Affect of a R3 glyphosate application on soybean pod abortion and yield

Megan Lane
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Acknowledgements

- Major Professor: Dr. Bob Hartzler
- Program of Study Committee
  - Dr. Ken Moore
  - Dr. Tom Loynachan
- Dr. Matthew Harbur
- Dawn Miller
- MS Agronomy faculty and staff
Background

- Grew up outside Toulon, IL
- Black Hawk East Community College 2003-2005
  - Associate of Science
- Illinois State University 2005-2007
  - Bachelor of Science in Agribusiness
Family

- Nathan and I were married Sept. 2008
- Our children:
  - Michelle is 3.5 years old
  - Hailey is 16 months
  - Lane baby 3 due July 29th
Employment

- 2013-present: Stay at home Mom
  - Field Scientist 2012
  - Assistant to the Field Scientist 2007-2011
- 2006: Alvey Ag Research
  - Intern- assisted the field scientist
  - Seasonal Fall help- worked in receiving and the lab
Introduction

- **Glyphosate:**
  - Commercially introduced in 1974
  - Most used herbicide worldwide
  - Broad spectrum, non-selective, translocated herbicide with low mammalian toxicity
  - Foliar applied, absorbed through the leaves then transported via phloem to the sinks
Introduction

- **Glyphosate:**
  - Inhibits the EPSPS enzyme that is a component of the shikimate acid pathway
    - Shikimate acid pathway synthesizes aromatic amino acids, vitamins, plant growth substances, and lignin
  - Susceptible plants:
    - glyphosate isn’t broken down or metabolized which results in decreased protein synthesis, cellular disruption, and plant death
Introduction

- Glyphosate accumulates in sinks of high meristematic and metabolic activity
- SB treated during reproductive stages primary sinks are the pods and flowers
Introduction

○ Glyphosate Resistant Cotton:
  ● Reports of decreased boll retention and pollinations problems when treated with glyphosate
  ● Negative effects include accumulation of glyphosate in reproductive structures, reductions in pollen viability, abnormal floral anatomy, and boll loss
Introduction

- Benefits of utilizing Roundup Ready Crops:
  - Wide spectrum weed control program
  - Environmentally friendly herbicide
  - A new site of action
  - Weeds treated as needed
  - Less herbicide dependancy
  - Works well with no-till
  - More cost effective
Introduction

- Glyphosate Resistant Crops:
  - > 80% of the 120 million ha of transgenic crops worldwide are glyphosate resistant crops
  - In 2004 48.4 million hectares of 60% were glyphosate resistant soybean
  - In the U.S. 6 yrs after soybean commercialization glyphosate resistant soybean made up over 80% of the soybean acres, eight years for 80% adoption in cotton, and ten years for 80% adoption in corn
Introduction

- Glyphosate resistant crops:
  - Reasons for high adoption rates:
    - Economic advantages
    - Superior weed control
    - Ease of use
    - Less tillage
    - Consistent, broad-spectrum weed control
Introduction

- Product Label
  - Label is a legal document
  - Designed to optimize weed control, minimize crop injury, and protect crop yield
  - Roundup Weathermax label states “it is against Federal law to use this product in any manner inconsistent with its labeling”
Introduction

- **Product Label**
  - The Roundup Weathermax supplemental label states “application of this product can be made in RR soybeans from emergence (cracking) through flowering (R2 stage soybeans)”
Many producers still apply glyphosate after R2

Late applications may be due to:

- Poor weed control from a previous application (could be from an inappropriate rate of glyphosate being applied, weed size, herbicide resistance, or environmental conditions)
- Weather restraints
- Equipment malfunctions
Introduction

- Producers are sometimes left with the predicament whether or not to apply glyphosate past the label timing to achieve weed control.

- Question at hand:
  - Does late glyphosate applications cause pod abortion and a reduction in soybean yield?
Materials and Methods

- Initiated in 2011 at SGS North America Inc. Wyoming
- Soil: silty clay loam (2010 SGS soil fertility report)
  - OM 3.2%
  - CEC 20
  - pH 6.3
Materials and Methods

- Field cultivated May 12, 2011
- 2010 crop was corn
- Fertilized according to SGS Toulon’s recommendations
Asgrow 3041V was planted on June 4, 2011
- 76 cm rows
- Seed depth of 3.81 cm
- 345,000 seeds/ha

John Deere 7100 sprocket driven planter

RCBD

Plot size: 3m x 6.1m
Materials and Methods

- Preemergence Applications on June 6, 2011
  - 1.0 kg ae/ha glyphosate (28 oz/Ac Touchdown Total)
  - 1.4 kg/ha S-metolachlor and .4 kg/ha metribuzin (2.1 pts/Ac Boundary)
### Materials and Methods

#### Table 1 Treatment list

<table>
<thead>
<tr>
<th>Treatment ¹</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Control</td>
</tr>
<tr>
<td>LRV3</td>
<td>1.12 kg ae / ha A @ V2-3</td>
</tr>
<tr>
<td>HRV3</td>
<td>2.24 kg ae / ha A @ V2-3</td>
</tr>
<tr>
<td>LRR3</td>
<td>1.12 kg ae / ha A @ R3</td>
</tr>
<tr>
<td>HRR3</td>
<td>2.24 kg ae / ha A @ R3</td>
</tr>
</tbody>
</table>

¹LRV3 = Low rate, V3 application; HRV3 = high rate, V3 application; LRR3= Low rate, R3 application; HRR3= high rate, R3 application.
## Materials and Methods

### Table 2 Significant trial activity dates

<table>
<thead>
<tr>
<th>Operation</th>
<th>Date</th>
<th>Soybean Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Stand Count</td>
<td>6/26/11</td>
<td>V2</td>
</tr>
<tr>
<td>Application #1</td>
<td>6/29/11</td>
<td>V3</td>
</tr>
<tr>
<td>Rating 7DAA1</td>
<td>7/6/11</td>
<td>V3-4</td>
</tr>
<tr>
<td>Application #2</td>
<td>8/5/11</td>
<td>R3</td>
</tr>
<tr>
<td>Rating 7DAA2</td>
<td>8/12/11</td>
<td>R3</td>
</tr>
<tr>
<td>Final Stand Count</td>
<td>10/16/11</td>
<td>R8</td>
</tr>
<tr>
<td>Harvest</td>
<td>10/24/11</td>
<td>R8</td>
</tr>
</tbody>
</table>
Materials and Methods

- Glyphosate treatments applied with:
  - $\text{CO}_2$ pressurized backpack sprayer
  - Calibrated to 4.5 L/ha
  - Roundup Weathermax
  - 2L mix
  - 20.4 g/L AMS
Materials and Methods

- PreHarvest Data Collection
  - FSC
  - Arbitrarily harvested 5 plants/plot
    - Determined:
      - Pods/plant
      - Seeds/pod
      - Seeds/plant

- Massey XP with a Harvest Master HM800 High Capacity Grain Gauge and Allegro CX Handheld
Materials and Methods

- Null Hypothesis: Late glyphosate applications will not affect pod abortion
- Ha1: glyphosate rate does affect pod abortion
- Ha2: glyphosate timing does affect pod abortion
Results and Discussion

- Variables analyzed
  - Grain weight, moisture, test weight, early stand counts, final stand counts, number of seeds per plot and per pod, number of pods per plot and per plant, and yield
- Yield-calculated taking out moisture
- Test weight-how much a bushel of sb would weigh based off what was in the bucket
- Plot weight-wet weight of the plot with no moisture correction
Results and Discussion

- No statistical differences found in:
  - Seed moisture
  - Test weight
  - Early stand count
  - Final stand count
  - Number of seeds/pod

- ANOVA found statistical differences in:
  - Weight
  - Yield
  - Number of seeds/plot
  - Number of pods/plant
## Results and Discussion

### Table 3 Effect of glyphosate rate and application timing on soybean parameters

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Early stand count</th>
<th>Final stand count</th>
<th>Pods/plant</th>
<th>Seeds/pod</th>
<th>Weight</th>
<th>Moisture</th>
<th>Yield</th>
<th>Test weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>300,510 Plants/ha</td>
<td>287,173 Plants/ha</td>
<td>9.7</td>
<td>2.5</td>
<td>3,770.6</td>
<td>11.9</td>
<td>4,001.4</td>
<td>965.4</td>
</tr>
<tr>
<td>LRV3</td>
<td>292,121 Plants/ha</td>
<td>275,557 Plants/ha</td>
<td>10.6</td>
<td>2.5</td>
<td>3,509.3</td>
<td>11.9</td>
<td>3,725.2</td>
<td>967.6</td>
</tr>
<tr>
<td>HRV3</td>
<td>296,638 Plants/ha</td>
<td>269,534 Plants/ha</td>
<td>9.9</td>
<td>2.5</td>
<td>3,546.7</td>
<td>12.0</td>
<td>3,745.4</td>
<td>966.3</td>
</tr>
<tr>
<td>LRR3</td>
<td>299,220 Plants/ha</td>
<td>274,482 Plants/ha</td>
<td>8.7</td>
<td>2.5</td>
<td>3,322.7</td>
<td>11.9</td>
<td>3,523.1</td>
<td>965.6</td>
</tr>
<tr>
<td>HRR3</td>
<td>299,004 Plants/ha</td>
<td>273,621 Plants/ha</td>
<td>10.4</td>
<td>2.6</td>
<td>3,173.3</td>
<td>12.0</td>
<td>3,374.9</td>
<td>963.4</td>
</tr>
<tr>
<td>LSD</td>
<td>NS¹</td>
<td>NS</td>
<td>1.3</td>
<td>NS</td>
<td>560</td>
<td>NS</td>
<td>323.3</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS¹ = Not significant
Results and Discussion

- Significant difference in seed weights is between the control and HRR3.
- Yield of the control is significantly different from HRR3.
Results and Discussion

- No differences between the number of seeds/pod
- Statistical difference in the number of pods/plant.
  - LRV3 and HRR3 is higher than LRR3 and found to be different;
  - LRV3 has the highest number of pods with 10.6 pods/plant and LRR3 has the lowest with only 8.7 pods/plant, an 18% reduction
Results and Discussion

- **HRR3**
  - had the highest number of pods/plant which was unexpected
  - Had the lowest yield
  - Had one of the lowest stand counts (not statistically different)
    - The plants may have compensated for the lower stand by producing more pods
Results and Discussion

- Treatment analysis by application timing
  - HRR3 and LRR3
    - Lower yield (HRR3)
    - No significant differences in the number of pods and seeds/plant
Results and Discussion

- Treatment analysis by application timing
  - Applications at V3
    - LRV3: Highest number of pods/plant and higher yield
    - HRV3: average pods and seeds per plant, and yield
Results and Discussion

- Treatment analysis by application rate
  - HRV3 and HRR3
    - Glyphosate applications of 2.24 kg/ha
    - Had the lowest final stand counts (not statistically different)
    - HRV3: average yields, weights, pod, and seed counts
    - HRR3: lowest yield and one of the higher pod counts
      - Applications applied after R3 did cause a loss in yield
Conclusions

- Further replications of this study or a similar study would help support these findings.
- A similar study conducted in Alabama found no significant differences between treatments.
  - Plant growth and yields were limited due to dry weather.
Conclusions

- Objective of this study was to determine if the glyphosate rate and application timing affects pod abortion.
- Statistical differences were found in pod and seed counts, weight, and yield.
- Null hypothesis that there is no effect on pod abortion from the application rate and timing, or their interaction is rejected.
Conclusions

- Data analysis found:
  - That application rate and timing does have an effect on pod abortion
  - Glyphosate applied during reproductive stages influenced yield
    - HRR3’s yield was statistically different from the highest yielding plot (control)
Conclusions

- Implications to producers:
  - Do not apply glyphosate to soybeans during reproductive stages, particularly at an increased rate
  - Glyphosate label needs to be followed when making applications
  - Applications after R2 to try to control weeds may decrease yield and should not be made
Questions?