Weed Management in Soybean
Questions from Ontario Farmers

Boundary
Roundup + Conquest
Guardian
Pursuit (Post)
Roundup (Post)

Peter H. Sikkema
University of Guelph
Ridgetown Campus
Question # 1

I heard RR soybeans are off patent. Can I grow bin run RR soybeans?
## Roundup Ready Soybean

<table>
<thead>
<tr>
<th>Date</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 28, 2011</td>
<td>Patent on first generation RR1 soybean expires. Seed planted before August 28, 2011 cannot be saved without breaching the TUA and patent law. Stockpiling is not allowed under the law. Seed purchased prior to patent expiry is still protected by the law regardless of when it is planted.</td>
</tr>
<tr>
<td>Spring 2012</td>
<td>RR1 soybean seed purchased after August 28, 2011 can be saved and replanted if you do not have to sign an agreement.</td>
</tr>
<tr>
<td>Spring 2013</td>
<td>Earliest a farmer could replant RR1 soybean seed from the bin is 2013 from seed purchased and saved in 2012.</td>
</tr>
</tbody>
</table>

***The patent for RR2Y soybean was filed on December 12, 2000 and expires on December 12, 2020 (20 years)***
I planted my corn very early this spring and put down my PRE residual corn herbicide. I had a really poor stand of corn and I want to re-seed to soybean. Is it safe?
Corn Herbicides

Injury (%) 2 WAE - Mean of 9 Studies

- Primextra
- Dual + Callisto
- Converge
- Battalion
- Frontier + Marksman

Nurse, AAFC
Swanton, UG
Sikkema, UG

0 20 40 60 80 100

6 WBP 4 WBP 2 WBP PRE
Corn herbicide injury in soybean

- Primextra
- Dual + Callisto
- Battalion
- Frontier + Marksman
- Converge
Corn Herbicides

Yield loss (% of check) - Mean of 9 Studies

- Primextra
- Dual + Callisto
- Converge
- Battalion
- Frontier + Marksman

Nurse, AAFC
Swanton, UG
Sikkema, UG
# Corn Herbicides

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Minimum Interval</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primextra</td>
<td>0</td>
<td>Less than 4% injury</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less than 5% yield loss</td>
</tr>
<tr>
<td>Battalion</td>
<td>4</td>
<td>4 wks – 7% injury</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 wks – 2% yield loss</td>
</tr>
<tr>
<td>Frontier + Marksman</td>
<td>6</td>
<td>6 wks – 2% injury</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 wks - 0% yield loss</td>
</tr>
<tr>
<td>Converge</td>
<td>Don’t</td>
<td>6 wks – 11% injury</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 wks – 14% yield loss</td>
</tr>
<tr>
<td>Dual + Callisto</td>
<td>Don’t</td>
<td>Injury year after</td>
</tr>
</tbody>
</table>
Question # 3

Is there a benefit of adding Crop Booster to Roundup in RR soybean?
No effect on weed control

Crop Booster – 4 studies

- Buckwheat, Wild
- Lamb's-quarters
- Mustard, Wild
- Nightshade, E. black
- Pigweed, Redroot
- Ragweed, Common
- Foxtail, Green
- All Weeds

Visual Weed Control (% 8 WAA)

Sikkema, UG
No effect on RR soybean yield

Crop Booster – 4 studies

- Check
  - Soybean Yield (bu/ac): 23.4

- Roundup
  - Soybean Yield (bu/ac): 41.6

- Roundup + Crop Booster
  - Soybean Yield (bu/ac): 41.4

Sikkema, UG
Crop Booster

Summary

1. No difference in weed control
2. No difference in RR soybean yield

Roundup (Post)
My IP soybeans are at the flowering stage and I have some weed escapes. Which herbicides are safest to apply at this late stage?
Late herbicide application in IP Soybean

Pinnacle & Pursuit cause the most injury!

Assure
Basagran
Reflex
FirstRate
Classic
Pursuit
Pinnacle

Injury (% 1 WAA)

Recommended Rate
Spray Overlap
Herbicide injury in soybean

Soybean usually recovers with no yield loss
Pinnacle injury in soybean

Pursuit injury in soybean
Late herbicide application in IP Soybean

Pinnacle & Pursuit cause the greatest yield loss!

Sikkema, UG
Nurse, AAFC
Late Herbicides

Summary

1. Assure, Basagran and Reflex
   a. May cause leaf burn shortly after application
   b. Crop usually recovers with no impact on yield

2. FirstRate and Classic
   a. May cause yellowing, reddening of the veins and stunting
   b. Crop usually recovers with no impact on yield

3. Pursuit and Pinnacle
   a. May cause yellowing, reddening of the veins and stunting
   b. Crop yield losses may occur
I heard about glyphosate-resistant weeds. What are my weed management options in RR soybean?
Roundup Ready Soybean

Weed Control Strategies

1. Single application of Roundup
2. PRE residual herbicide followed by a POST application of Roundup
3. Tankmix of Roundup with another POST herbicide
4. Sequential application of Roundup
Yield (bu/ac)

- Weed-free: 53
- Roundup EP: 53
- Roundup LP: 46
- Roundup + Pursuit EP: 53
- Boundary PRE; Roundup LP: 52
- Roundup EP; Roundup LP: 55

Average of 11 studies

Sikkema, UG
Nurse, AAFC
Roundup Ready Soybean

Weed Control

Weed Control (%)

Roundup EP
Roundup LP
Roundup + Pursuit EP
Pursuit PRE; Roundup LP
Roundup EP; Roundup LP

Sikkema, UG Nurse, AAFC

- Velvetleaf
- Pigweed
- Ragweed
- Lamb's-quarters
- Foxtail
Roundup Ready Soybean

Weed Control

- Velvetleaf
- Pigweed
- Ragweed
- Lamb's-quarters
- Foxtail

Sikkema, UG Nurse, AAFC
Roundup Ready Soybean

Weed Control

- Velvetleaf
- Pigweed
- Ragweed
- Lamb’s-quarters
- Foxtail

Sikkema, UG Nurse, AAFC
Weed management options in RR soybean

- Roundup EP
- Roundup LP
- Boundary (PRE); Roundup LP
- Roundup + Pursuit EP
Conclusions

1. Excellent soybean yields can be obtained with different weed management programs
2. Weed management is field specific
3. The most consistent weed control was provided by
   a. A residual herbicide (PRE) fb glyphosate (LP)
   b. A tankmix of glyphosate plus a residual herbicide (EP)
   c. A sequential application of glyphosate applied EP fb LP
Due to the possibility of glyphosate-resistant weeds or weed shifts, the following are recommended:

a. A diverse crop rotation
b. Inclusion of multiple herbicide modes-of-action
   a. Preemergence residual followed by glyphosate postemergence
   b. Postemergence tankmix of glyphosate + another effective effective herbicide
Which PRE residual should I use?

It depends …

Weed Control (%) – 8 WAA

- Pursuit PRE; Roundup LP
- Boundary PRE; Roundup LP
- Broadstrike RC + Dual PRE; Roundup LP

Sikkema, UG Nurse, AAFC
Which PRE residual should I use?

It depends …

Weed Control (% – 8 WAA)

- Pursuit PRE; Roundup LP
- Boundary PRE; Roundup LP
- Broadstrike RC + Dual PRE; Roundup LP

Sikkema, UG Nurse, AAFC

Velvetleaf  Pigweed  Ragweed  Lamb's-quarters  Foxtail
Glyphosate Resistant Giant Ragweed

Sikkema, UG
Giant Ragweed Survey
Day of application

1 day after application

7 days after application

28 days after application
Day of application

1 day after application

7 days after application

28 days after application
Day of application

1 day after application

7 days after application

28 days after application
Day of application

1 day after application

7 days after application

28 days after application
Ontario 2009: 17 sites confirmed
Canada fleabane - Survey

Canada fleabane in soybean in Essex county in 2010
Suspected Glyphosate Resistant Canada fleabane

Susceptible

Control 450 g/ha 900 g/ha

Resistant

Control 450 g/ha 900 g/ha

Two weeks after application
Results: Ontario 2010
9 sites
Question # 6

When is the best time to apply Roundup in RR soybean?
Roundup Ready Soybean

Roundup Application Timing

Yield (bu/ac)

Average of 16 Experiments

Hamill, AAFC
Sikkema, UG
### Roundup Ready Soybean

#### Application Timing

<table>
<thead>
<tr>
<th>Days After Emergence</th>
<th>Delay in Application</th>
<th>Yield Loss (bu/ac)</th>
<th>Value ($/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>1</td>
<td>1.0</td>
<td>13.00</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>2.0</td>
<td>26.00</td>
</tr>
<tr>
<td>25</td>
<td>3</td>
<td>3.0</td>
<td>39.00</td>
</tr>
<tr>
<td>26</td>
<td>4</td>
<td>4.0</td>
<td>52.00</td>
</tr>
</tbody>
</table>
Roundup Ready Soybean

So, what is the right application timing?

Well, it depends …

1. Relative time of weed emergence
2. Weed species composition
3. Weed density
4. Environmental and fertility conditions
5. Soybean and Roundup price
Roundup Ready Soybean

Early/Correct Application Timing

1. Protect the full yield potential of the crop
   a. Severe yield losses may result if application is delayed too long
2. Generally weeds are easier to control when they are young and actively growing
3. Late emerging weeds generally do not reduce crop yield
4. A second application will be required in some fields
Question # 7

Does time of day affect weed control with postemergence herbicides in soybean?
Time of Day

Pursuit

Weed Control (%), 4 WAA

- Velvetleaf - Ridgetown and Harrow
The chart shows the weed control percentage of Common ragweed in Harrow for different times of the day. The control is measured in 4 WAA (Whole Aboveground Area) units. The chart indicates that the highest weed control was at 3 pm with 60% control, followed by 12 pm with 58% control. The lowest control was at 6 am with 33% control. The chart also highlights significant differences between the times of day for weed control.
Time of Day

Roundup (2 sites)

Weed Control (%) 8 WAA

Barnyard grass
Green foxtail
Lamb's-quarters
Time of Day

Weed Control (%): Velvetleaf - Ridgetown

- 4 am: 45%
- 9 am: 76%
- 12 pm: 89%
- 3 pm: 87%
- 6 pm: 87%
- 9 pm: 45%
- 12 am: 36%

Legend:
- Velvetleaf - Ridgetown
Weed Control (%): Time of Day

Pigweed - Ridgetown and Harrow

6 am: 81
9 am: 91
12 pm: 95
3 pm: 92
6 pm: 92
9 pm: 84
12 am: 62
Time of Day

Roundup

Weed Control (%): Common ragweed - Ridgetown

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Weed Control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 am</td>
<td>74</td>
</tr>
<tr>
<td>9 am</td>
<td>90 (a)</td>
</tr>
<tr>
<td>12 pm</td>
<td>94 (a)</td>
</tr>
<tr>
<td>3 pm</td>
<td>92 (a)</td>
</tr>
<tr>
<td>6 pm</td>
<td>93 (a)</td>
</tr>
<tr>
<td>9 pm</td>
<td>79 (b)</td>
</tr>
<tr>
<td>12 am</td>
<td>53 (c)</td>
</tr>
</tbody>
</table>
Glyphosate

Time of Day
Time of Day

Roundup

2-4 bu/ac difference in yield

Yield (bu/ac)

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Yield (bu/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weedy</td>
<td>30</td>
</tr>
<tr>
<td>6 am</td>
<td>43</td>
</tr>
<tr>
<td>9 am</td>
<td>47</td>
</tr>
<tr>
<td>12 pm</td>
<td>46</td>
</tr>
<tr>
<td>3 pm</td>
<td>46</td>
</tr>
<tr>
<td>6 pm</td>
<td>46</td>
</tr>
<tr>
<td>9 pm</td>
<td>44</td>
</tr>
<tr>
<td>12 am</td>
<td>44</td>
</tr>
</tbody>
</table>

Yield (bu/ac)
Time of Day

Summary

1. Change in efficacy during the day is thought to be due to:
   a. Changes in air temperature
      i. Epicuticular wax is more fluid at higher temperatures
      ii. Increase in membrane permeability
      iii. Increase in rates of diffusion
      iv. Increase in enzyme activity and metabolic processes
   b. Changes in leaf angle
      i. Decrease in spray interception and retention
Leaf orientation during the day

Leaf orientation during the night
Time of Day

Summary

2. Time of day affects …
   a. The level of weed control
   b. Soybean yield
   c. Net returns
Question # 8

I have heard about glyphosate resistant weeds so I want to add a tankmix partner to my preplant burndown. Is it safe to add 2,4-D or Amitrol?
Amitrol 240

Yield (% of check) - Mean of 6 Studies

Hamill, AAFC
Swanton, UG
Sikkema, UG

14 DPP
7 DPP
1 DPP
7 DAP
2,4-D 600 Ester

Injury (%) 7 DAE - Mean of 6 Studies

- 14 DPP
- 7 DPP
- 1 DPP
- 7 DAP

0.5 L/ac
1.0 L/ac

Less than 1% injury

Hamill, AAFC
Swanton, UG
Sikkema, UG
2,4-D 600 Ester

Yield (\% of check) - Mean of 6 Studies

<table>
<thead>
<tr>
<th>Time</th>
<th>0.5 L/ac</th>
<th>1.0 L/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 DPP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 DPP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 DPP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 DAP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Less than 1\% yield loss

Hamill, AAFC
Swanton, UG
Sikkema, UG
1. When applied 2 weeks before seeding soybean …
   a. There was less than 1% injury
   b. There was less than 1% yield loss
I just scouted my field and noticed that there are manganese deficiency symptoms and weed escapes. Should I add manganese to glyphosate?
Roundup + Manganese

Every Mn formulation reduced weed control with Roundup

Summary of 4 experiments across 12 weed species

Sikkema, UG
Roundup + Manganese

Roundup + Ecoman
Roundup + MangaMax
Roundup + ManMax
Roundup + Superman
Roundup + This Stoller
Roundup + Nortrace 6%
Roundup + Notrace 22%
Roundup + WolfTrax

Soybean Yield (bu/ac)

Sikkema, UG
Roundup + Superman

Weed free
Weed free + Superman
Roundup
Roundup + Superman
Roundup fb Superman

Soybean Yield (bu/ac)

Summary of 2 experiments

Sikkema, UG
Is there an effect of nozzle selection, water carrier volume and spray pressure on weed control?
Flat fan vs Air Induction

Reflex - Weed Control – 4 WAA

Weed Control (%)

- Velvetleaf: FF 70%, AI 73%
- Common ragweed: FF 91%, AI 86%
- Lamb's-quarters: FF 72%, AI 68%

No difference in broadleaf weed control with Reflex, Basagran, FirstRate and Roundup

Sikkema, UG
Spieser, OMAFRA

1 No difference in broadleaf weed control with Reflex, Basagran, FirstRate and Roundup
Water Volume - Flat Fan

Weed Control – 4 WAA

Sikkema, UG
Spieser, OMAFRA

1 No difference in broadleaf weed control with Basagran, FirstRate and Roundup
Water Volume – Air Induction

Weed Control – 4 WAA

Weed Control (%)

<table>
<thead>
<tr>
<th>Weed Type</th>
<th>Water Volume (L/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velvetleaf - Reflex</td>
<td>64  100 L/ha</td>
</tr>
<tr>
<td>Common ragweed - Reflex</td>
<td>74  200 L/ha</td>
</tr>
<tr>
<td>Barnyard grass - Assure</td>
<td>77  100 L/ha</td>
</tr>
<tr>
<td></td>
<td>85  200 L/ha</td>
</tr>
<tr>
<td></td>
<td>69  100 L/ha</td>
</tr>
<tr>
<td></td>
<td>82  200 L/ha</td>
</tr>
</tbody>
</table>

1 No difference in broadleaf weed control with Basagran, FirstRate and Roundup

Sikkema, UG
Spieser, OMAFRA
Water Volume – Air Induction

Roundup Weed Control – 4 WAA

Vegetable: Velvetleaf
- 100 L/ha: 92%
- 200 L/ha: 88%

Vegetable: Lady's thumb
- 100 L/ha: 85%
- 200 L/ha: 77%

Sikkema, UG
Spieser, OMAFRA
Weed Control – 4 WAA

No difference in broadleaf weed control with Reflex, FirstRate and Roundup

Sikkema, UG
Spieser, OMAFRA

1 No difference in broadleaf weed control with Reflex, FirstRate and Roundup
Nozzles, Water Volume & Pressure

Summary

1. Nozzle selection (FF vs AI)
   a. No difference in broadleaf weed control with Basagran, FirstRate, Reflex and Roundup
   b. Reduced barnyard grass control (3%) with Assure with the AI nozzle
Nozzles, Water Volume & Pressure

Summary

1. Nozzle selection (FF vs AI)
   a. No difference in broadleaf weed control with Basagran, FirstRate, Reflex and Roundup
   b. Reduced barnyard grass control (3%) with Assure with the AI nozzle

2. Higher water volume (FF)
   a. Improved velvetleaf and lamb’s-quarters control with Reflex
   b. Improved barnyard grass control with Assure
Nozzles, Water Volume & Pressure

Summary

1. Nozzle selection (FF vs AI)
   a. No difference in broadleaf weed control with Basagran, FirstRate, Reflex and Roundup
   b. Reduced barnyard grass control (3%) with Assure with the AI nozzle

2. Higher water volume (FF)
   a. Improved velvetleaf and lamb’s-quarters control with Reflex
   b. Improved barnyard grass control with Assure

3. Higher water volume (AI)
   a. Improved velvetleaf and ragweed control with Reflex
   b. Improved barnyard grass control with Assure
   c. Lower velvetleaf and lady’s thumb control with Roundup
1. Nozzle selection (FF vs AI)
   a. No difference in broadleaf weed control with Basagran, FirstRate, Reflex and Roundup
   b. Reduced barnyard grass control (3%) with Assure with the AI nozzle
2. Higher water volume (FF)
   a. Improved velvetleaf and lamb’s-quarters control with Reflex
   b. Improved barnyard grass control with Assure
3. Higher water volume (AI)
   a. Improved velvetleaf and ragweed control with Reflex
   b. Improved barnyard grass control with Assure
   c. Lower velvetleaf and lady’s thumb control with Roundup
4. Higher spray pressure (AI)
   a. Improved lamb’s-quarters control with Basagran
   b. Improved barnyard grass control with Assure
Thank You

1. Research Technicians: Christy Shropshire, Todd Cowan, Lynette Brown and Chris Kramer
2. Grain Farmers of Ontario
3. Agricultural Adaptation Council (Farm Innovation Program)
4. Herbicide Manufacturers
Weed Management in Soybean
Questions from Ontario Farmers

Boundary
Roundup + Conquest
Guardian
Pursuit (Post)
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Peter H. Sikkema
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