Reducing Spray Drift and Its Effects

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Today's Presentation

- New GM technology
- Off-site movement of herbicides
- Response of soybean to 2,4-D
- Response of soybean to Dicamba
- Effect of glyphosate on potatoes

Glyphosate-Resistant Weeds

- Glyphosate-resistant soybean became commercially available in 1996.
- Since 1996, 24 weeds have been documented to be glyphosate resistant (www.weedscience.org).

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New Genetically Engineered Technology

- Resistance to:
  - 2,4-D (+ triclopyr, fluroxypyr, and fops - ACCase inhibitors)
  - Dicamba
  - ALS
  - HPPD

Synthetic Auxin Herbicides

- 2,4-D and dicamba resistant soybean will be available in the next few years.
- Low amounts of auxin mimic herbicides can cause epinasty.
  - Epinasty: leaf crinkling, bubbling, strapping, and/or twisting and bending of petioles, branches, and stems.

Epinasty

- Epinasty can lead to reduced leaf area, changed leaf angle, and malformed growth.
- The greater the amount of epinasty is often associated with a reduction in yield potential.

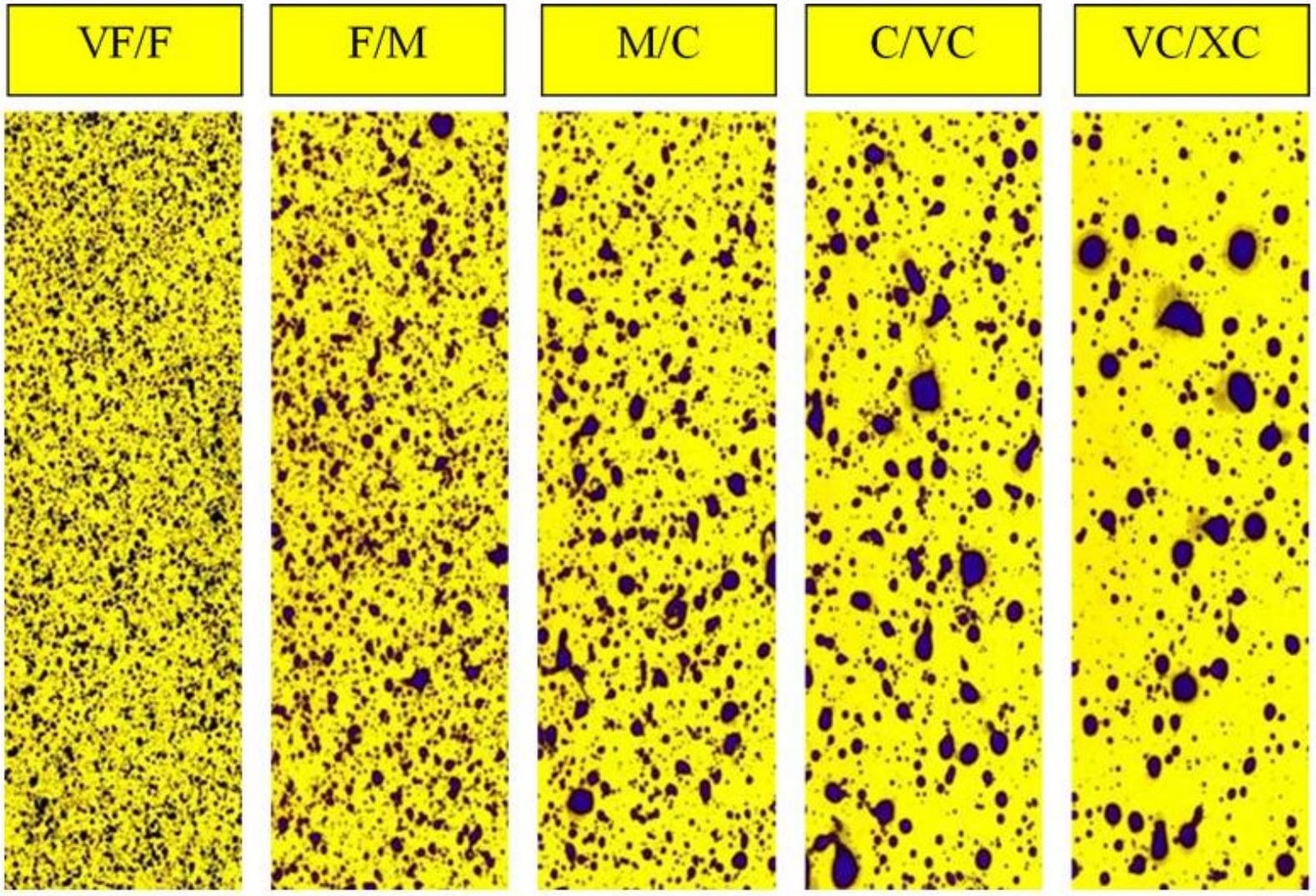
Inadvertent Exposure to Herbicides

- Particle drift (including inversions)
- Volatilization
- Contamination of spraying equipment
- Misapplication

Drift – Particle Size

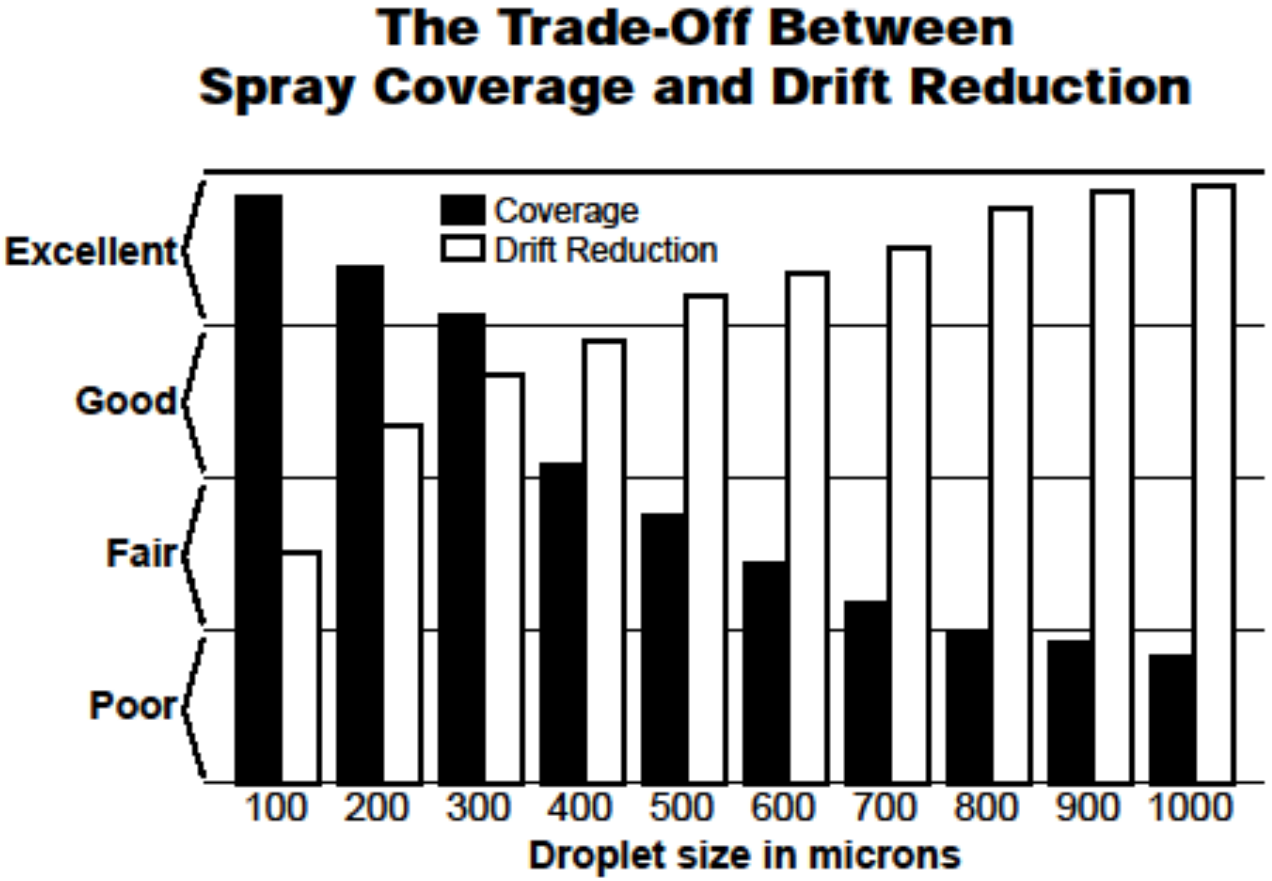
Influence of droplet size on potential distance of drift			
Droplet diameter (microns)	Type of droplet	Time required to fall 10 feet	Lateral distance droplets travel in falling 10 feet in a 3 mph wind
5	Fog	66 minutes	3 miles
20	Very fine spray	4.2 minutes	1,100 feet
100	Fine spray	10 seconds	44 feet
240	Medium spray	6 seconds	28 feet
400	Coarse spray	2 seconds	8.5 feet
1,000	Fine rain	1 second	4.7 feet

Coverage of Droplets

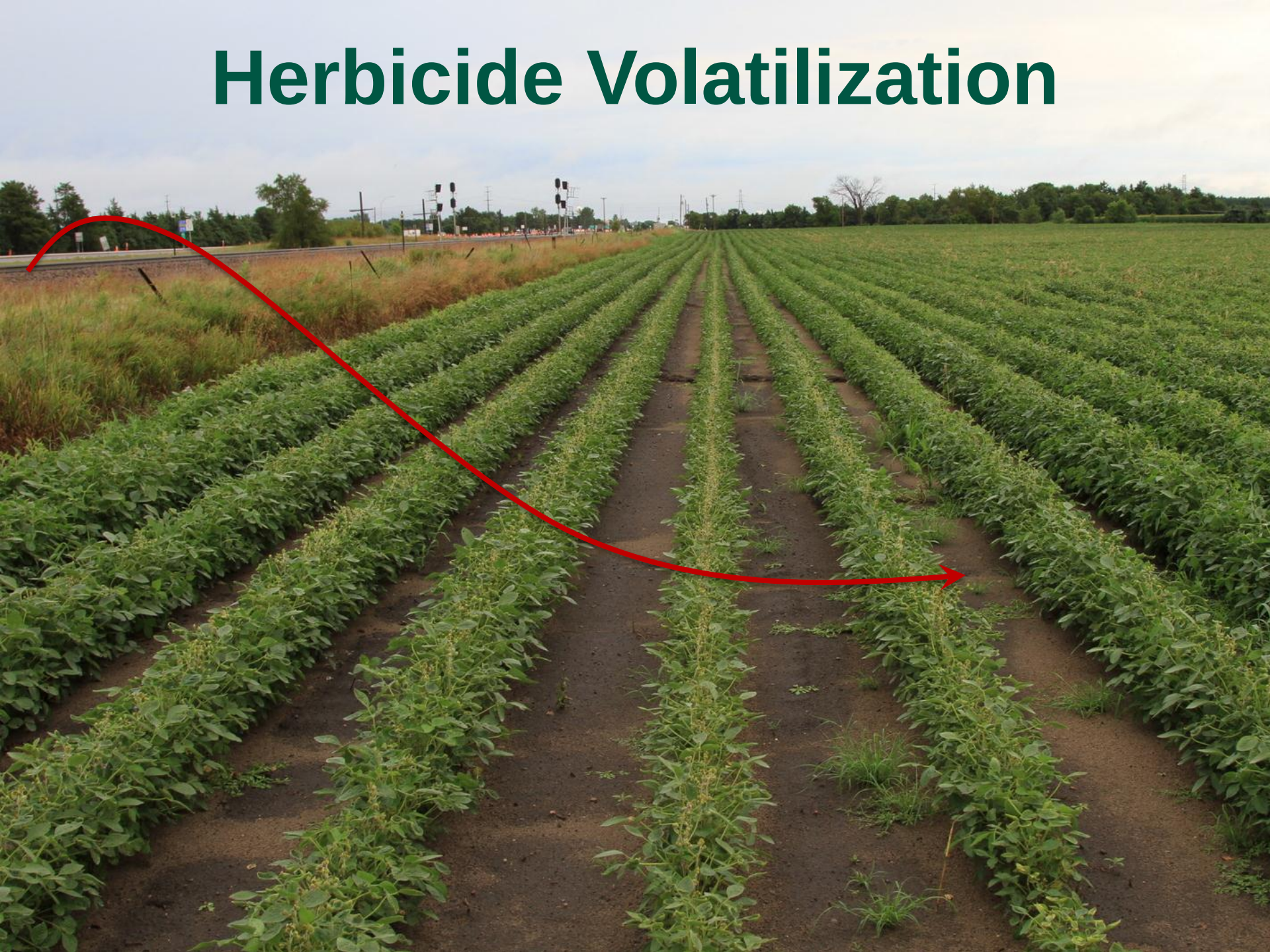


http://www.wilger.net/Drop%20cat%20drop%20sizes.jpg Image courtesey of Tom Wolf, Agriculture and Agri-Food Canada, Research Centre

What's the Trade-Off?



Herbicide Volatilization



Tank Contamination

- Tank Contamination
  - Soybean injury can occur from 0.01% of 8 fl oz/A dicamba
- Incomplete clean-out
  - 0.01% = 6.4 oz left after 16 fl oz/A Clarity in 500 gallon spray tank
  - 0.1% = 2 quarts left after 16 fl oz/A Clarity in 500 gallon spray tank
- Contaminated jugs or equipment
  - 0.01% = 0.05 oz or 1.5 mL Clarity in 500-gallon load

Tank Residue Case Study

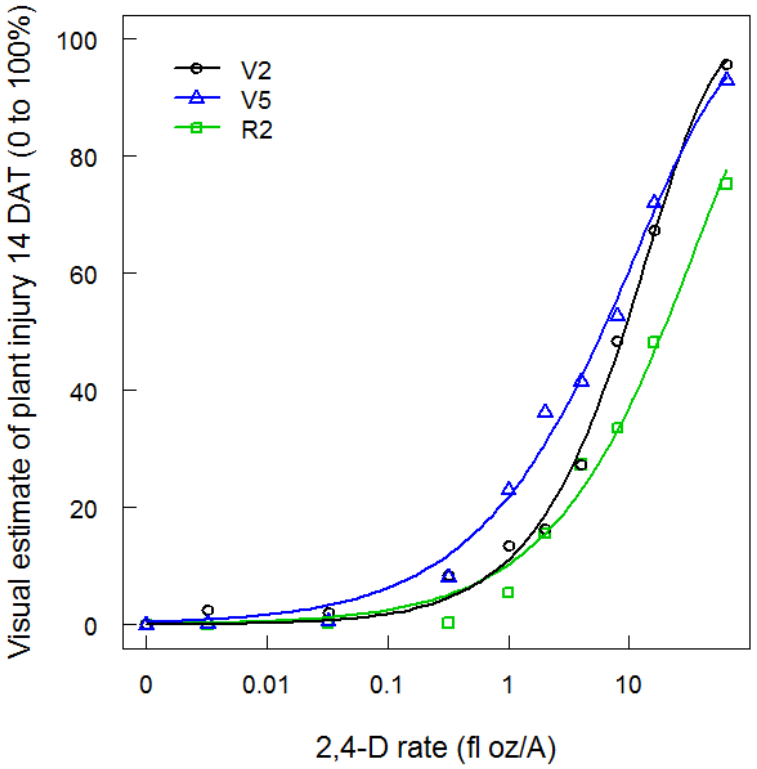
Water source	Dicamba (ppb)	Use rate (%)
Spray tank	945	0.024%
Spray tank after overnight	822	0.021%
Spray boom	24,800	0.63%

Based on 1 pt/A Clarity applied in 15 gal/A.
Spray tank cleaned out prior to test.

(Boerboom, 2004)

Response of Glyphosate-resistant Soybean to 2,4-D

Soybean Injury from 2,4-D at 14 DAT



Estimated 2,4-D dose that caused soybean injury (ED) at 14 DAT.

	Soybean growth stage		
ED %	V2	V5	R2
	---------- fl oz/A ----------		
ED_{20}	2.19	0.84	3.11
ED_{50}	9.02	5.97	18.8

- Soybean injury of 20% would need 3 to 10% of 32 fl oz/A 2,4-D solution drifting.

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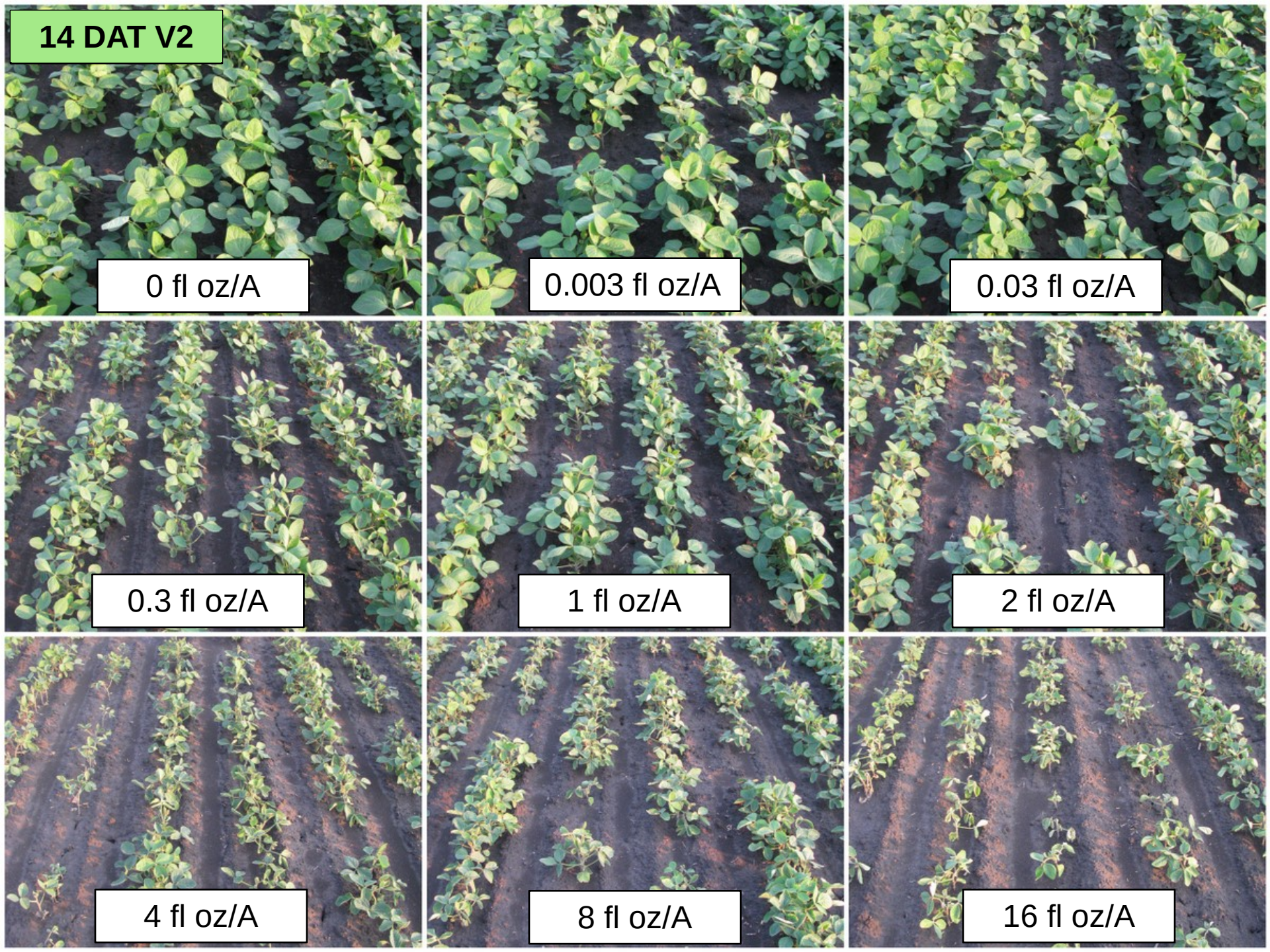
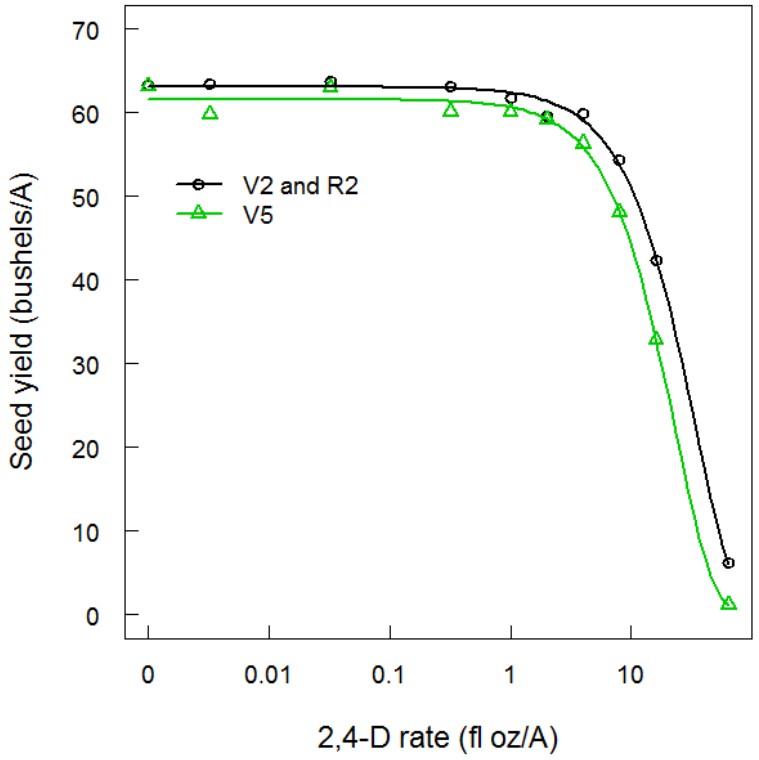

14 DAT V2
0 fl oz/A
0.003 fl oz/A
0.03 fl oz/A
0.3 fl oz/A
1 fl oz/A
2 fl oz/A
4 fl oz/A
8 fl oz/A
16 fl oz/A

Yield Reduction



Estimated 2,4-D dose (ED) resulting in yield reduction.

ED %	Soybean growth stage	
	V2 and R2	V5
	---------- fl oz/A ----------	
ED_{10}	5.8 (0.36 pt)	4.2 (0.26 pt)
ED_{20}	10.4 (0.65 pt)	7.4 (0.46 pt)

- A 10% reduction in seed yield would need 13 to 18% solution drift of 32 fl oz/A 2,4-D.

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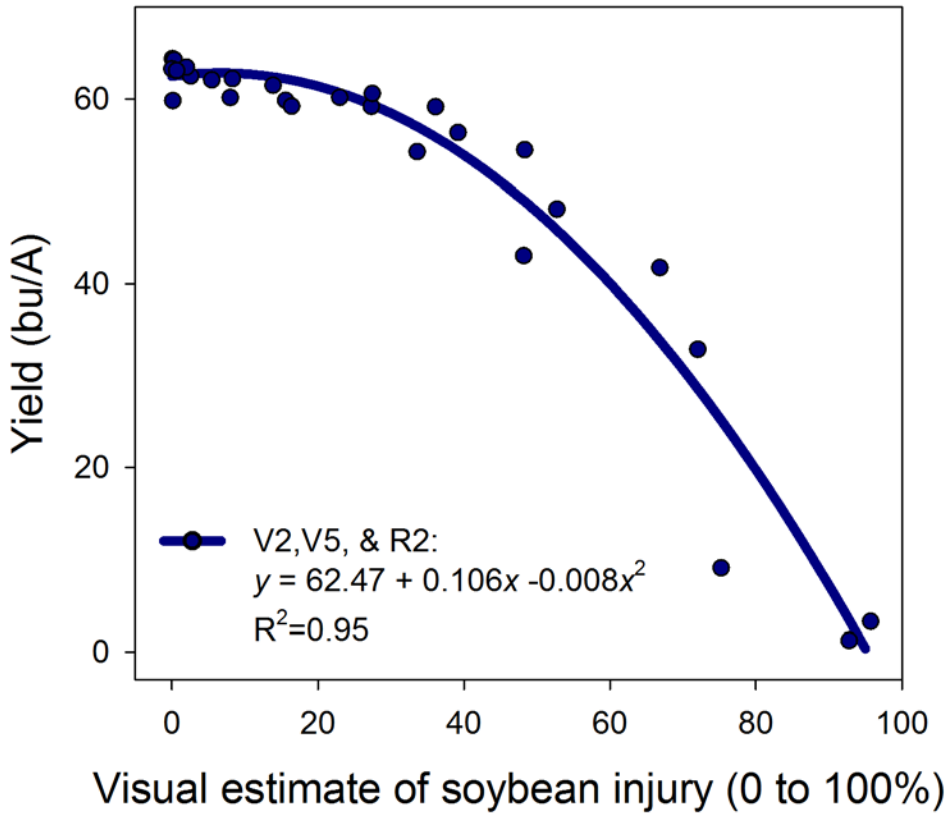
Yield Reduction

- Reduction in the number of:
  - Main stem nodes
  - Reproductive nodes
  - Pods
  - Seeds

Can Yield Loss be Estimated from Injury Symptomology?

Soybean Yield Loss and Injury



Soybean injury from 2,4-D causing soybean yield loss (YL).

	Soybean growth stage
YL%	V2, V5, & R2
	---- % injury ----
YL_{10}	35
YL_{20}	47

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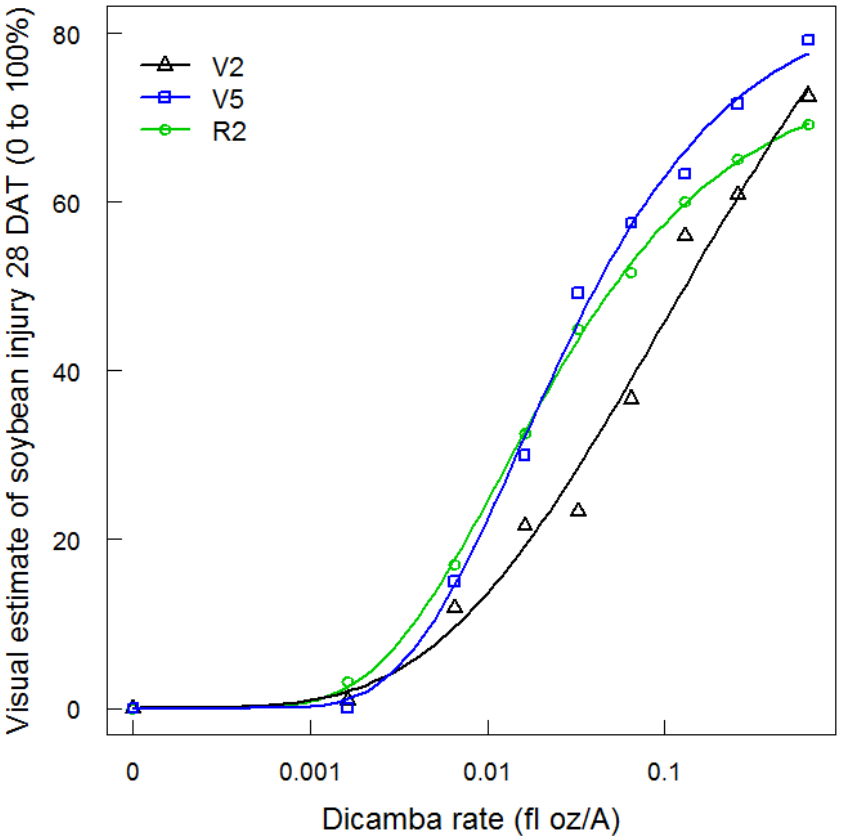
Implications of 2,4-D Drift

- Injury symptoms can be difficult to detect.
- Soybean was most sensitive to 2,4-D at the V5 growth stage.
- Crop injury and yield loss take a fairly high amount of 2,4-D (13 to 18%) to cause yield loss.
- Greatest injury from 2,4-D will likely occur as a result of misapplication or tank contamination, but cultivars may vary is sensitivity.
- Soybean injury can be used as a quick and easy method to estimate yield loss, but environment and human error can result in variable estimates.

Response of Glyphosate-resistant Soybean to Dicamba Exposure

Soybean Injury from Dicamba at 28 DAT



Estimated dicamba dose that caused soybean injury (ED) at 28 DAT in 2009.

	Soybean growth stage		
ED %	V2	V5	R2
	---------- fl oz/A ----------		
ED_{20}	0.03	0.01	0.01
ED_{50}	0.13	0.04	0.05

- Soybean injury of 20% would need 0.06 to 0.2% of 16 oz/A dicamba solution drifting.

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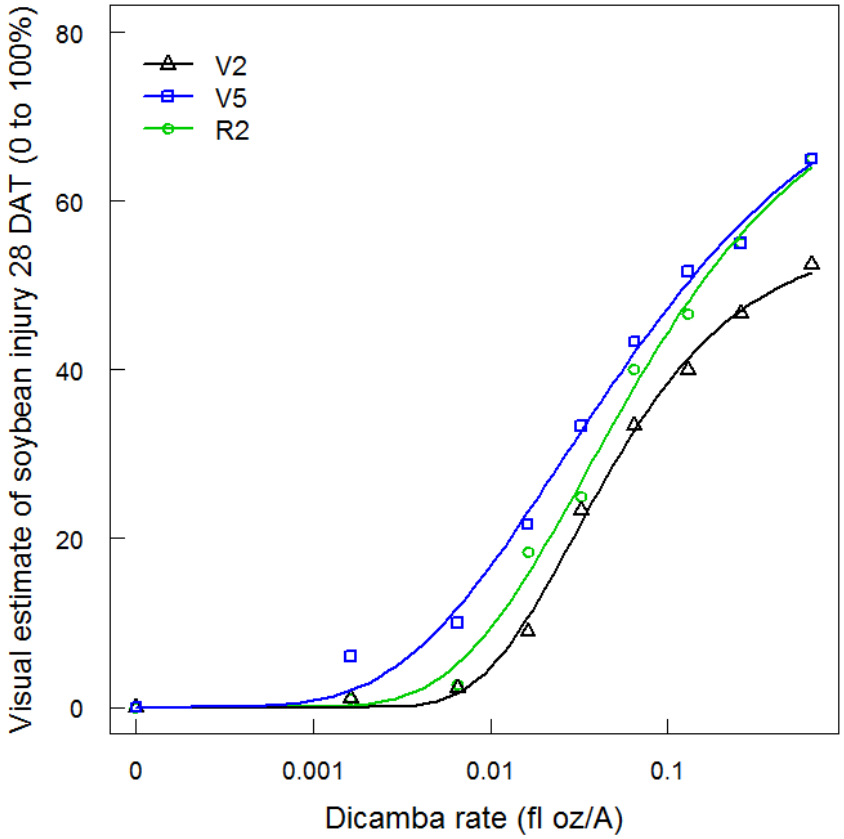
Soybean Injury from Dicamba at 28 DAT



Estimated dicamba dose that caused soybean injury (ED) at 28 DAT in 2010.

	Soybean growth stage		
ED %	V2	V5	R2
	---------- fl oz/A ----------		
ED_{20}	0.04	0.02	0.03
ED_{50}	0.45	0.13	0.15

- Soybean injury of 20% would need 0.1 to 0.3% of 16 oz/A dicamba solution drifting.

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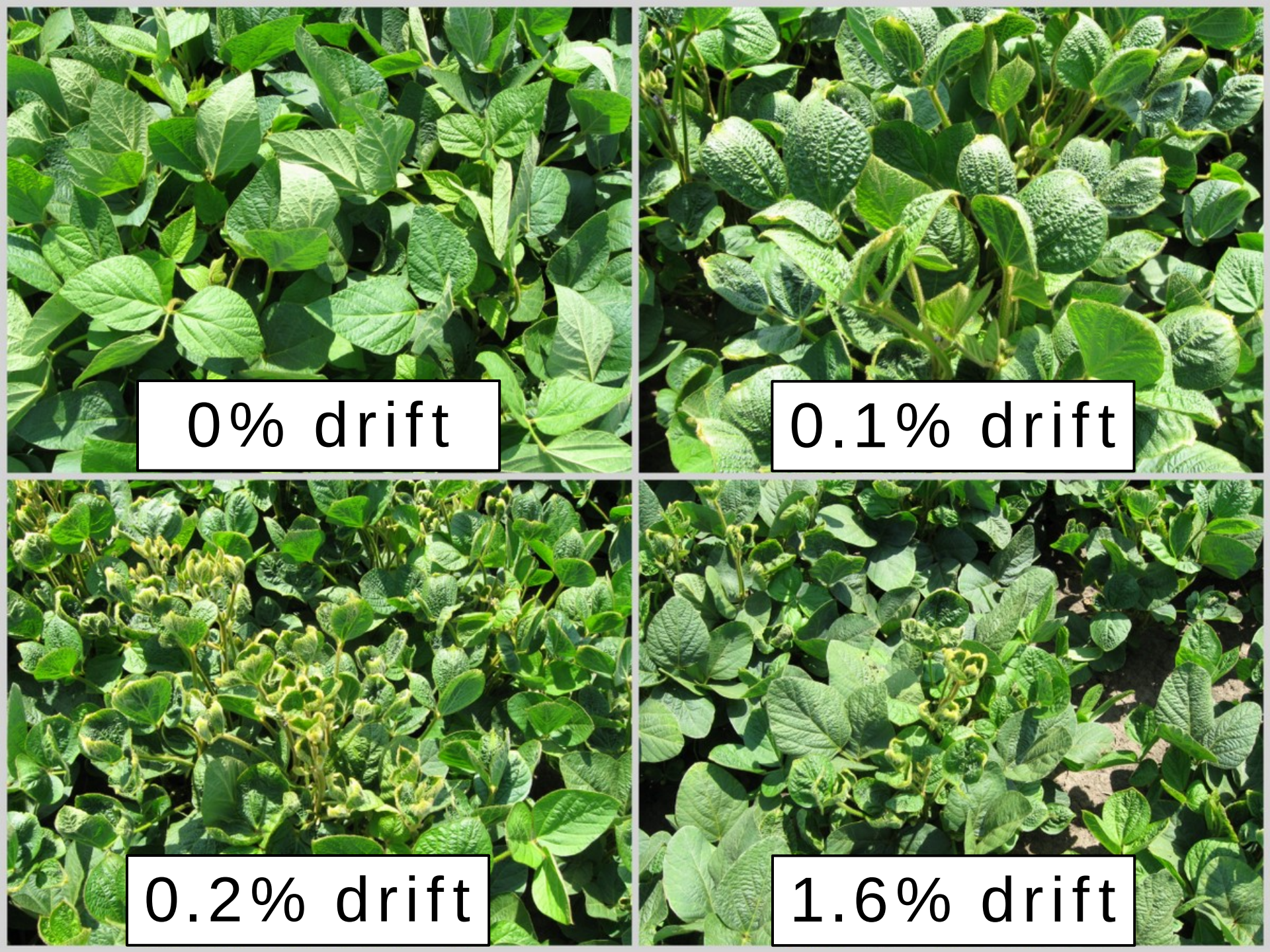
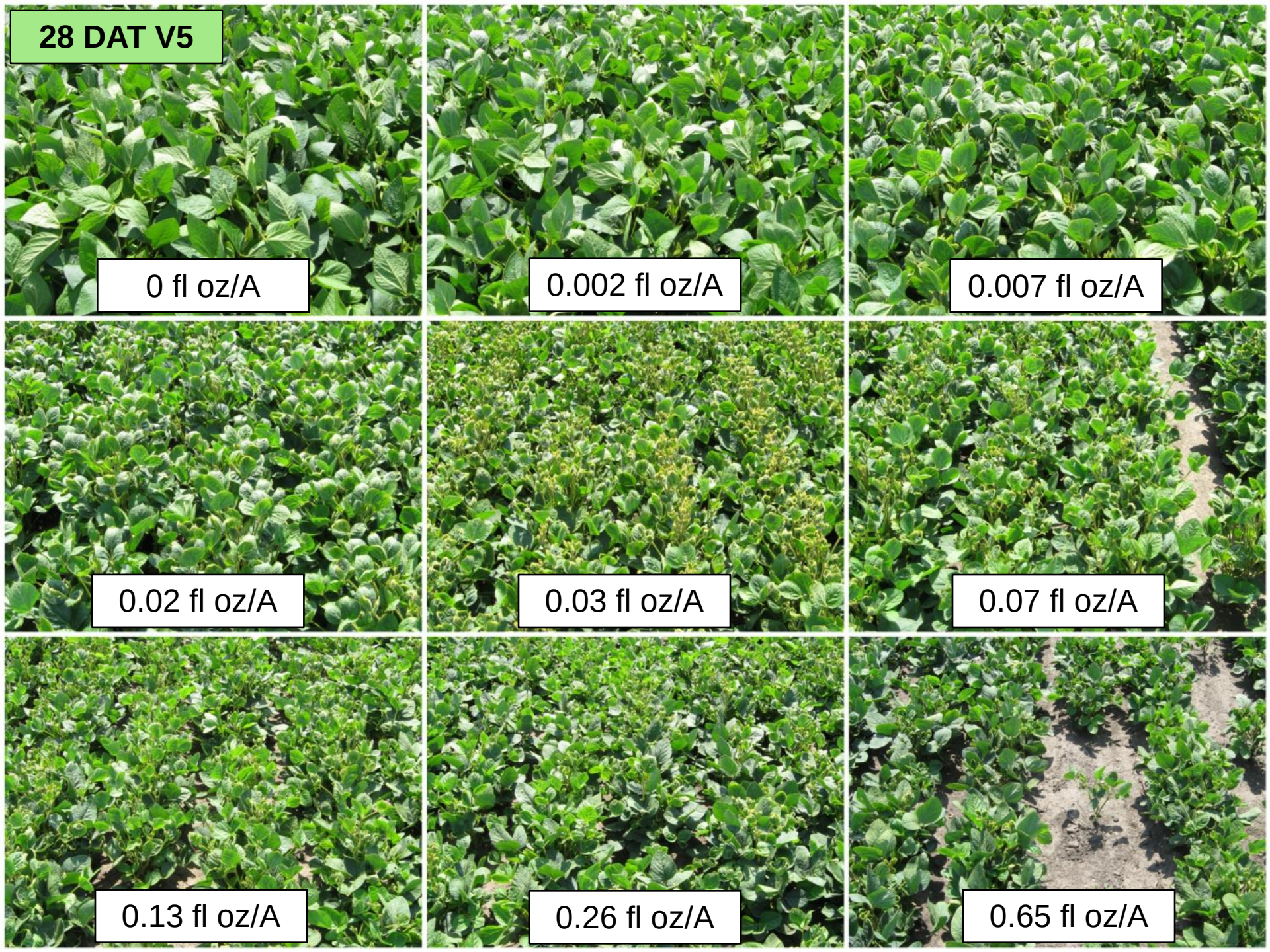
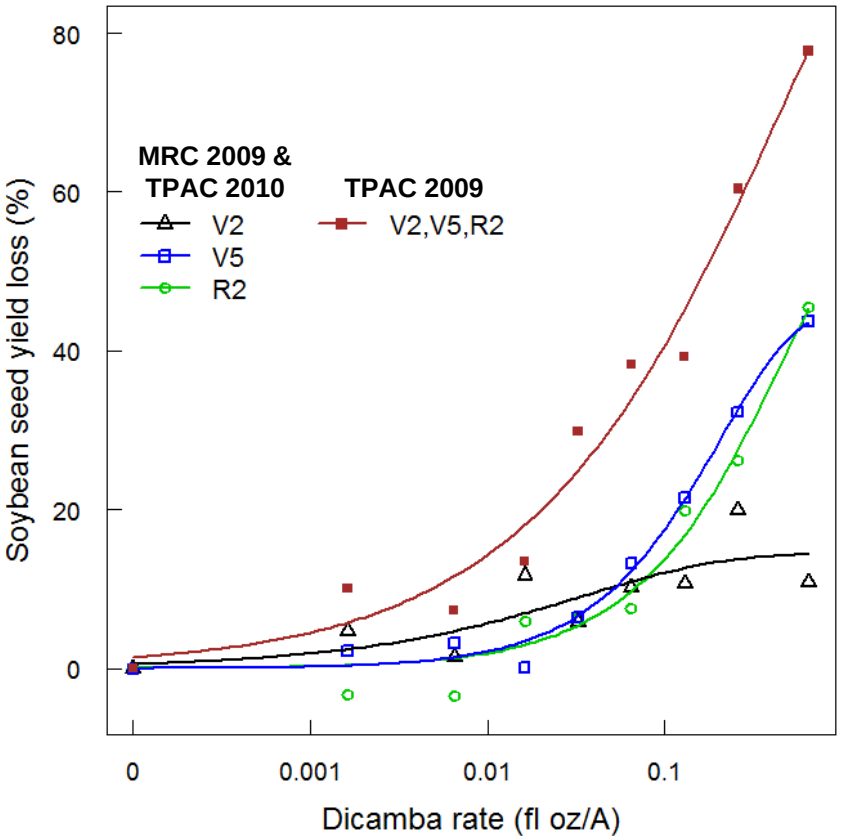

0% drift
0.1% drift
0.2% drift
1.6% drift


28 DAT V5
0 fl oz/A
0.002 fl oz/A
0.007 fl oz/A
0.02 fl oz/A
0.03 fl oz/A
0.07 fl oz/A
0.13 fl oz/A
0.26 fl oz/A
0.65 fl oz/A

Soybean Yield Loss from Dicamba



Estimated dicamba dose that caused soybean yield loss.

	Soybean growth stage			
	MRC 2009 & TAPC 2010			TPAC 2009
ED %	V2	V5	R2	V2, V5, R2
	---------- fl oz/A ----------			
ED_{10}	0.02	0.31	0.02	0.005
ED_{20}	-	0.07	0.03	0.02

- Soybean yield loss of 10% would need 0.03 to 1.9% of 16 oz/A dicamba solution drifting.

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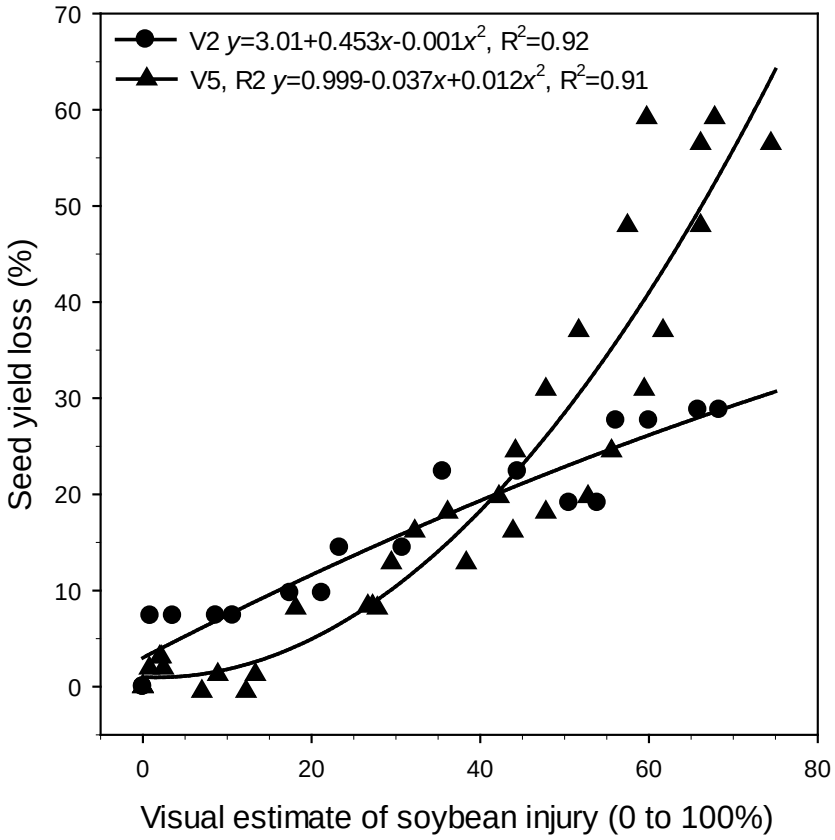
Can Yield Loss be Estimated from Injury Symptomology?

Soybean Yield Loss and Injury



Soybean injury from dicamba causing soybean yield loss (YL).

	Soybean growth stage	
YL%	V2	V5 & R2
	------ % injury ------	
YL_{10}	16	29
YL_{20}	42	42

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20% injury


30% injury

Implications of Dicamba Drift

- Injury symptoms are easy to identify with dicamba. Leaf puckering is a predominate symptom.
- Soybean are sensitive to dicamba, and a small amount of drift (0.06 to 1.9% dicamba) can cause injury and yield loss.
- Soybean plants under drought stress are more sensitive to dicamba exposure.
- Soybean injury can be used as a quick and easy method to estimate yield loss, but environment and human error can result in variable estimates.

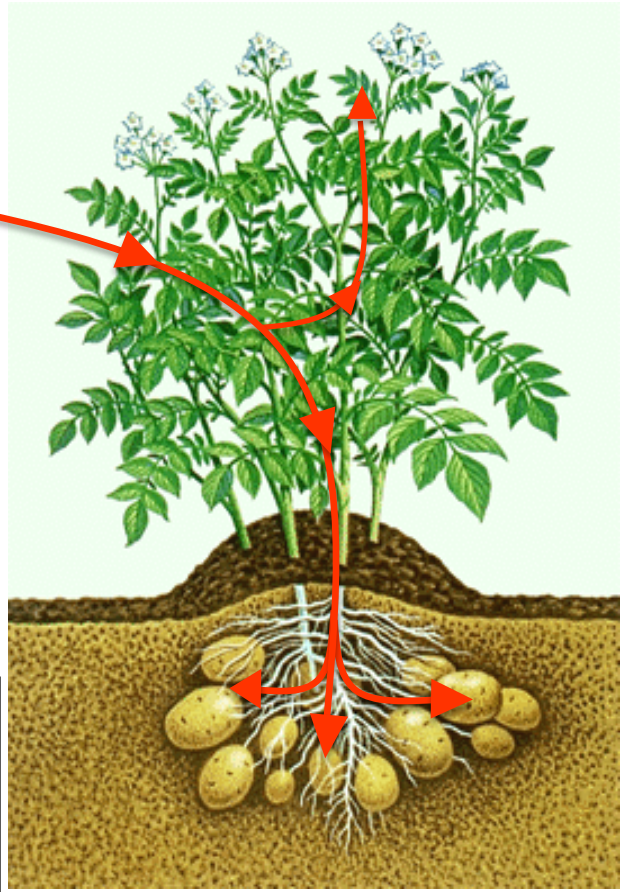
How to Mitigate Off-site Contact

- Properly clean out spray equipment
- Use appropriate nozzles and pressure
- Check wind direction
- Avoid spraying in high winds
- Check your speed-promotes boom bounce
- Avoid hot and calm days
- Use anti-drift agent
- Communicate with neighbors, staff, and local contractors

Glyphosate and Potatoes

Movement of Glyphosate

- **Glyphosate will move to tubers and residues accumulate in the eyes causing sprouting problems the next year, and/or can malform potatoes.**



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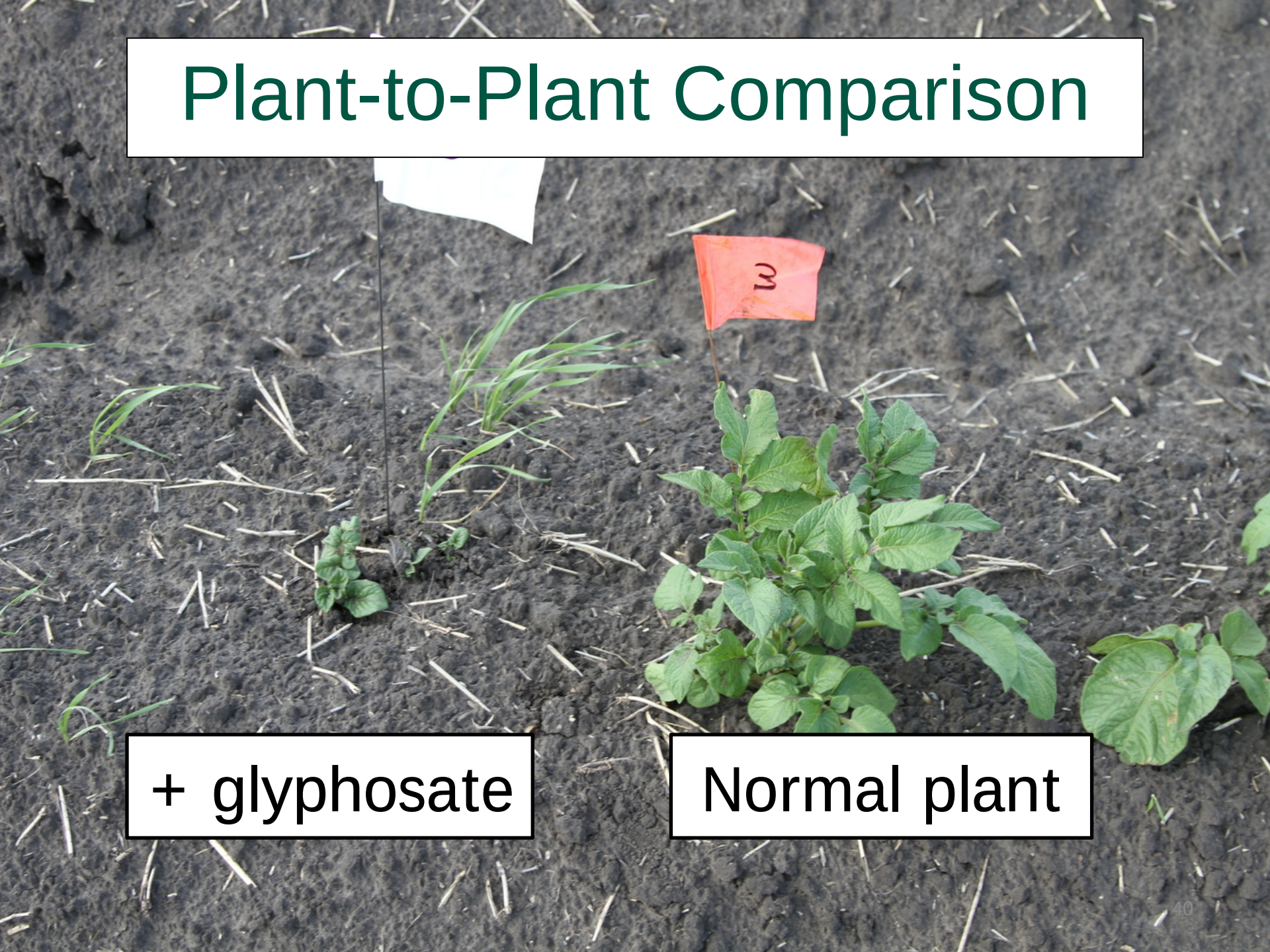
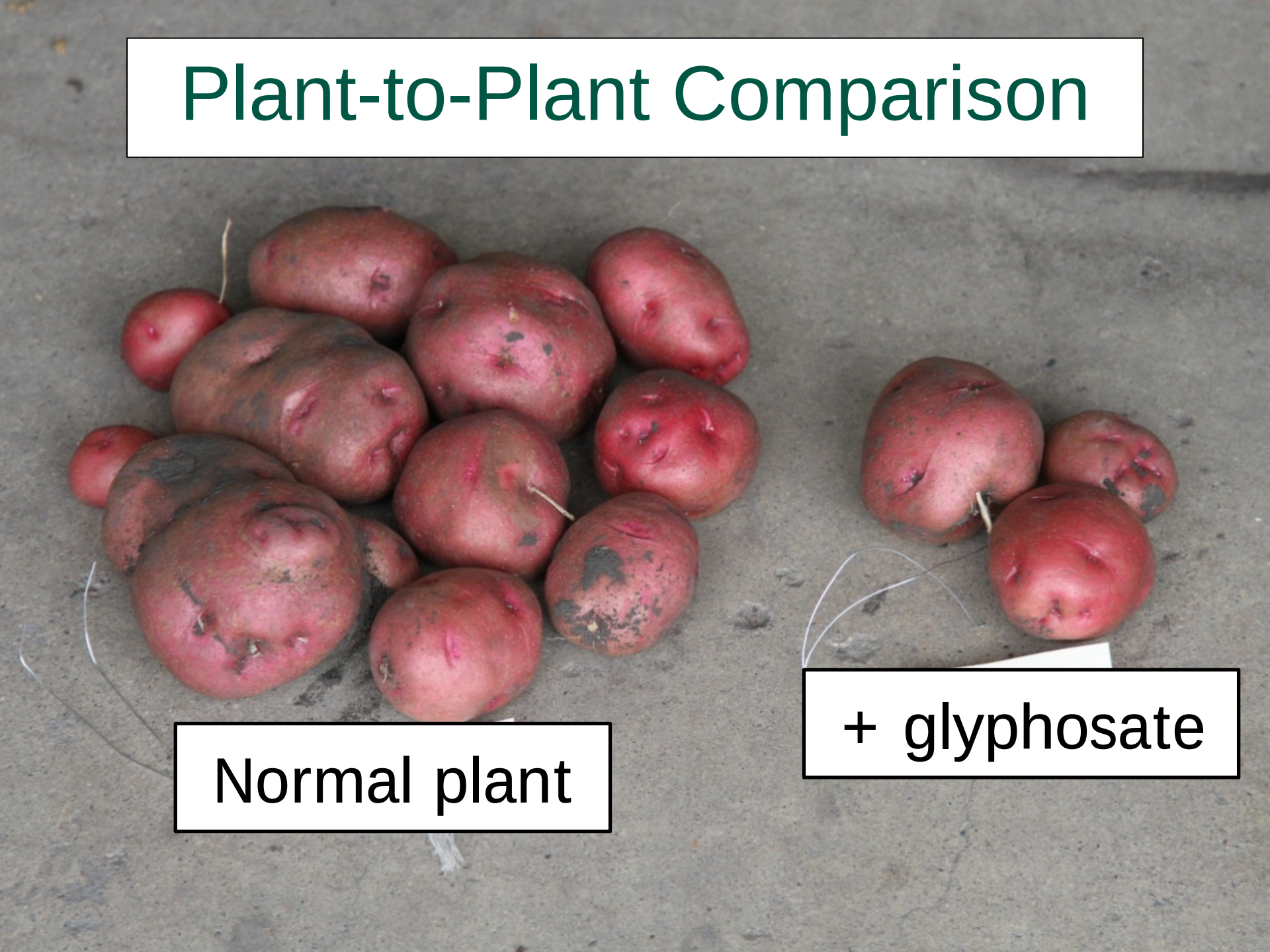
Glyphosate Levels

- Amount: 0.007 to 0.036 ppm glyphosate

Plant-to-Plant Comparison



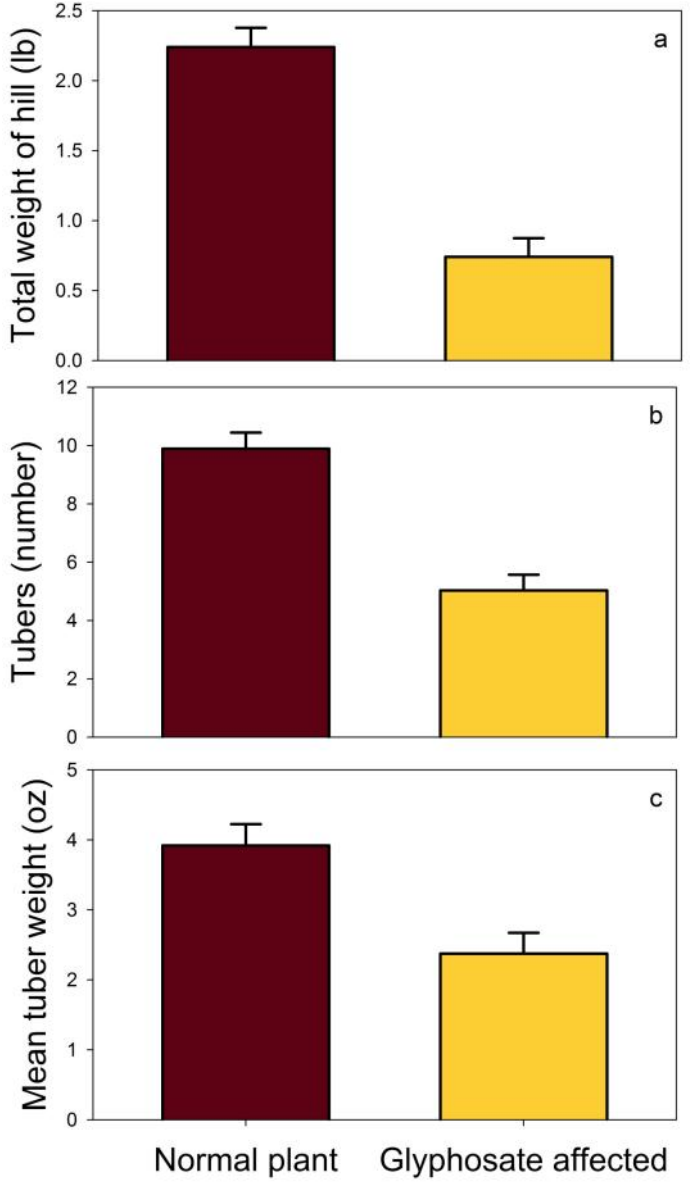
Plant-to-Plant Comparison



Glyphosate Residues in Seed Potato

Seed pieces with glyphosate residues had a:

- 67% reduction in total yield (from 2.25 to 0.75 lb/hill)
- 50% reduction in tuber number (10 to 5 tubers/hill)
- 38% reduction in mean tuber weight (3.9 to 2.4 oz/tuber)



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Cost of Production

Total operating and overhead costs per acre in 2013				
Corn	Soybean	Wheat	Barley	Potatoes
$648	$421	$300	$447	$3,000

- 100 acres of potatoes is worth **$300,000**.
- Damaging a potato crop is VERY expensive!

www.ers.usda.gov/

QUESTIONS?

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