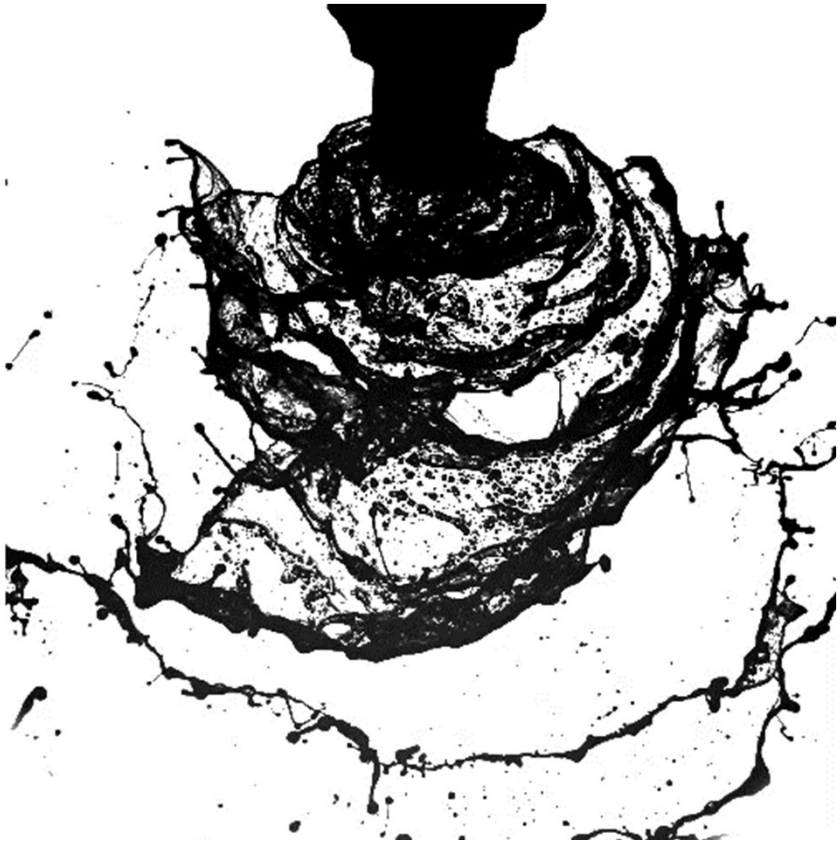
TTI11004
63 psi

WHAT'S A DRA? – VIDEOS

Dicamba alone



Dicamba + DRA (AG16098)

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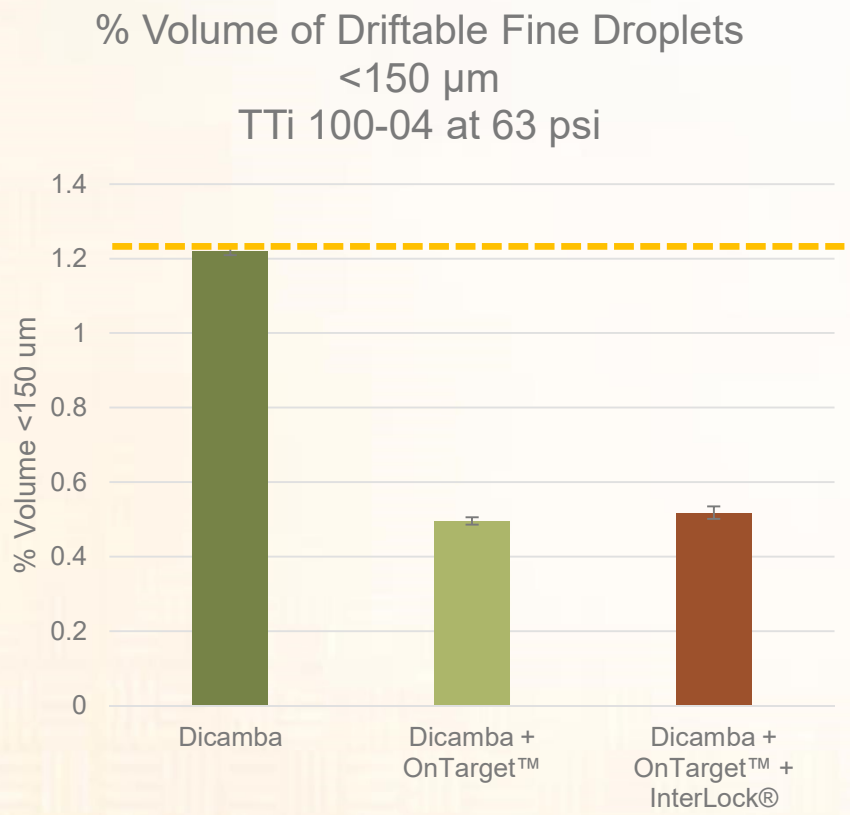
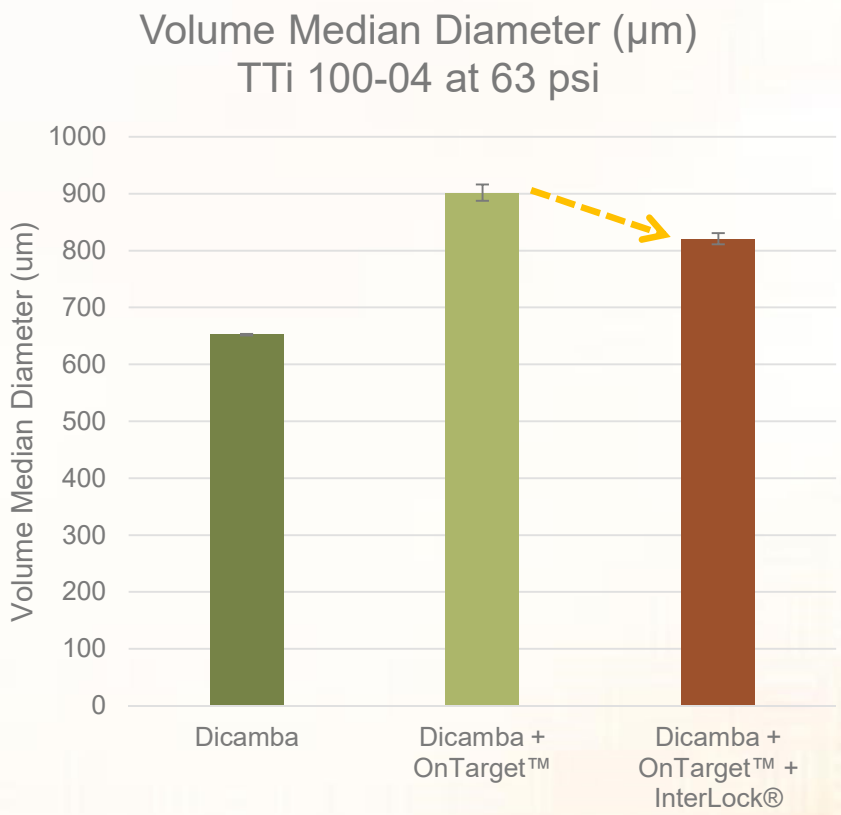
Applying Spray Analysis Insights: Approval with Herbicides for New Traits





Error bars represent the 95% confidence interval about the mean

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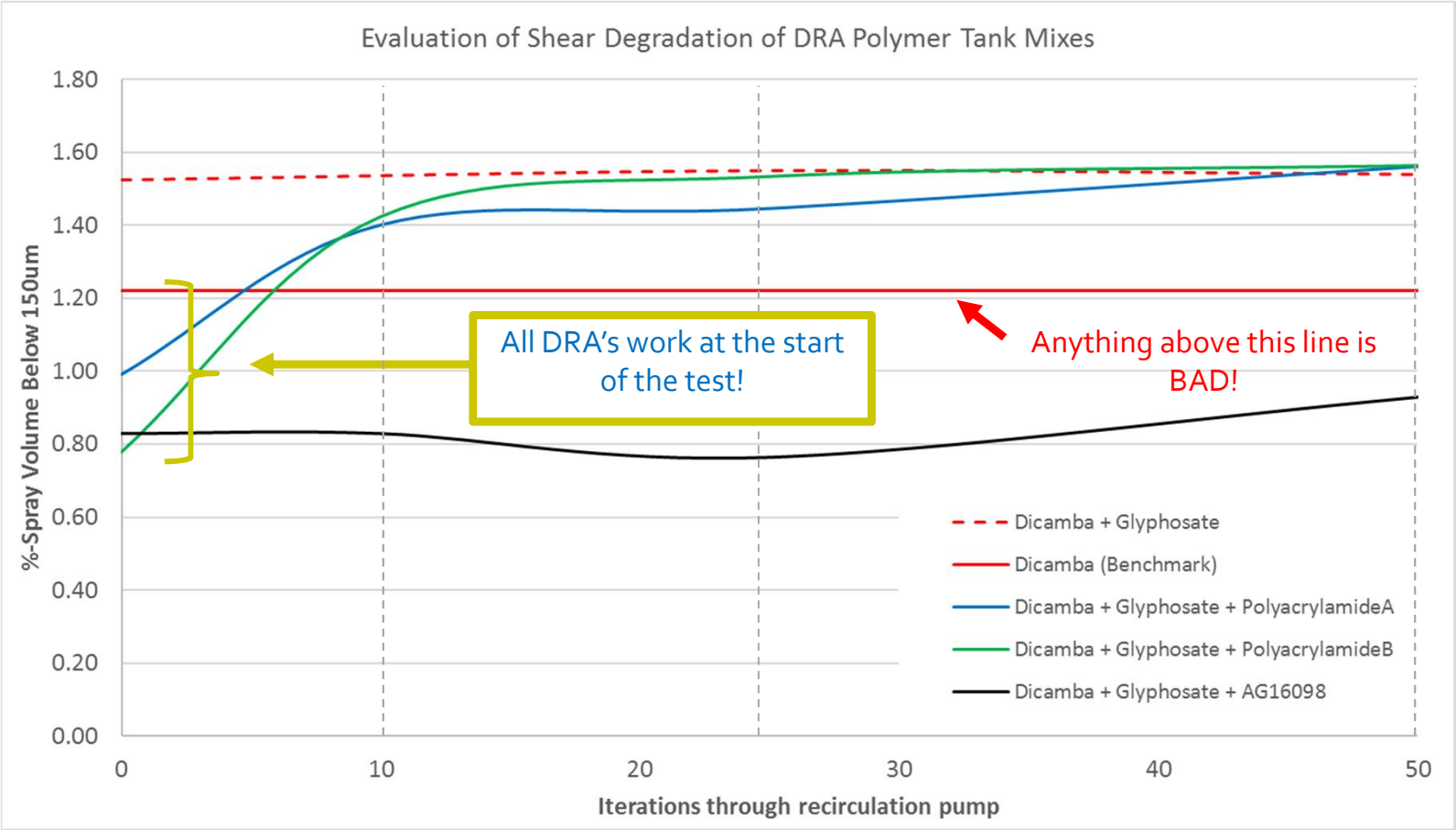
Shear Test Experimental Results



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Previous Shear Work

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

Richard, D. L. et. al. 1996.

Zhu, H., et. al. 1997.

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Future of DRA Development @ Winfield United

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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

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Come visit us at Booth #312

Acknowledgements:
All of the Winfield United Product Development Team

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

Thank You

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