

New Technologies for Reducing Off-Target Movement

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Off-Target Movement of Pesticides

- Drift
 - Application phenomenon endemic to all applications and chemistries
- Volatility
 - Physical phenomenon related to each molecule
- What are our options for reducing drift and volatility?
 - Mostly handled by label directions or regulation
 - Wind speed, temperature restrictions, application timings, nozzle specifications, geographical restrictions, buffer zones

Plant Sensitivity as Biomarker

Tomato injury from 2,4-D and glyphosate



2,4-D injury

NCSU Photo



Glyphosate injury

Clemson Univ. Photo

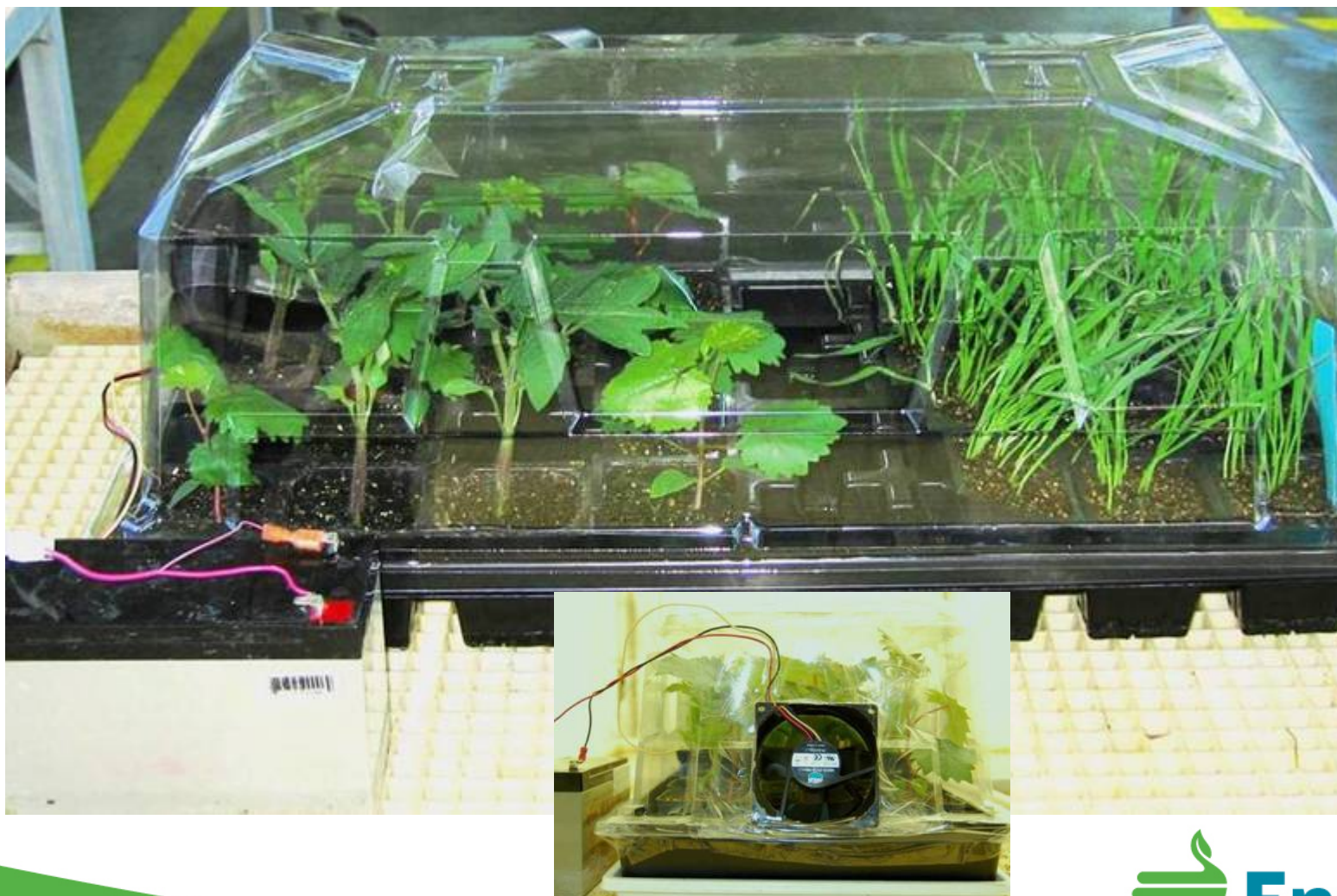
Enlist Weed Control System

- Novel herbicide resistance traits introgressed into corn, soybeans and cotton
 - Provides tolerance to 2,4-D in corn, soy and cotton
 - Will be stacked with leading herbicide and insect tolerant traits
- Stewardship of the system is a key component of the offering
 - Central piece of stewardship program is improving control of drift and volatility
 - Integrate as much into product offering as possible to improve grower acceptance by reducing complexity
- Development of novel 2,4-D products that provide significant improvements in drift and volatility control

Start Small and Work Big

- Volatility
 - Compound related phenomena
 - Can we reduce 2,4-D volatility further than the amines?
 - Esters > Amines > Other Salts?
- Drift
 - Application related phenomena
 - Application equipment technology
 - Formulated product technology

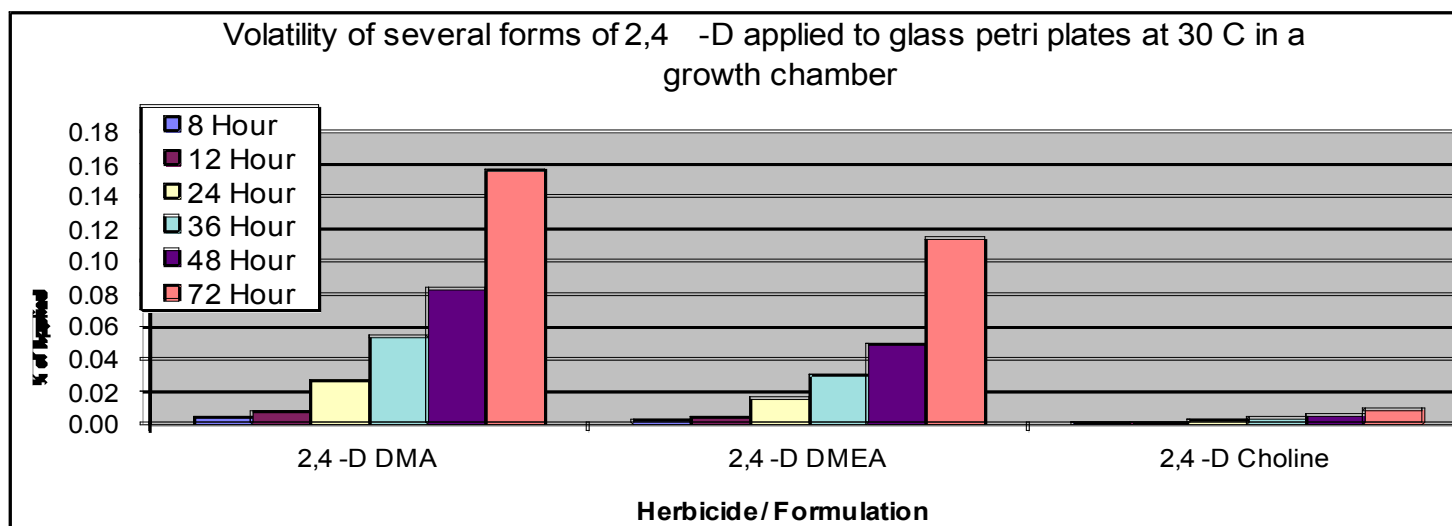
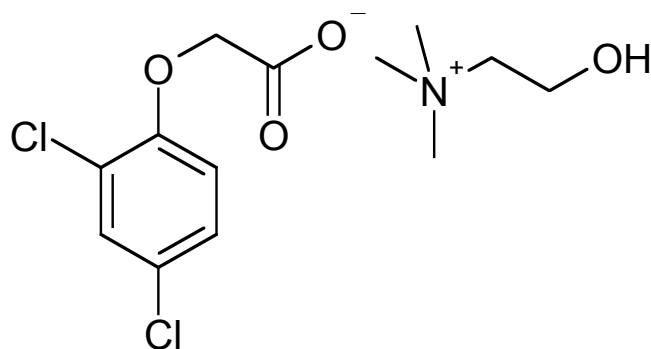
Plant Effects – Humidome Setup



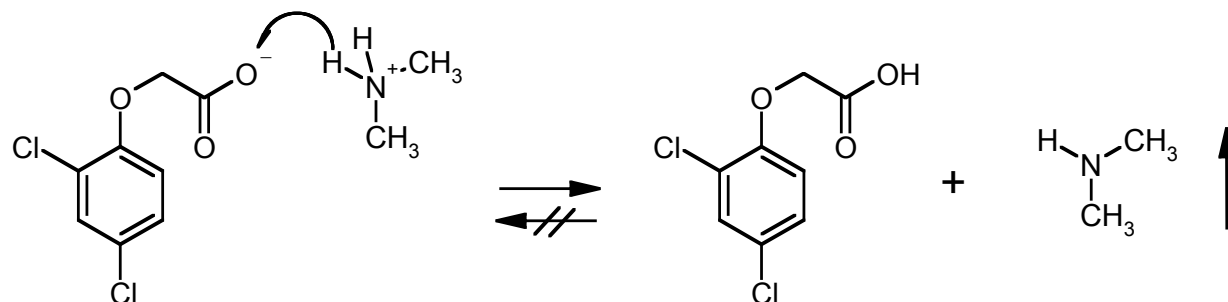
Grapes After 24hr Exposure @ 40°C



Choline Salt - A New Form of 2,4-D

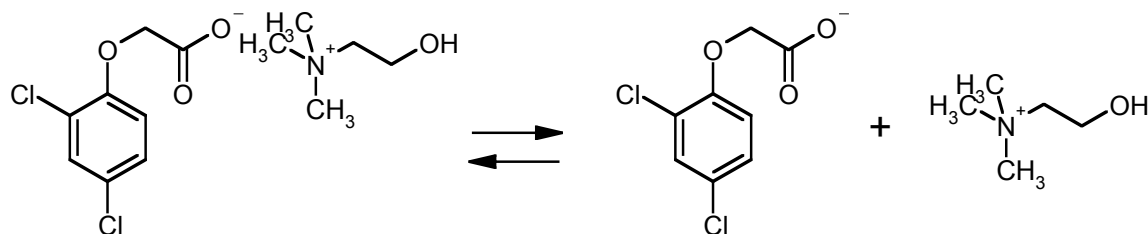


Potential Mechanism for Reduced Volatility



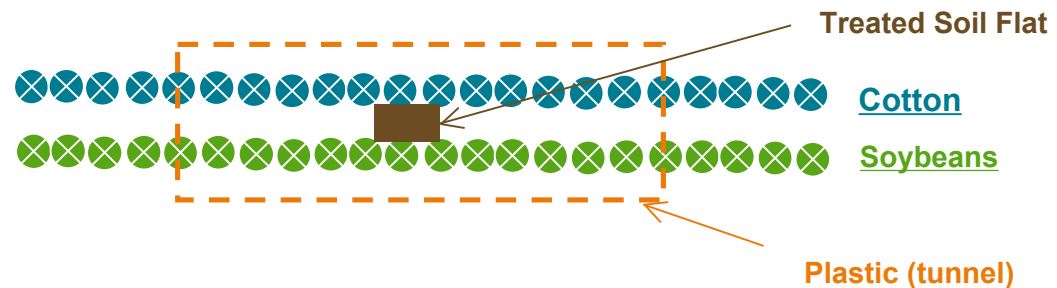
2,4-D DMA Salt thermally unstable

Amine itself is highly volatile leaving behind 2,4-D to volatilize



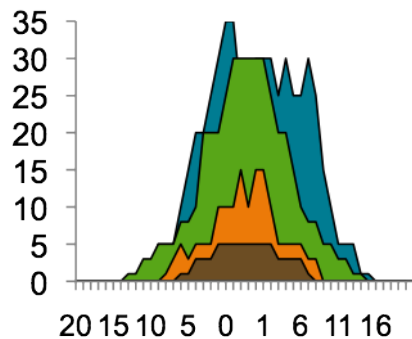
2,4-D Choline Salt in equilibrium with 2,4-D acid anion and choline cation, both having very low volatility

Semi-field Screening and Demonstration Studies with Mississippi State University

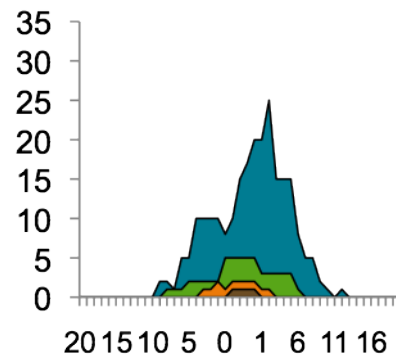


Cotton Results

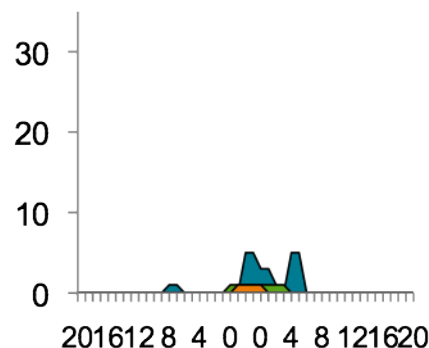
2,4-D Ester + Glyphosate



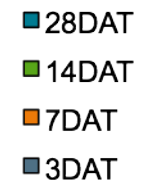
2,4-D Amine + Glyphosate



2,4-D Choline + Glyphosate



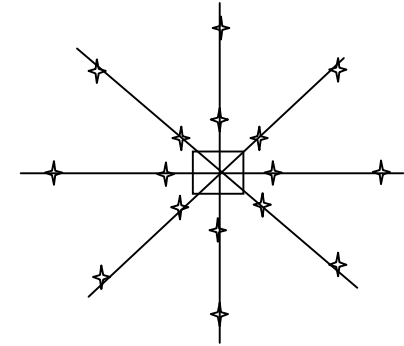
% visual injury



Feet from centerline

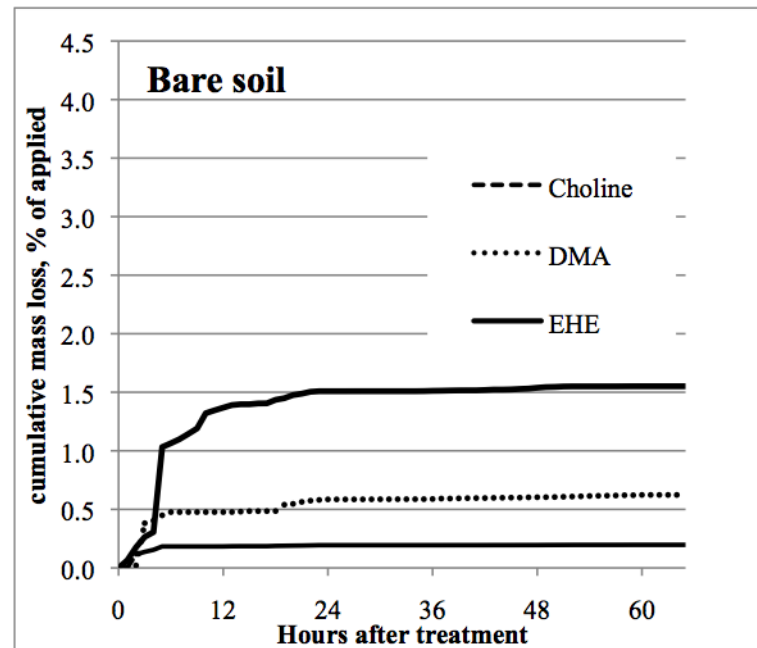
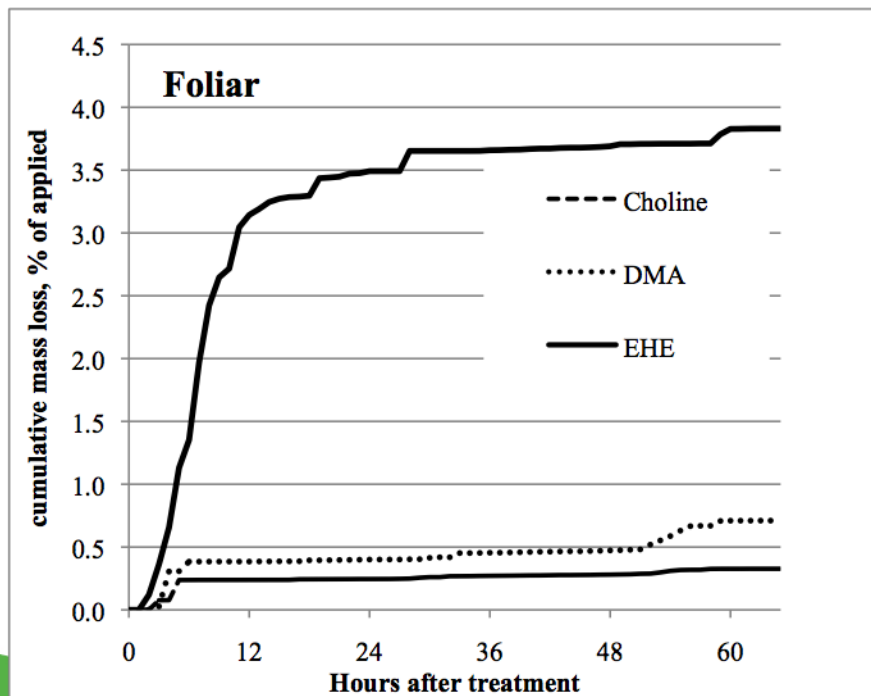
Large-Scale Field Volatility Study Design

- 4 sites
 - 2010 – 2 x IN
 - Soybean field (conventional) and bare soil
 - 2011 – AR & GA
- Rate and size of treated areas for detection
 - Ester @ 1120 g a/ha on 0.25 ha
 - DMA @ 2240 g a/ha on 2.25 ha
 - GF-2654 (2,4-D choline) @ 4480 g a/ha on 2.25 ha
- sampling
 - Air-sampling pumps, OVS tubes, XAD-5 resin
 - 6-hour intervals
 - Plant response (in-field and potted plants)



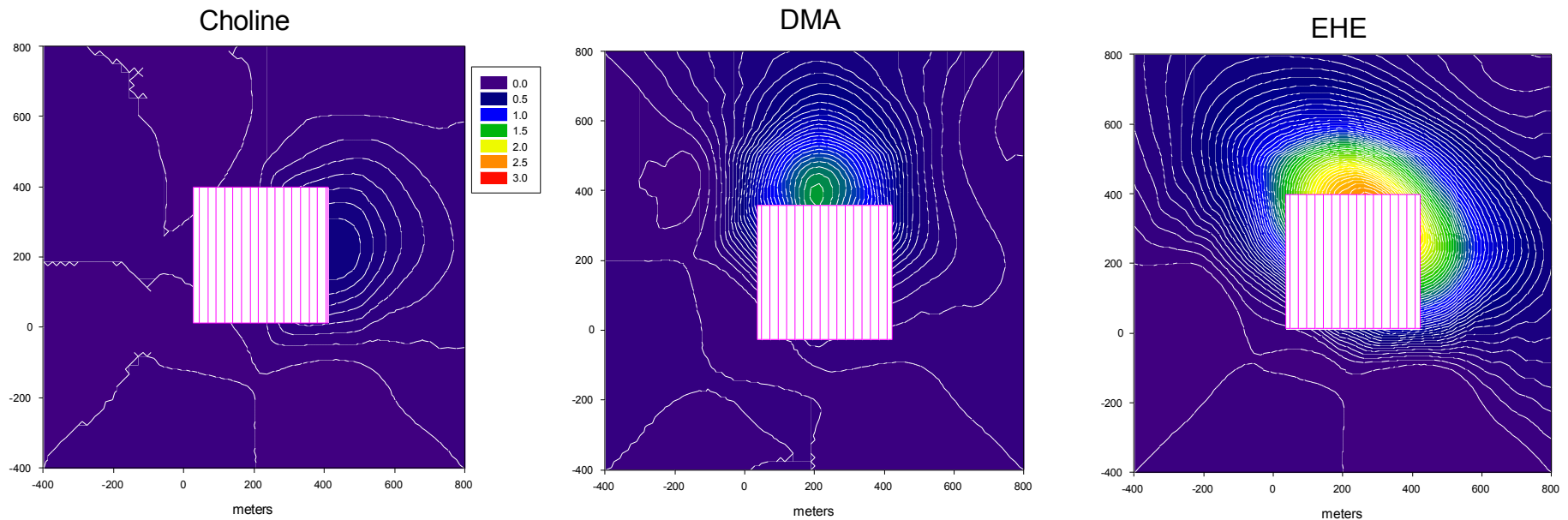
Three Day Cumulative Vapor Loss of 2,4-D

- Choline 8-12x < EHE
 - Foliar > bare soil
- Choline 2-3x < DMA



Extrapolation to Larger Scale

Simulated exposure from 40-acre treatment area: first 6 hours after application - units: ($\mu\text{g}/\text{m}^3$)-hr



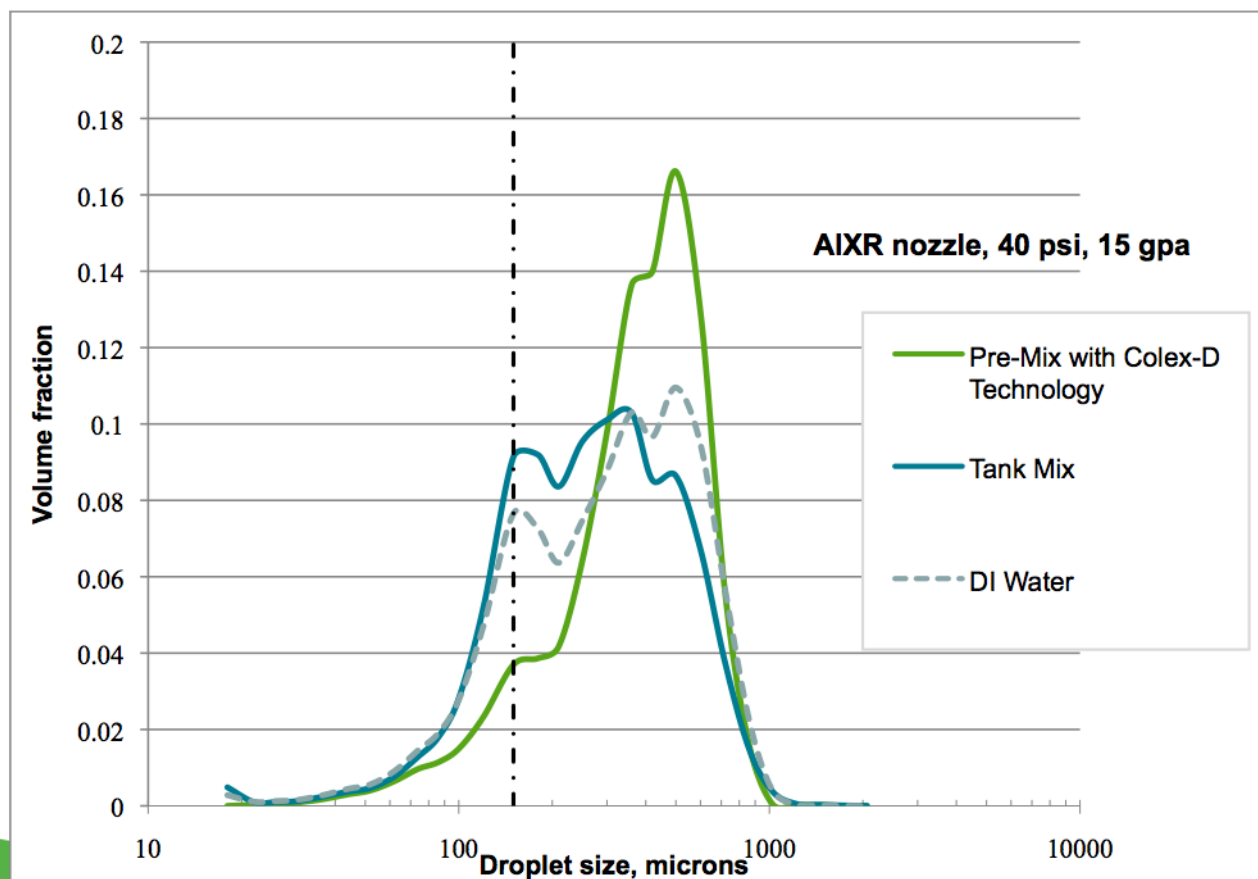
Relate model estimates over time to plant effects => risk assessment & stewardship recommendations

Controlling Drift

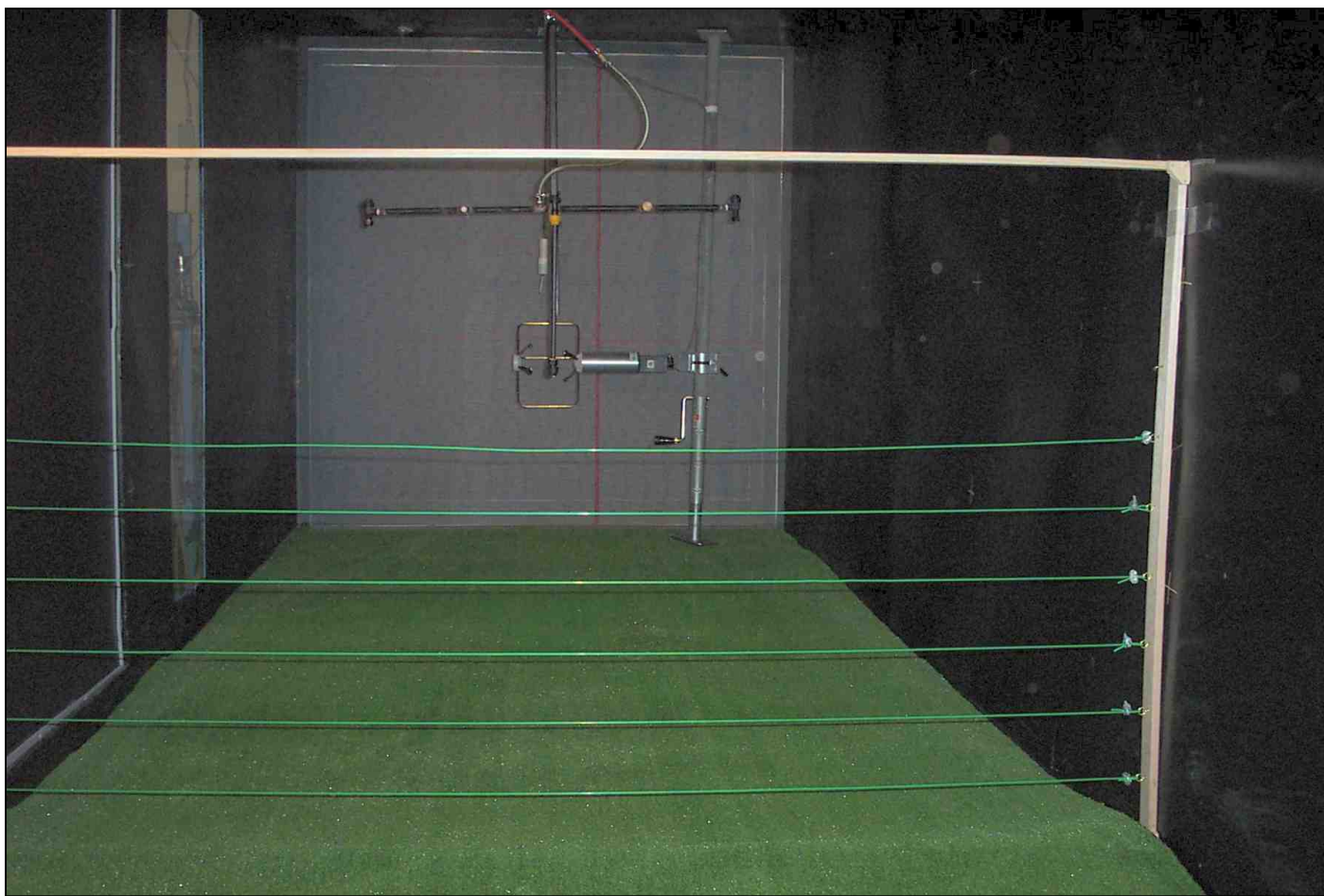
- Focus has been on application technology
- New formulation science provides opportunity for drift control improvements within the product
- Drift particle research
 - Laboratory droplet size measurements
 - Wind tunnel flux and deposition
 - Small-scale field demonstration trials
 - Full field-scale drift trials

Laboratory Droplet Size Measurements

- Sympatec laser



Wind Tunnel Looking Upstream



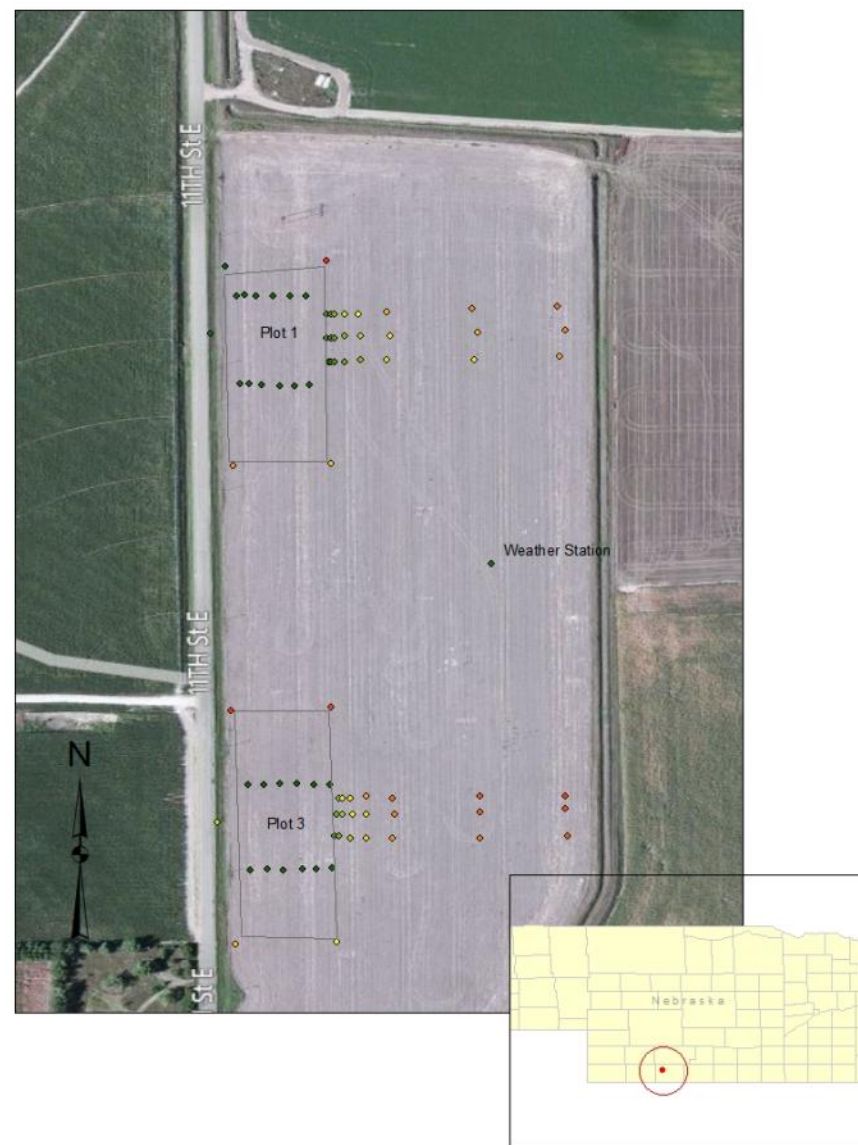
Andrew Hewitt in Australia

In the Field Research

- Generate field-scale drift deposition information
 - ISO-compliant trial
- Compare
 - 2,4-D choline/glyphosate premix with Colex-D™ technology versus a tank mix of 2,4-D DMA and glyphosate using three common nozzles
- Dye tracer and 2,4-D
- Confirmation and refinement of buffer zone requirements
 - Regulatory and stewardship
- Confirmation and calibration of drift modeling

Site – McCook, NE

- 2 application plots
 - Plot 1 – 180 x 460 ft
 - Plot 3 – 180 x 535 ft
- Wheat stubble, 14" high
- Deposition collectors – petri dishes
 - 2 lines of 6 in-plot
 - Triplicate downwind lines
 - 0, 5, 10, 25, 50, 100, 250, 400 ft
 - 1 upwind per plot
 - c. 25 ft away (on the edge of the road)
- Weather station – 30 sec wind/temp/RH continuous
 - Winds 3 – 11 mph



Treatment List

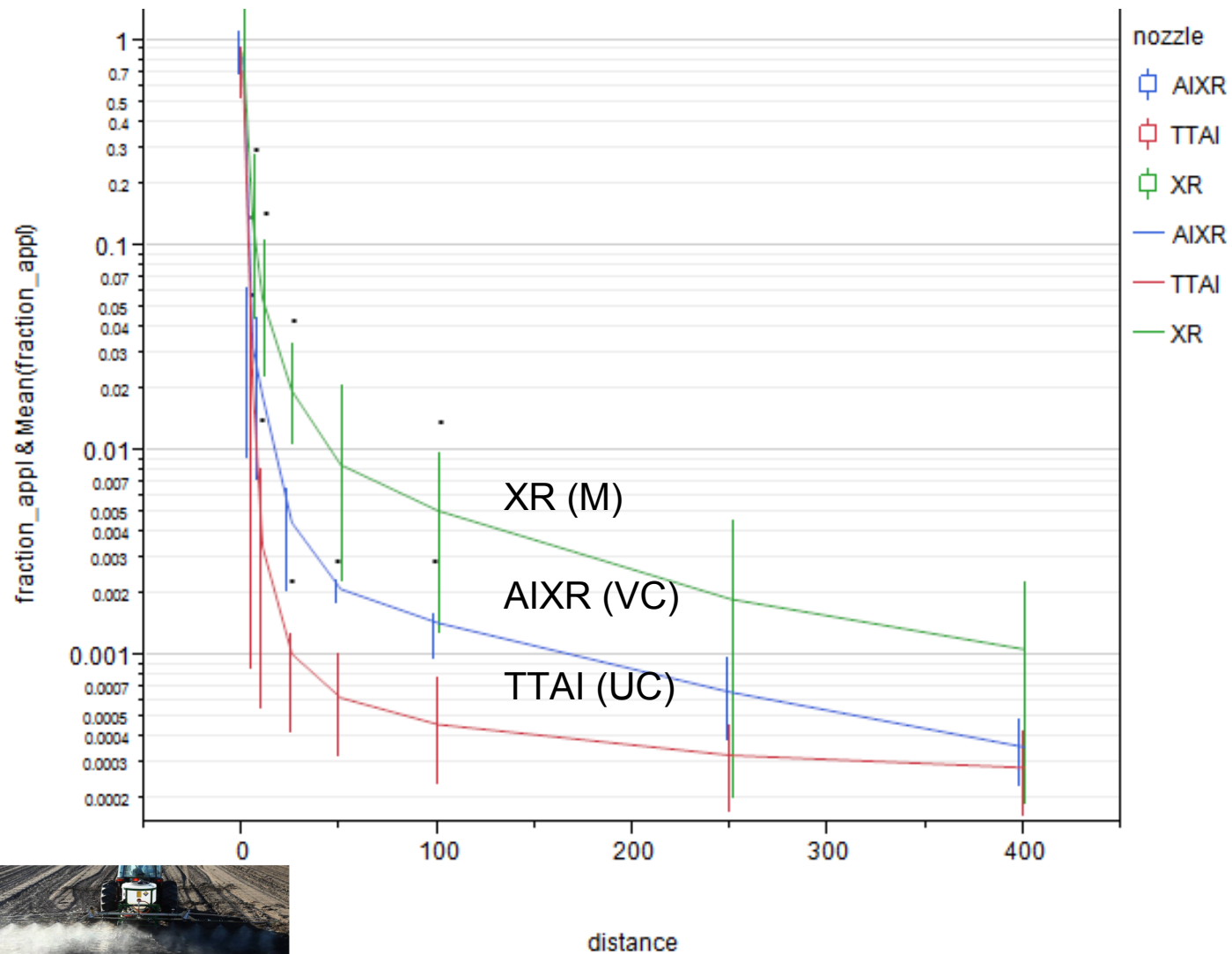
- Mixes:
 - GF-2726 + 0.2% rhodamine WT (water tracing dye)
 - DMA 4 IVM + Glyphosate + 0.2% rhodamine WT
 - Nozzles (all 110°, 04 orifice @ 40 psi)
 - XR - Medium
 - AIXR – Very/Extremely coarse
 - TTAI – Ultra coarse
- 6 treatments

Application Parameters

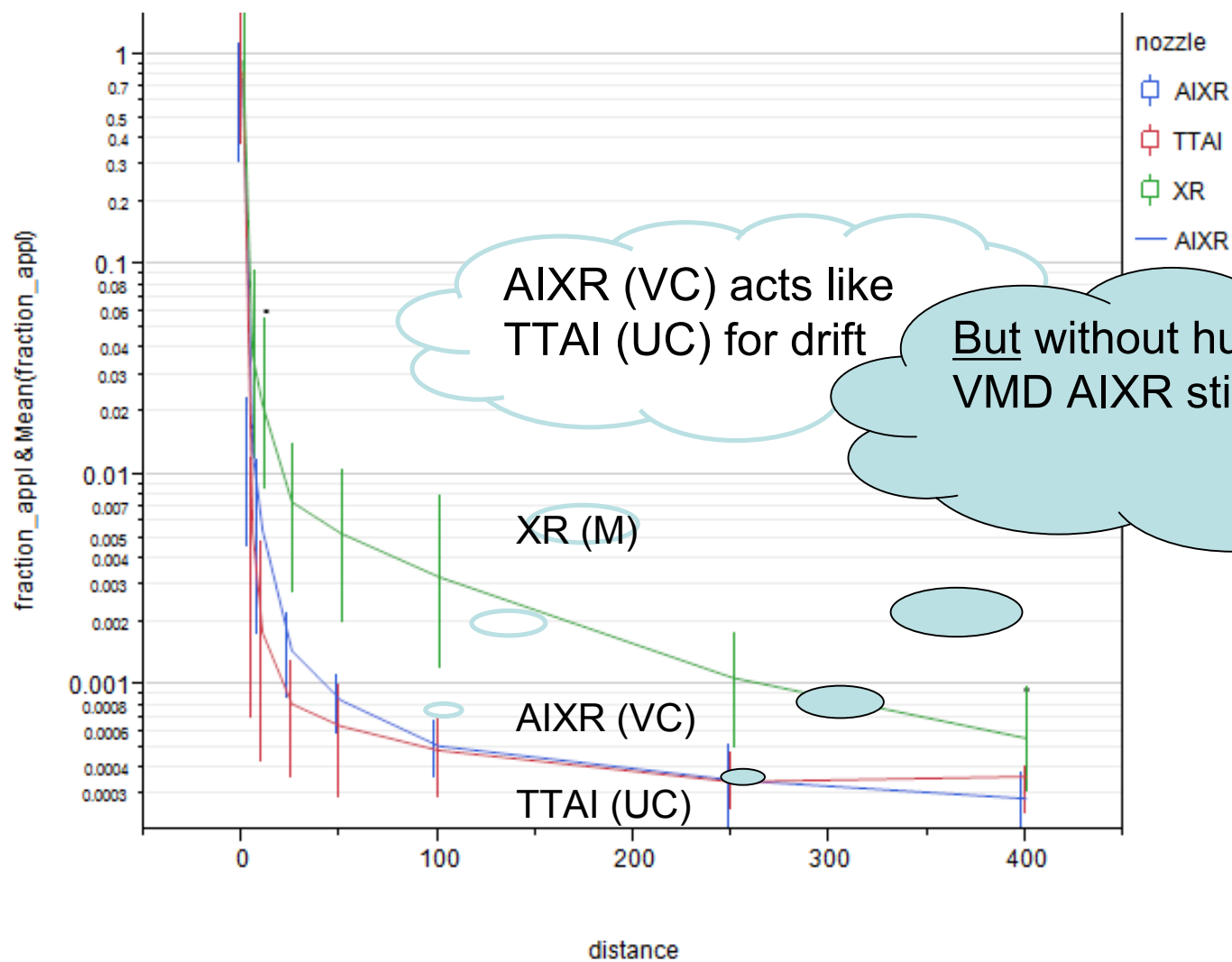
- 2 John Deere 4730 sprayers; 800 gal ss tanks
 - 90-ft boom



2,4-D DMA + Glyphosate Tank Mix



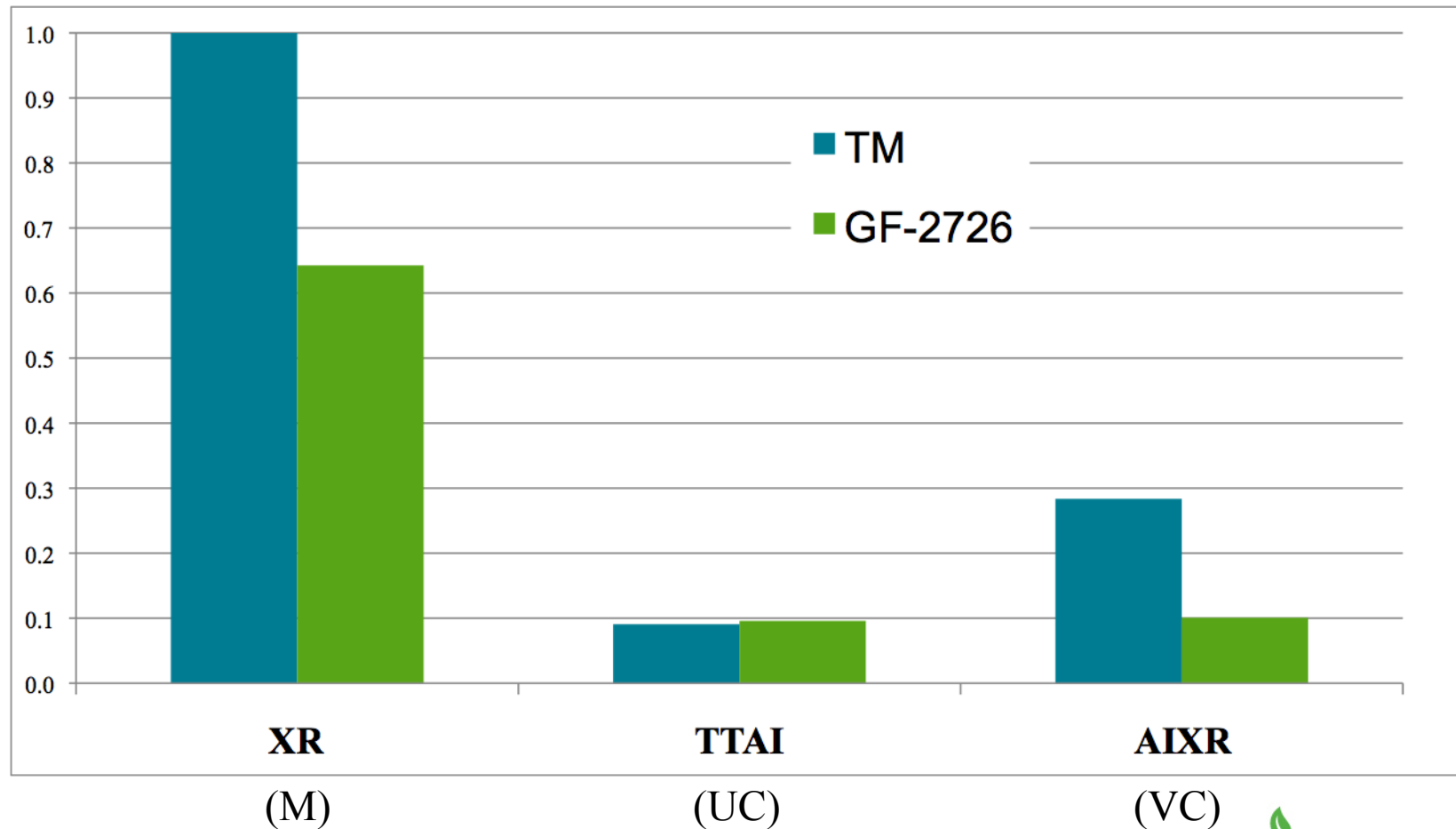
GF-2726



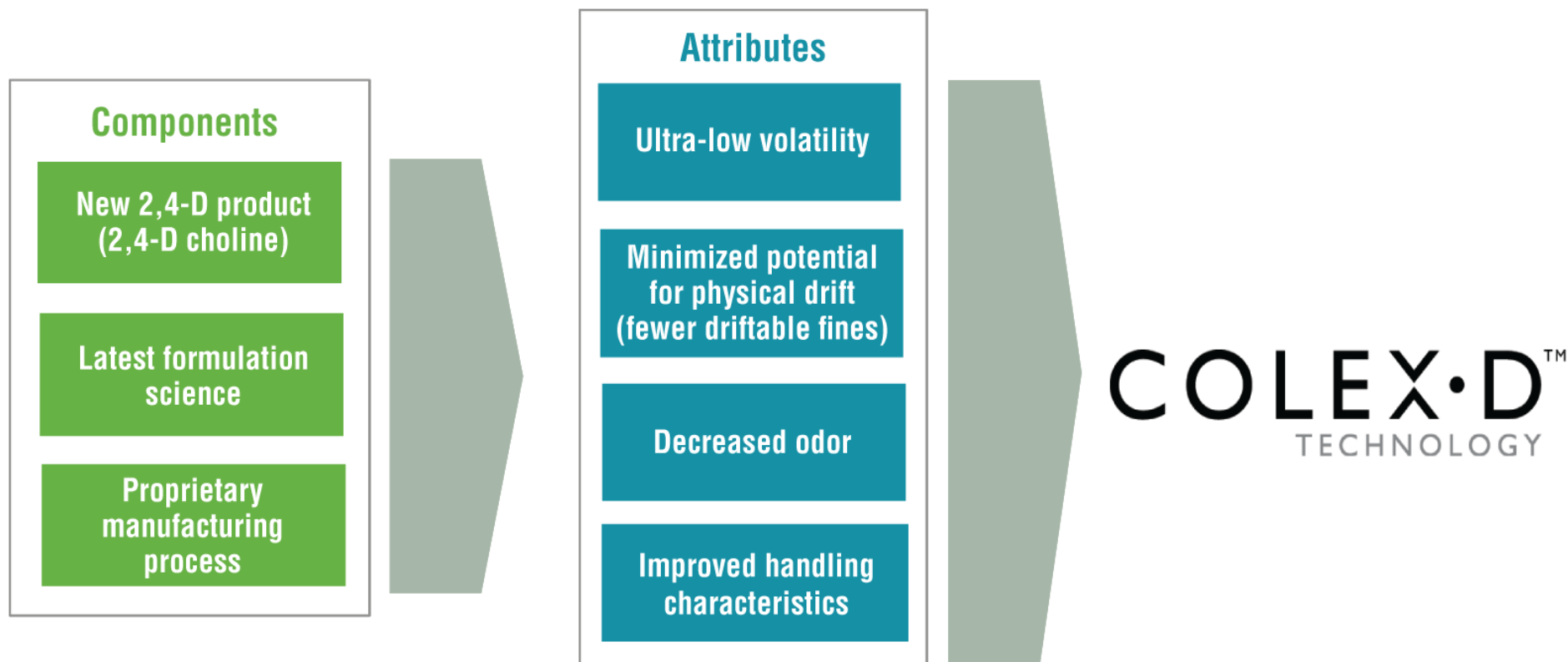
AIXR (VC) acts like
TTAI (UC) for drift

But without huge drops!
VMD AIXR still VC

Relative Average Deposition @ 100 ft



Colex-D Technology



Thank You

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