

Wheat Response to Glyphosate Drift

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Interest in Glyphosate Drift?

- ▶ Roundup and other glyphosate products labeled in Roundup Ready corn, soybean, and cotton
- ▶ Roundup used extensively as a preplant burndown



Herbicide Drift

Drift can occur from both ground and aerial applications

Aerial applications will probably increase

Drift potential – off-target movement to nontransgenic crops expected



Drift Research – Crop Response

Seldom does drift occur at the 1x rate

Drift of 1/10th to 1/100th of use rate common

Previous “simulated drift” research – rate response in a constant spray volume



Rice and Corn Simulated Drift Research Roundup Ultra

| Rate ^a | Percent yield reduction vs. no Roundup Ultra | | | |
|------------------------------|----------------------------------------------|-------------------------|--------|--------|
| | Rice | | Corn | |
| | 2-3 leaf | 2-3 tiller ^b | 6 leaf | 9 leaf |
| oz/A | % reduction | | | |
| 4 (1/8 th X) | 83 | 42 | 78 | 33 |
| 2 (1/16 th X) | 15 | 32 | 43 | 0 |
| 1 (1/32 nd X) | 6 | 6 | 22 | 5 |
| 0.5 (1/64 th X) | 6 | 7 | 8 | 0 |
| 0.25 (1/128 th X) | 4 | 7 | 4 | 7 |

^a **Spray volume 15 GPA; Roundup Ultra X rate = 32 oz/A**

^b **Panicle differentiation (initiation of reproductive stage)**

Crop Injury With Sub-Lethal Roundup Rates



Rice



Corn

Wheat Response to Roundup Ultra Drift

| Rate (oz/A) | Injury 14 DAT (%) | | |
|---------------------------|-------------------|------------|-----------------|
| | First Node | Boot Stage | Early Flowering |
| (1/8 th X) | 55 a | 42 b | 43 b |
| (1/16 th X) | 40 b | 30 c | 27 c |
| .5 (1/64 th X) | 16 d | 18 d | 15 d |

Apply volume 15 GPA; Roundup Ultra X rate = 32 oz/A

Heat Injury With Sub-Lethal Roundup Rate



Wheat Response to Roundup Ultra Drift

| | Yield Reduction (%) | | |
|---------------------------|---------------------|------------|-----------------|
| Rate (oz/A) | First Node | Boot Stage | Early Flowering |
| (1/8 th X) | 72 a | 45 b | 54 b |
| (1/16 th X) | 29 c | 30 c | 25 cd |
| .5 (1/64 th X) | 8 e | 13 de | 2 e |

Apply volume 15 GPA; Roundup Ultra X rate = 32 oz/A

Simulated Drift??

Drift from aerial or ground equipment decreases with movement down wind from point of application

Degree of evaporation depends on relative humidity and temperature

As water in spray droplets evaporate, droplets become more concentrated with herbicide and surfactant

Impossible to simulate drift but there must be a better way than using a constant spray volume

?Does varying rate in constant spray volume really simulate drift?



Roundup Drift – Carrier Volume Study Corn

Roundup Ultra applied to 6-leaf corn
K rate = 32 oz/A

Spray volume

Constant:

4 oz ($1/8^{\text{th}}$) and 2 oz ($1/16^{\text{th}}$) rates – 25 GPA

Proportional:

4 oz ($1/8^{\text{th}}$) rate – 3.1 GPA

2 oz ($1/16^{\text{th}}$) rate – 1.6 GPA

Speed (adjusted to obtain desired spray
volume):

0.625 mph - $1/8^{\text{th}}$ and $1/16^{\text{th}}$ constant (25 GPA)

5 mph - $1/8^{\text{th}}$ proportional (3.1 GPA)

10 mph – $1/16^{\text{th}}$ proportional (1.6 GPA)



Corn - Roundup Ultra Drift

2 oz/A (1/16th X rate) – 28 DAT



Constant
25 GPA
21% yield reduction

Proportional
1.6 GPA
88% yield reduction

Wheat – Roundup Ultra Drift

Proportional GPA – First Node Application



4 oz/A (1/8th X rate)
3.1 GPA
61% injury



2 oz/A (1/16th X rate)
1.6 GPA
49% injury

Wheat – Roundup Ultra Drift

2 oz/A (1/16th X rate) – First Node Application



Constant
25 GPA
29% Injury



Proportional
1.6 GPA
49% Injury

Wheat Roundup Ultra Drift Yield Reduction

| Roundup Ultra rate | Spray volume | Percent yield reduction vs. no Roundup Ultra | |
|--------------------------|-----------------|-------------------------------------------------|---------|
| | | First Node | Heading |
| oz/ A | GPA | % reduction | |
| 4 (1/8 th X) | 25 | 48 abc | 36 cd |
| 4 (1/8 th X) | 3.1 | 62 a | 45 bc |
| 2 (1/16 th X) | 25 | 10 e | 11 e |
| 2 (1/16 th X) | 1.6 | 57 ab | 26 d |

First node application on 2/27 and 3/27; Heading application on 4/6 and 4/12.

Conclusions

Glyphosate Drift on Wheat

Wheat is very sensitive to glyphosate at first node, boot stage, and flowering.

Roundup Ultra (2 oz/A) at first node reduced yield by as much as 57% and at heading 26%.

Visual injury was highly correlated with yield reduction although injury symptoms are not what would be expected.

Conclusions

Glyphosate Drift on Wheat

Constant spray volume drift research may underestimate negative effects of systemic herbicides on sensitive crops.

Precaution should be taken when glyphosate products are applied to fields adjacent to wheat.

Ways to Reduce Herbicide Drift

- Use common sense
- Consider using drift reduction nozzles that increase droplet size
- Use lower spray pressure (nozzle dependent)
- Maintain correct spray boom height
- Avoid application under windy conditions
- Consider using buffer zones
- Consider using drift reduction additives

Heat Injury With Sub-Lethal Roundup Rate



Procedure to Follow When Glyphosate Injury to Wheat is Expected

- Analyze for glyphosate residue
- Where?

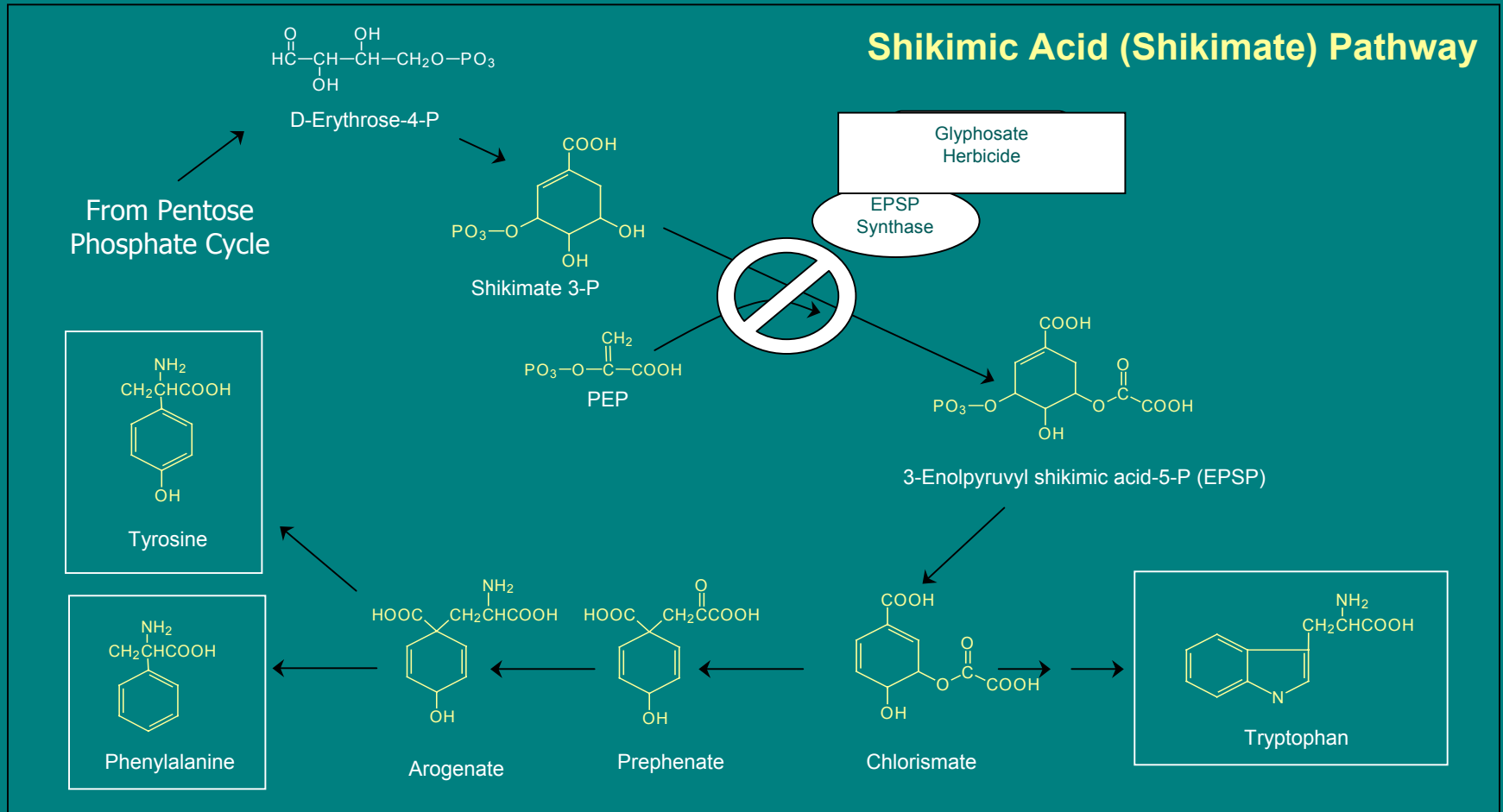
Qscar E. Olson Biochemistry Labs
South Dakota State University
SAS 133, Box 2170
Brookings, SD 57007-1217
Telephone Number: 605-688-6172
FAX Number: 605-688-6295

Procedure to Follow When Glyphosate Injury to Wheat is Expected

- Call before samples are sent
- Overnight fresh samples to arrive no later than Thursday
- Collect samples (double handful of green plant material) as soon as injury symptoms appear (earlier the better)
- Sample cost \$70
- Qscar E. Olson Biochemistry Labs
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Glyphosate Mode of Action

Inhibition of 5-enolpyruvylshikimate-3-phosphate (EPSP) Synthase



Procedure to Follow When Glyphosate Injury to Wheat is Expected

Analyze for shikimate (shikimic acid) accumulation – extraction and measurement using spectrophotometric-based leaf disc assay is rapid and simple

Collect leaves as soon as possible after the suspected drift event or immediately after appearance of glyphosate injury; freeze leaf samples

Collect youngest leaves of most severely injured plants along the edge of the potential drift event. Also collect leaves from unaffected plants for comparison.

At 14 days after application of glyphosate at 1 and ½ x rate, shikimate was detectable in wheat.

At 1/8 and 1/16 x “drift rates” rates, shikimate was no longer significantly different from that present in the nontreated control.

Henry, Shaner, and West. 2007. *Weed Science* 55:1-5.

Questions?

