

OFF-TARGET MOVEMENT

- There are three ways in which off-target movement can occur: particle drift, sprayer contamination and volatility
 - Particle Drift:
 - Movement of spray droplets on the wind
 - Occurs DURING application
 - Impacts adjacent fields
 - By far the most common source of off-target movement
 - Sprayer Contamination:
 - When improperly rinsed spray equipment is used to treat a crop that is sensitive to herbicides in previous loads
 - Second most common form of off-target movement
 - Volatility:
 - Movement of a herbicide in the form of gas vapors
 - Can impact adjacent fields or fields far away from where it was applied
 - Occurs AFTER application
 - By far the least common source of off-target movement
- This section discusses each of these in detail and provides recommendations for reducing the risk of off-target movement

Roundup Ready® Xtend Crop System
OFF-TARGET MOVEMENT

Volatility

- Movement of a herbicide in the volatilized form
- Occurs AFTER the spray application
- Least frequent cause of off-target movement
- Can be influenced by:
 - Chemical properties of the herbicide formulation
 - Temperature
 - Use rate
 - Vapor pressure
 - Relative humidity

ROAD AHEAD

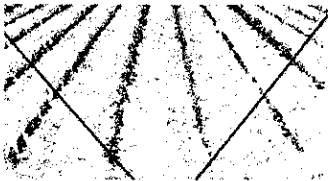

OFF-TARGET MOVEMENT: VOLATILITY

- Movement of a herbicide in the form of gas vapors
- Occurs AFTER the spray application
- By far the least frequent source of off-target application
- Influenced by:
 - Chemical properties of the herbicide formulation
 - Temperature
 - Use rate
 - Vapor pressure
 - Relative humidity
- While Monsanto does not anticipate restrictions related to temperature on the chemistry labels, vapor pressure or relative humidity, it is a sound best practice for applicators to pay attention to the impact of these factors with any herbicide they spray

Roundup Ready® Xtend Crop System
OFF-TARGET MOVEMENT

Sprayer Contamination

- Second most likely source of off-target movement
- Thorough triple rinsing is required in the Roundup Ready® Xtend Crop System
 - Effective method to remove herbicide contamination from sprayer system
- See label for specific instructions for triple-rinse

Boom Contamination	Tank Contamination
 <p style="text-align: center;">"V-Shaped" Pattern</p>	 <p style="text-align: center;">Uniform Injury Across a Field</p>

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OFF-TARGET MOVEMENT: SPRAYER CONTAMINATION

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- Thorough triple rinsing is required in the Roundup Ready® Xtend Crop System
 - Effective method for removing herbicide contamination from sprayer system
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[IF ASKED:]

- Commercial tank cleaner is required as part of the triple-rinse process

Roundup Ready® Xtend Crop System

OFF-TARGET MOVEMENT

Particle Drift

- Most common form of off-target movement regardless of herbicide being sprayed
- Physical movement of spray particles
 - Occurs DURING application
 - Impacts adjacent or near-by fields
- Influenced largely by:
 - Wind speed
 - Boom height
 - Sprayer ground speed
 - Increases in sprayer ground speed can cause:
 - Air turbulence that can disrupt uniform spray coverage and encourage drift
 - Fluctuations in spray pressure that can change droplet size outside desired range
 - Droplet size
 - Nozzle selection
 - Spray pressure

BEAT FOR THE ROAD AHEAD

OFF-TARGET MOVEMENT: PARTICLE DRIFT

May also be referred to as "physical drift"

- Most common form of off-target movement
- Physical movement of spray particles
 - Occurs during application
 - Impacts adjacent or nearby fields
- Influenced largely by:
 - Wind speed
 - Boom height
 - Sprayer ground speed
 - Increases in sprayer ground speed can cause:
 - Air turbulence that can disrupt uniform spray coverage and encourage drift
 - Fluctuations in spray pressure that can change droplet size outside desired range
 - Droplet size
 - Nozzle selection
 - Spray pressure
 - Droplet size will covered in more detail later in this presentation

Roundup Ready® Xtend Crop System
PREPARING THE SPRAYER

Nozzle Selection: Droplet Size

- The smaller the droplets, the slower they fall, and the farther they can drift
- Large spray droplets improve on-target application and reduce the likelihood of drift
- Nozzle selection is only part of the equation
 - Nozzle selection and pressure combined determine droplet size and percentage of driftable fines

EFFECT OF DROPLET SIZE μ (IN MICRONS) TIME IT TAKES TO FALL

25,400 droplets per inch
 2,540 droplets per inch
 254 droplets per inch
 127 droplets per inch
 63 droplets per inch
 25 droplets per inch

extremely fine | 1 μ | 2.2 seconds
 very fine | 10 μ | 2.2 seconds
 fine | 100 μ | 2.2 seconds
 medium | 200 μ | 4 seconds
 coarse | 400 μ | 2 seconds
 ultra-coarse | 1000 μ | 1 second

Source: Ross and Lemhi, 1985
 For illustrative purposes only. Boom height in the Roundup Ready® Xtend Crop System should be no more than 20 inches above pest or crop canopy.







ROAD AHEAD

PREPARING THE SPRAYER: NOZZLE SELECTION: DROPLET SIZE

- The smaller the droplets, the slower they fall, and the farther they can drift
- Large spray droplets improve on-target application and reduce the likelihood of drift
- Nozzle selection is only part of the equation
 - Nozzle selection and pressure combined determine droplet size and the percentage of driftable fines

Roundup Ready® Xtend Crop System
PREPARING THE SPRAYER
Nozzle Selection

- Refer to herbicide labels for spray nozzles approved for use in the Roundup Ready® Xtend Crop System

DROPLETS		DISTANCE		NOZZLES	DRIFTABLE FINES
Category	Microns	Boom Ht. 20"	Boom Ht. 50"	Type	% Fines
UC Ultra-Coarse	> 622	50 ft.	90 ft.		<1.5%
XC Extremely Coarse	428-622	69 ft.	138 ft.	 	1.5-3.3%
VC Very Coarse	349-428	108 ft.	207 ft.	 	3.4-5.6%
M Medium Coarse	177-218	358 ft.	544 ft.		11.7-22.3%

Distances to 10% visual response were achieved from spray drift nozzles and Monsanto Company herbicides at appropriate wind speeds at 10 mph.

BEST FOR THE ROAD AHEAD

PREPARING THE SPRAYER: NOZZLE SELECTION

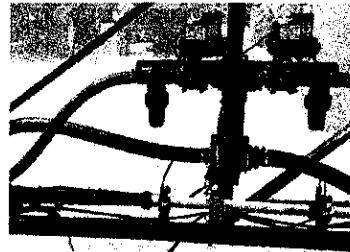
- Notice the increase in distance that droplets can travel when booms are raised higher than 20 inches
- Note the high percentage of fines in medium-coarse droplets as opposed to the very low number of fines in ultra-coarse droplets
- Fines are responsible for a great deal of particle drift
- Nozzle manufacturers are continuing to develop new nozzles with superior coverage that deliver large droplets with minimal fines
- Refer to herbicide labels for spray nozzles approved for use in the Roundup Ready® Xtend Crop System

Roundup Ready® Xtend Crop System

POST-SPRAYING

Triple-Rinse Clean-Out is Required

- Properly and thoroughly clean spray equipment
 - Use triple-rinse method to thoroughly clean entire sprayer system
 - Triple-rinse is the most effective practice to reduce off-target movement from spray contamination of any herbicide
- Sprayer parts can trap herbicide, and additives and surfactants can cling



BUILT FOR LIFE
ROAD AHEAD

POST-SPRAYING: TRIPLE-RINSE CLEAN-OUT

- Properly and thoroughly clean spray equipment
 - Use triple-rinse method to thoroughly clean entire sprayer system
 - Triple-rinsing is the most effective practice to reduce off-target movement from spray contamination of any herbicide
- Sprayer parts can trap herbicide and additives and surfactants can cling

Prevent Off Target Movement

- Do not spray when drift is likely and take caution near susceptible crops
- ***Follow Application Requirements & Label***
- Use low volatility registered products
- Approved drift reductions agents are recommended

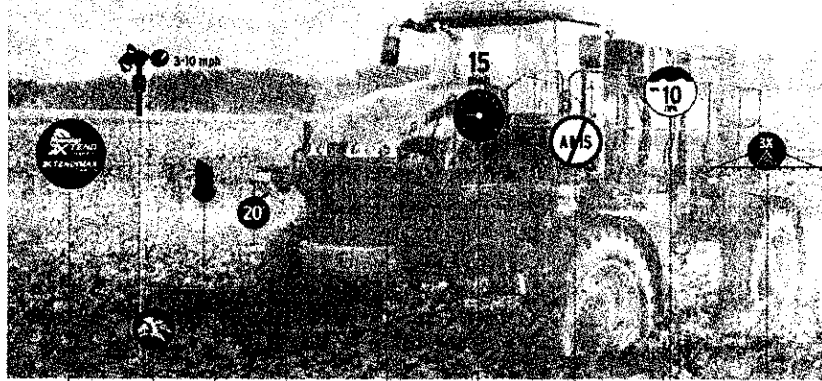


This information is for educational purposes only and is not an offer to sell Roundup Xtend™, Xtendimax™, or Roundup Ready 2 Xtend™. These products are not yet registered or approved for sale or use anywhere in the United States.

BUILT FOR THE
ROAD AHEAD

Anticipated Application Requirements

Monsanto has developed application requirements for the Roundup Ready® Xtend Crop System to help maximize weed control with on-target applications and minimize the potential of off-target movement.




- Use Roundup Ready® Xtend Crop System with Roundup Ready® Xtend Crop System only. Do not use Roundup Ready® Xtend Crop System with other Roundup Ready® Xtend Crop System products pending regulatory approval.
- Do not exceed 4 mph.
- Apply Roundup Ready® Xtend Crop System at 0.5 to 1.0 gpa.
- To maximize efficacy, use Roundup Ready® Xtend Crop System and Roundup Ready® Xtend Crop System products only. Do not use Roundup Ready® Xtend Crop System products with other Roundup Ready® Xtend Crop System products pending regulatory approval.
- Set the spray height no higher than 20" above the ground on target canopy. Do not allow the height to lift or spray directly into the canopy. Increase the spray distance for symptoms due to particle drift.
- Do not exceed 15 mph ground speed.
- Absolutely no tillage and no-tillage based systems are required for applications. Do not use Roundup Ready® Xtend Crop System with tillage or no-tillage systems pending regulatory approval.
- Monitor for off-target movement and adjust application rate accordingly.
- Use appropriate off-target protection measures.

Field Support

- **Crop Response**
 - Similar to current herbicide products
- **Lack of Performance**
 - Similar to current herbicide products
 - Approved label conditions may require additional information in some cases
- **Off Target Movement**
 - Anticipate label language will be similar to Enlist™ Duo for sensitive crops
 - Following Application Requirements should mitigate most risk
 - Final plan cannot be developed and communicated until label is registered

GET FOR THE
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 CORN STATES

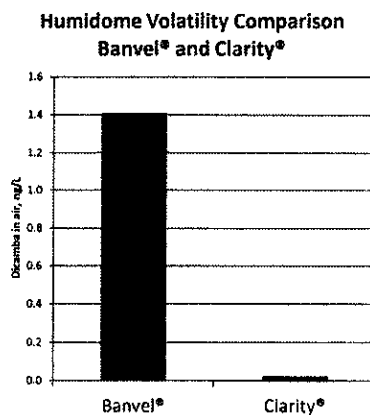
WAPORGRIP™ HERBICIDE TECHNOLOGY
FORMULATIONS

BUILT FOR THE
**ROAD
AHEAD**
2015 SEED PARTNER MEETING

Alison MacInnes- Monsanto Research Chemist
John Hemminghaus- Team Lead, Herbicide Formulations

Historical Dicamba Formulations

- Banvel® – launched in the 1960s
 - DMA (dimethylamine) salt of dicamba
 - Most volatile salt form of dicamba that is commercially available (based on humidome testing)
- Clarity® – launched in 90s
 - DGA (diglycolamine) salt of dicamba
 - Significantly lower volatility potential than Banvel
- Monsanto invested in dicamba formulation development for several years, developing an industry leading expertise
 1. Dicamba salt effect
 2. Adjuvant impact
 3. Volatility reduction



Can mention that in adding AMS volatility of Clarity increases to be similar to that of Banvel alone. This was recommended on Clarity label

**The Next Generation of Dicamba Formulations
contain VaporGrip™ Technology**



Pending regulatory approval, a premix containing glyphosate and dicamba. Based on DGA dicamba salt.



Pending regulatory approval, a dicamba standalone formulation. Based on DGA dicamba salt.

Both formulations contain VaporGrip™ technology that lowers the potential for dicamba volatility even lower the current commercial options.

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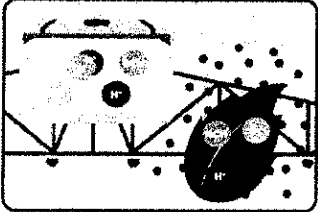
**GOING FOR THE
ROAD AHEAD**

Share story on how VG was discovered

Roundup Ready® Xtend Crop System CHEMISTRY

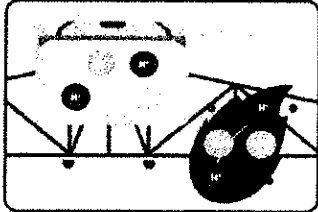
How VaporGrip™ Technology Works

DMA Dicamba
(Not approved for use in the Roundup Ready® Xtend Crop System)



In the tank there is the potential for dicamba acid (DCH) to form in solution and create off-target movement of dicamba through volatility after spraying

**Low-Volatility Dicamba
with VaporGrip™ Technology**



In the tank, VaporGrip Technology prevents the formation of dicamba acid (DCH) in solution, minimizing potential off-target movement of dicamba through volatility after spraying

BUILT FOR THE ROAD AHEAD

ROUNDUP READY® XTEND CROP SYSTEM CHEMISTRY: HOW VAPORGRIP™ TECHNOLOGY WORKS

- Roundup Xtend™ and XtendiMax™ herbicides will feature VaporGrip™ Technology
- A proprietary technology discovered and developed by Monsanto
- VaporGrip™ Technology, along with the specific salt of dicamba and all of the product components, work together to make Monsanto's proprietary formulations so effective
 - VaporGrip™ Technology is not a stand-alone additive, but rather a part of the formulation of Roundup Xtend™ and XtendiMax™ herbicides
 - VaporGrip™ Technology is NOT part of the M1691 herbicide formulations for 2015

How VaporGrip™ Technology Works

- In the tank, there is the potential for dicamba acid (DCH) to form in solution and create off-target movement of dicamba through volatility after spraying
- In the tank, VaporGrip™ Technology prevents the formation of dicamba acid (DCH) in solution, minimizing potential off-target movement of dicamba through volatility after spraying
- In other words, VaporGrip™ Technology effectively blocks free H⁺ ions from combining with dicamba anions, thus reducing the potential for volatilization
- Herbicide volatility, which occurs after application, is influenced by the type of salt used in the herbicide formulation, temperature, use rate and vapor pressure
- Roundup Xtend™ and XtendiMax™ herbicides utilize a low-volatility salt of dicamba and VaporGrip™ Technology to further reduce the potential for volatilization