Institute of Ag Professionals

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Minnesota Crop Production Retailers Association Trade Show

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Herbicide Resistance?
Not on My Farm ...

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Lisa M. Behnken, Extension Educator
2014 CPM Short Course
UP TO YOUR EARS IN RAGWEED?
Painting Ourselves in a Corner…Again!!!
Glyphosate–Resistant Weeds
5 Stages of Loss

- Denial
- Anger
- Bargaining
- Depression
- Acceptance

Are we here yet?
Responsible Ethical Agriculture for Life...
<table>
<thead>
<tr>
<th>Year</th>
<th>Crop</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>Corn</td>
<td>Dual</td>
<td>Callisto</td>
</tr>
<tr>
<td>2002</td>
<td>Soy</td>
<td>Prowl</td>
<td>Glyphosate</td>
</tr>
<tr>
<td>2003</td>
<td>Corn</td>
<td>Dual</td>
<td>Accent + atrazine fb Callisto</td>
</tr>
<tr>
<td>2004</td>
<td>Corn</td>
<td>Prowl</td>
<td>Glyphosate</td>
</tr>
<tr>
<td>2005</td>
<td>Corn</td>
<td>Dual</td>
<td>Callisto</td>
</tr>
<tr>
<td>2006</td>
<td>Corn</td>
<td>Dual + Simazine</td>
<td>Callisto + atrazine</td>
</tr>
<tr>
<td>2007</td>
<td>Corn</td>
<td>Dual + Simazine</td>
<td>Impact fb Callisto</td>
</tr>
<tr>
<td>2008</td>
<td>Soy</td>
<td>Prowl</td>
<td>Glyphosate</td>
</tr>
<tr>
<td>2009</td>
<td>Corn</td>
<td>Dual</td>
<td>Callisto + atrazine</td>
</tr>
</tbody>
</table>

**McLean Co. IL**

**Henry Co. IA**

**ETHICAL... RESPONSIBLE?**

**How to Ruin a Good Herbicide**

Bob Hartzler
1. Farmer attitude...Do I really have to worry about a problem that I don’t have?
2. Extra cost of management
3. Time.....Additional time needed for implementing management, and being timely!
4. Crop injury to current crop & carryover concerns for subsequent crops
5. Product availability....both seed and chemical
Estimated cost of weed escapes

There is a cost and it’s recurring!!!
What Happens if/when we Develop Glyphosate Resistant Grasses?

- 13 confirmed species
- 6 confirmed in USA
Glyphosate-resistant Weed Development in the U.S.

2013: 14 species; 35 states

- Rigid Ryegrass (1)
- Horseweed/Marestail (24)
- Common Ragweed (11)
- Italian Ryegrass (6)
- Giant Ragweed (11)
- Waterhemp (14)
- Palmer Amaranth (19)
- Hairy Fleabane (1)
- Johnsongrass (3)
- Kochia (7)
- Junglerice (1)
- Goosegrass (2)
- Annual Bluegrass (3)
- Spiny Amaranth (1)

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Our Current Situation - Multiple resistance

<table>
<thead>
<tr>
<th></th>
<th>SOA#’s</th>
<th></th>
<th>SOA#’s</th>
<th></th>
<th>SOA#’s</th>
<th></th>
<th>SOA#’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2,4,5,9,14,27</td>
<td>SOA#’s 2,9</td>
<td>2,5,9,14</td>
<td>2,4,5,9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMON WATERHEMP</td>
<td>Amaranthus rudis</td>
<td>GIANT RAGWEED</td>
<td>Ambrosia trifida</td>
<td>COMMON RAGWEED</td>
<td>Ambrosia artemisiifolia</td>
<td>KOCHIA</td>
<td>Kochia scoparia</td>
</tr>
<tr>
<td>SHOWN RESISTANCE TO:</td>
<td>2 4 5 9 14 27</td>
<td>SHOWN RESISTANCE TO:</td>
<td>2 9</td>
<td>SHOWN RESISTANCE TO:</td>
<td>2 5 9 14</td>
<td>SHOWN RESISTANCE TO:</td>
<td>2 4 5 9</td>
</tr>
</tbody>
</table>
Rethink your weed management strategies

- Assume no new herbicide SOA’s
- What *non-chemical* weed management tactics should farmers adopt over the next couple of years?
Rethink our weed management strategies

Herbicide Inputs
- Move away from:
- Total Post & One-Pass Post with soil residual
- Start with a PRE (full rate or full split rate)
- Earlier Post Timing – target max. of 3-inch weeds
Rethink our weed management strategies

Weed Control

Herbicide Inputs

Crop Rotation

Crop Competition

Cultural Control
- Inter-row cultivation
- Work fields closer to planting date
- Delay planting if targeting early-emerging weeds
- Develop weed maps
Rethink our weed management strategies

Herbicide Inputs

Cultural Control

Crop Rotation
- Goal is to reduce the seed bank
- Increase diversity of:
  - Planting dates
  - Harvest dates
  - Herbicide SOA’s

Crop Competition

Weed Control
Rethink our weed management strategies

Herbicide Inputs

Crop Rotation

Cultural Control

Weed Control

Crop Competition
- Via Crop Rotation
- Focus on early-season weed control
- Narrow rows
- Increased seeding rates
Practice perimeter weed management
Corn soybean rotation is an unsustainable system

- Need at least 2 years away from soybean
  - 2 years of corn??
  - Alfalfa
  - Others

- No weed seed production should be your goal!!!
### ROTATE SOA #'s OVER YEARS

<table>
<thead>
<tr>
<th>Available Corn SOA #'s</th>
<th>Available Soybean SOA #'s</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>
**Several PRE Options in Corn**

<table>
<thead>
<tr>
<th>Tier 1</th>
<th>SOA #</th>
<th>Girw</th>
<th>Colq</th>
<th>Cowh</th>
<th>Sugarbeet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumax</td>
<td>5</td>
<td>G</td>
<td>G/E</td>
<td>E</td>
<td>18</td>
</tr>
<tr>
<td>Surestart/TripleFlex</td>
<td>2</td>
<td>G</td>
<td>G/E</td>
<td>G</td>
<td>26</td>
</tr>
<tr>
<td>Verdict - &gt;10 oz/A</td>
<td>14</td>
<td>G</td>
<td>G/E</td>
<td>G/E</td>
<td>NCS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tier 2</th>
<th>Girw</th>
<th>Colq</th>
<th>Cowh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrazine &lt;0.38#</td>
<td>5</td>
<td>P/F</td>
<td>G/E</td>
</tr>
<tr>
<td>Atrazine + Tier 3</td>
<td>15</td>
<td>F/G</td>
<td>G/E</td>
</tr>
<tr>
<td>Zemax</td>
<td>15</td>
<td>F/G</td>
<td>G/E</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tier 3</th>
<th>Girw</th>
<th>Colq</th>
<th>Cowh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual</td>
<td>15</td>
<td>N</td>
<td>P/F</td>
</tr>
<tr>
<td>Harness/Surpass</td>
<td>15</td>
<td>P</td>
<td>F/G</td>
</tr>
<tr>
<td>Outlook</td>
<td>15</td>
<td>N</td>
<td>P/F</td>
</tr>
</tbody>
</table>

**Girw = Giant Ragweed; Colq = Lambsquarters; Cowh = Waterhemp.**
Follow a PRE with a timely application of a POST for extended control; Diversification of SOA’s will help combat herbicide resistant biotypes.

Note POST weed control offers more opportunities to diversify effective SOA’s.

<table>
<thead>
<tr>
<th>Corn POST</th>
<th>Tier 1</th>
<th>SOA</th>
<th>Girw</th>
<th>Colq</th>
<th>Cowh</th>
<th>Sugarbeet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callisto</td>
<td>27</td>
<td></td>
<td>G</td>
<td>G/E</td>
<td>E</td>
<td>18</td>
</tr>
<tr>
<td>Capreno</td>
<td>2 27</td>
<td></td>
<td>G</td>
<td>G/E</td>
<td>G/E</td>
<td>18/24</td>
</tr>
<tr>
<td>Halex GT</td>
<td>9 15, 27</td>
<td></td>
<td>E</td>
<td>E</td>
<td>G/E</td>
<td>18</td>
</tr>
<tr>
<td>Hornet</td>
<td>2 4</td>
<td></td>
<td>G/E</td>
<td>P/F</td>
<td>P/F</td>
<td>26</td>
</tr>
<tr>
<td>Impact</td>
<td>27</td>
<td></td>
<td>G</td>
<td>G/E</td>
<td>G/E</td>
<td>18</td>
</tr>
<tr>
<td>Laudis</td>
<td>27</td>
<td></td>
<td>G</td>
<td>G/E</td>
<td>G/E</td>
<td>10/18*</td>
</tr>
<tr>
<td>Status</td>
<td>4</td>
<td></td>
<td>G/E</td>
<td>G/E</td>
<td>G</td>
<td>4</td>
</tr>
<tr>
<td>Liberty (in LL Corn)</td>
<td>10</td>
<td></td>
<td>G</td>
<td>F</td>
<td>G</td>
<td>0</td>
</tr>
</tbody>
</table>
Soybean Pre’s not as effective

- Less flexibility in rotational crops
- More limited application windows
Several PRE Options in Soybean

Why the big spread in Girw response to Tier 1 options?

<table>
<thead>
<tr>
<th>Tier 1</th>
<th>SOA#</th>
<th>Girw/Colq/Cowh/Sugarbeet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authority First/Sonic</td>
<td>2/14</td>
<td>P/G G/E G/E 30</td>
</tr>
<tr>
<td>Gangster</td>
<td>2/14</td>
<td>P/G G/E G 30</td>
</tr>
<tr>
<td>Optill</td>
<td>2/14</td>
<td>F/G G/E G 40</td>
</tr>
<tr>
<td>Prefix</td>
<td>15/14</td>
<td>F G G/E 18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tier 2</th>
<th>Girw/Colq/Cowh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary</td>
<td>P/F G G/E 18</td>
</tr>
<tr>
<td>Verdict - 5 oz/A</td>
<td>P G F/G NCS</td>
</tr>
<tr>
<td>Valor</td>
<td>N/P G G/E 4 to 10</td>
</tr>
</tbody>
</table>

Girw = Giant Ragweed; Colq= Lambsquarters; Cowh = Waterhemp.
All of the SOA #14 options must be applied by 3 days after planting except:

Prefix can be applied from cracking - V3

**Soybean PRE Rotation**

<table>
<thead>
<tr>
<th>Tier 1</th>
<th>SOA#</th>
<th>Girw</th>
<th>Colq</th>
<th>Cowh</th>
<th>Sugarbeet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authority First/Sonic</td>
<td>2 14</td>
<td>P/G</td>
<td>G/E</td>
<td>G/E</td>
<td>30</td>
</tr>
<tr>
<td>Gangster</td>
<td>2 14</td>
<td>P/G</td>
<td>G/E</td>
<td>G</td>
<td>30</td>
</tr>
<tr>
<td>Optill</td>
<td>2 14</td>
<td>P/F</td>
<td>G/E</td>
<td>G</td>
<td>40</td>
</tr>
<tr>
<td>Prefix</td>
<td>15 14</td>
<td>F</td>
<td>G</td>
<td>G</td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tier 2</th>
<th>Girw</th>
<th>Colq</th>
<th>Cowh</th>
<th>Sugarbeet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary</td>
<td>P</td>
<td>G</td>
<td>G/E</td>
<td>18</td>
</tr>
<tr>
<td>Verdict</td>
<td>P/F</td>
<td>G/E</td>
<td>F/G</td>
<td>NCS</td>
</tr>
<tr>
<td>Valor</td>
<td>P</td>
<td>G</td>
<td>G/E</td>
<td>4 to 10</td>
</tr>
</tbody>
</table>

Girw = Giant Ragweed; Colq= Lambsquarters; Cowh = Waterhemp.
Follow a PRE herbicide with a timely application of a POST herbicide for extended weed control; Diversification of SOA’s will help combat herbicide resistant biotypes.

Note Soybean options for broadleaf weed control has a limited number of SOA’s

<table>
<thead>
<tr>
<th>SOA</th>
<th>Girw</th>
<th>Colq</th>
<th>Cowh</th>
<th>Sugarbeet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadet 14</td>
<td>P</td>
<td>F</td>
<td>F</td>
<td>NCS</td>
</tr>
<tr>
<td>Cobra 14</td>
<td>G</td>
<td>P</td>
<td>G/E</td>
<td>0</td>
</tr>
<tr>
<td>First Rate 2</td>
<td>E</td>
<td>P</td>
<td>P</td>
<td>30</td>
</tr>
<tr>
<td>Flexstar GT  14 9</td>
<td>G/E</td>
<td>F-E</td>
<td>E</td>
<td>18</td>
</tr>
<tr>
<td>Flexstar 14</td>
<td>G</td>
<td>P/F</td>
<td>G/E</td>
<td>18</td>
</tr>
<tr>
<td>Resource 14</td>
<td>P</td>
<td>F</td>
<td>F</td>
<td>1</td>
</tr>
<tr>
<td>Liberty (in LL Soybean) 10</td>
<td>G</td>
<td>F</td>
<td>G</td>
<td>0</td>
</tr>
</tbody>
</table>

Girw = Giant Ragweed; Colq= Lambsquarters; Cowh = Waterhemp.
**ROTATED SOA #'s OVER 3 YEARS**

<table>
<thead>
<tr>
<th>Corn SOA #'s</th>
<th>Soybean SOA #'s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>10*</td>
<td>10*</td>
</tr>
<tr>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>27</td>
<td></td>
</tr>
<tr>
<td>15**</td>
<td>15**</td>
</tr>
</tbody>
</table>

- **If you include Liberty as part of your program**
- **not effective for ragweed**
Overuse of SOA’s
Especially where rotational flexibility is a goal!!

• Corn
  – SOA 4 (PGR)
  – SOA 27 (HPPD)

• Soybean
  – SOA 14 (PPO)
  – SOA 10 (glufosinate)
Residual herbicides are the key to successfully managing waterhemp

- Increase the rate of the herbicide, if allowed by the label.
- Apply the herbicide in a split application two-thirds early, with the remaining one-third at planting or early post (if labeled).
- Apply the herbicide closer to planting time.
Residual Herbicides

• The addition of an overlapping residual herbicide to the post-emergence treatment is likely to reduce or eliminate waterhemp emergence for the remainder of the season.

• Effective overlapping residual herbicides include but are not limited to Group 15 herbicides such as:
  – Anthem, Cinch, Dual II Magnum, Outlook, Prefix, Warrant and Zidua.
Controlling Large Waterhemp in Soybean

• The answer can be summarized as follows:
  – there are NO postemergence herbicides that will consistently control large weeds in soybean, especially if the weeds are resistant to glyphosate.
Highlights from Three Trials 2013 & 2014

- Glyphosate Resistant GIRW Site
  - 2013 & 2014
  - Planted June 13, 2013 and May 23, 2014
- College (not resistant) 2014
  - May 21, 2014
- Some yields
  - Economic impact in 2015
Resistant GIRW Site

- Delayed planting in 2013
- First flush of ragweed taken out with tillage
  - Non-chemical possibility?
  - Decreased density to manage
  - Improves uniformity of plant size to control
  - Target fewer species
- Could compare this to what a good PRE herbicide could do for you
Trt. 8 (SOA 9)

*Roundup PowerMax* 44 fl oz/a + N-PaK AMS 3 qt/a

**POST I** (1-2” weeds) sprayed 6/28/13

*Roundup PowerMax* 22 fl oz/a + N-PaK AMS 3 qt/a

**POST II** (14 days after) sprayed 7/1/13

July 26, 2013  33% GIRW Control

August 15, 2013  28% GIRW Control

Sept. 6, 2013  23.8 bu.a (b)
Trt. 8 (SOA 9)
*Roundup PowerMax* 44 fl oz/a + N-PaK AMS 3 qt/a
POST I (1-2” weeds) sprayed 6/28/13
*Roundup PowerMax* 22 fl oz/a + N-PaK AMS 3 qt/a
POST II (14 days after) sprayed 7/1/13

Can’t overpower with glyphosate!
(SOA 9)

July 26, 2013  33% GIRW Control

August 15, 2013  28% GIRW Control

Sept. 6, 2013  23.8 bu.a (b)
Trt 12
*Sonic 6.4 oz/a (SOA 2 & 14)*
PRE sprayed on 6/13/13
*Flexstar GT* 3.5 pt/a + 28% UAN 2.5% V/V + MSO 1% V/V *(SOA 9 & 14)*
POST II (1-2” weeds) sprayed 7/1/13

June 28, 2013  PRE = 43% GIRW Control

Aug 15, 2013  91% GIRW Control

Sept. 6, 2013  32.4 bu.a (a)
Trt 12
*Sonic 6.4 oz/a (SOA 2 & 14)*
PRE sprayed on 6/13/13

*Flexstar GT* 3.5 pt/a + 28% UAN 2.5% V/V + MSO 1% V/V *(SOA 9 & 14)*
POST II (1-2” weeds) sprayed 7/1/13

ALS Chemistry is not working, either. *(SOA 2)*

*Firstrate AuthorityFirst* Sonic

July 1, 2013

Aug 15, 2013 91% GIRW Control
Sept. 6, 2013 32.4 bu.a (a)
3 weeks after application

ALS (FirstRate) (1x)  Untreated

2012
Trt. 14

*Prefix 2 pt/a (SOA 14 & 15)*

**PRE** sprayed on 6/13/13

*Cobra* 12.5 fl oz/a + 28% UAN 2.5% V/V + COC 0.5% V/V  *(SOA 14)*

**POST II** (1-2” weeds) sprayed 7/1/13

---

**June 28, 2013**  PRE = 51% GIRW Control

**Aug 15, 2013**  92% GIRW Control

**Sept. 6, 2013**  33.9 bu.a (a)
Trt. 11

Verdict 5 oz/a (SOA 14 & 15)
PRE sprayed on 6/13/13

*Flexstar GT* 3.5 pt/a + 28% UAN 2.5% V/V + MSO 1% V/V (SOA 9 & 14)
POST II (1-2” weeds) sprayed 7/1/13

---

June 28 PRE = 40% GIRW Control

Aug 15, 2013  91% GIRW Control

Sept. 6, 2013  33.7 bu.a (a)
Trt. 13

**Verdict 5 oz/a (SOA 14 & 15)**

**PRE** sprayed on 6/13/13

*Cobra* 12.5 fl oz/a + 28% UAN 2.5% V/V + COC 0.5% V/V *(SOA 14)*

**POST II** (1-2” weeds) sprayed 7/1/13

---

**July 1, 2013**  
PRE = 38% GIRW Control

**Aug 15, 2013**  
97% GIRW Control

**Sept. 6, 2013**  
29.7 bu.a (a)
Trt. 10

**Flexstar GT** 3.5 pt/a + 28% UAN 2.5% V/V + MSO 1% V/V *(SOA 9 & 14)*

**POST I** (1-2” weeds) sprayed 6/28/13

**Cobra** 12 fl oz/a + 28% UAN 4% V/V + COC 0.5% V/V *(SOA 14)*

**POST IV** (14 days after) sprayed 7/15/13

---

**July 15, 2013**  
86% GIRW Control

**Aug 15, 2013**  
99% GIRW Control

**Sept. 6, 2013**  
33.5 bu.a (a)
Trt. 17

*Liberty 280* 28 fl oz/a + **N-PaK AMS** 3 qt/a

**POST I** (1-2” weeds) sprayed 6/28/13

*Liberty 280* 28 fl oz/a + **N-PaK AMS** 3 qt/a

**POST IV** (14 days after) sprayed 7/15/13

---

**July 15, 2013** 60% GIRW Control

**Aug 15, 2013** 93% GIRW Control

**September 6, 2013**
Trt. 17

*Liberty 280* 28 fl oz/a + *N-PaK AMS* 3 qt/a

**POST I** (1-2” weeds) sprayed 6/28/13

*Liberty 280* 28 fl oz/a + *N-PaK AMS* 3 qt/a

**POST IV** (14 days after) sprayed 7/15/13

**NEED SOA 10 and/or 14 to control this population.**

July 15, 2013  60% GIRW Control

Aug 15, 2013  93% GIRW Control

September 6, 2013
Resistant GIRW Site 2014

- Planted May 23, 2014
  - plot area in 2013 did not go to seed
- Need to use PPOs, Liberty (SOA 14, 10)
- Three pass systems
  - PRE / POST I / POST II
  - POST I / POST II
    - Must be well-timed, 2” giant ragweed
- Other options
  - Metribuzin (SOA 5)  Lorox (SOA 7)
Trt. 16 (SOA 9 / 9)
Glyphosate Check

*Roundup PowerMax* 32 oz/a + N-Pak AMS 3.3 gal/100 gal

**POST I** (2 in GIRW) sprayed 6/6/14

*Roundup PowerMax* 32 oz/a + N-Pak AMS 3.3 gal/100 gal

**POST II** (2 in GIRW regrowth) sprayed 7/03/14

July 16, 2014

Giant ragweed control = 48%

August 6, 2014
Trt. 8 (SOA 2, 14, 15 / 9, 14)

*Dual Magnum* 16 oz/a + *Sonic* 6.4 oz wt/a

**PRE** sprayed 5/24/14

*Roundup PowerMax* 32 oz/a + *Cobra* 12 oz/a + COC 1.5 pt/a + N-Pak AMS 3.3 gal/100 gal

**POST I** (2 in GIRW) sprayed 6/6/14

71% Injury

---

*June 5, 2014*

69% Control

*August 6, 2014*

65% Control
Trt. 4 (SOA 5, 14, 15 / 9, 14)

Fierce 3 oz wt/a + Metribuzin 5 oz wt/a
PRE sprayed 5/24/14

Cobra 12 oz/a + Roundup PowerMax 32 oz/a + COC 1.5 pt/a + N-Pak AMS 3.3 gal/ 100 gal
POST I (2 in GIRW) sprayed 6/6/14

76% Injury

Fierce alone and with Lorox Classic FirstRate = ~85% Control

June 5, 2014 85% Control  August 6, 2014 82% Control
Trt. 7 (SOA 2, 5, 14 / 9, 14)

Gangster V 2.5 oz wt/a + Gangster FR 0.5 oz wt/a + Metribuzin 5 oz wt/a
PRE sprayed 5/24/14

Cobra 12 oz/a + Roundup PowerMax 32 oz/a + COC 1.5 pt/a + N-Pak AMS 3.3 gal/100 gal
POST I (2 in GIRW) sprayed 6/6/14

75% Injury

August 6, 2014

83% Control

June 5, 2014

77% Control
Trt. 13 (SOA 14, 15 / 9, 14)

*Prefix* 2 pt/a + *Sharpen* 1 oz/a

PRE sprayed 5/24/14

*Cobra* 12 oz/a + *Roundup PowerMax* 32 oz/a + COC 1.5 pt/a + N-Pak AMS 3.3 gal/100 gal

POST I (2 in GIRW) sprayed 6/06/14

73% Injury

June 5, 2014 85% Control

August 6, 2014 92% Control
Trt. 15 (SOA 9, 14, 15 / 14)

Prefix 2 pt/a + Roundup PowerMax 32 oz/a + NIS 0.125% v/v + N-Pak AMS 3.3 gal/100 gal

POST I (2 in GIRW) sprayed 6/6/14

Cobra 12 oz/a + COC 1.5 pt/a + N-Pak AMS 3.3 gal/100 gal

POST II (2 in GIRW regrowth) sprayed 7/03/14

August 6, 2014
76% Control

June 30, 2014
76% Control

46% Injury

75% Injury

92% Control
Trt. 14 (SOA 9, 14 / 14)

*Flexstar GT* 3.5 pt/a + COC 1 % v/v + N-Pak AMS 3.3 gal/100 gal

**POST I** (2 in GIRW) sprayed 6/6/14

*Cobra* 12 oz/a + COC 1.5 pt/a + N-Pak AMS 3.3 gal/100 gal

**POST II** (2 in GIRW regrowth) sprayed 7/03/14

---

**August 6, 2014**

60% Injury

**June 30, 2014**

72% Control

**August 6, 2014**

91% Control
Trt. 12 (2, 14 / 9, 14 / 14)

Authority First 6.4 oz wt/a  PRE sprayed 5/24/14

Flexstar GT 3.5 pt/a + COC 1% v/v + N-Pak AMS 3.3 gal/100 gal

POST I (2 in GIRW) sprayed 6/6/14

Cobra 12 oz/a + COC 1.5 pt/a + N-Pak AMS 3.3 gal/100 gal

POST II (2 in GIRW regrowth) sprayed 7/03/14

3-Pass Systems

77% Control

June 30, 2014  91% Control

August 6, 2014  97% Control

60% Injury
Trt. 10 (SOA 14, 15 / 14 / 9, 14)

**Verdict** 5 oz/a   **PRE** sprayed 5/24/14

*Cobra* 12 oz/a + COC 1.5 pt/a + N-Pak AMS 3.3 gal/ 100 gal

**POST I** (2 in GIRW) sprayed 6/6/14

*Roundup PowerMax* 32 oz/a + *Cobra* 12 oz/a + COC 1.5 pt/a + N-Pak AMS

**POST II** (2 in GIRW regrowth) sprayed 7/03/14

- **95% Control**
- **70% Control**
- **68% Injury**
- **79% Injury**
- **98% Control**
Trt. 1 (SOA 14, 15 / 14 / 9)

**Fierce** 3 oz wt/a PRE sprayed 5/24/14

* Cobra 12 oz/a + COC 1.5 pt/a + N-Pak AMS 3.3 gal/100 gal

**POST I** (2 in. GIRW) sprayed 6/6/14

* Roundup PowerMax 32 oz/a + *Cobra* 12 oz/a + COC 1.5 pt/a + N-Pak AMS 3.3 gal/100 gal

**POST II** (2 in regrowth) sprayed 7/03/14

---

**August 6, 2014**

96% Control

**July 10, 2014**

83% Control

74% Injury

**July 5, 2014**

83% Control

74% Injury
Trt. 17 (SOA 14, 15 / 10 / 10)

Verdict 5 oz/a PRE sprayed 5/24/14
Liberty 280 29 oz/a + N-Pak AMS 3.3 gal/100 gal
POST I (2 in GIRW) sprayed 6/6/14
Liberty 280 29 oz/a + N-Pak AMS 3.3 gal/100 gal
POST II (2 in GIRW regrowth) sprayed 7/03/14

16% Injury
10% Injury

June 30, 2014 96% Control
August 6, 2014 96% Control
Lessons Learned

- There are challenges with achieving acceptable control of a SOA 2- and SOA 9- resistant giant ragweed population in soybean.

- Over 95% control of giant ragweed was ONLY achieved with the three-pass systems:
  - PRE followed by two well-timed POST herbicide applications (2” giant ragweed)
  - Relied on the of SOA 10 and/or SOA 14 to achieve this level of control
  - **WARNING** - Over-reliance on SOA 10 and 14 without a diversified plan destines these SOA’s to failure.
Lessons Learned cont.

- The average weed control with the two-pass systems was between 65 – 85%.
  - Selected treatments reached 90-92% (3 of 13)

- SOA group 14 herbicides reminds us of the crop phytotoxicity that must be accepted by farmers to achieve satisfactory control

- It also demonstrates the need for an integrated system, one that includes non-chemical approaches to manage weed populations with multiple SOA resistance.
<table>
<thead>
<tr>
<th>#</th>
<th>Species</th>
<th>Country</th>
<th>First Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Acalypha australis</em>&lt;br&gt;Asian Copperleaf</td>
<td>2011 - China</td>
<td>2011</td>
</tr>
<tr>
<td>2</td>
<td><em>Amaranthus quitensis</em>&lt;br&gt;Mucronate Pigweed</td>
<td>2005 - Bolivia</td>
<td>2005</td>
</tr>
<tr>
<td>3</td>
<td><em>Amaranthus tuberculatus</em> (&lt;i&gt;=A. rudis&lt;/i&gt;)&lt;br&gt;Tall Waterhemp</td>
<td>2001 - United States (Kansas)&lt;br&gt;*Multiple - 2 SOA's&lt;br&gt;2002 - United States (Illinois)&lt;br&gt;*Multiple - 3 SOA's&lt;br&gt;2005 - United States (Missouri)&lt;br&gt;*Multiple - 3 SOA's&lt;br&gt;2009 - United States (Illinois)&lt;br&gt;*Multiple - 4 SOA's&lt;br&gt;2009 - United States (Iowa)&lt;br&gt;2014 - United States (Indiana)</td>
<td>2001</td>
</tr>
<tr>
<td>4</td>
<td><em>Ambrosia artemisiifolia</em>&lt;br&gt;Common Ragweed</td>
<td>2005 - United States (Delaware)&lt;br&gt;*Multiple - 2 SOA's&lt;br&gt;2006 - United States (Ohio)&lt;br&gt;*Multiple - 2 SOA's</td>
<td>2005</td>
</tr>
</tbody>
</table>
Trt. 22 (SOA 9, 14 / 9)
*Roundup PowerMax* 32 oz/a + *Cobra* 12.5 oz/a + *COC* 1 pt/a + *N-Pa-K AMS* 3 qt/a

**POST I** (2” weeds) sprayed 6/13/14
*Roundup PowerMax* 32 oz/a + *N-Pa-K AMS* 3qt/a

**LATE POST IV** sprayed 7/03/14

June 16, 2014  
65% Injury

94% Control  
July 28, 2014  
98% Control
Trt. 22 (SOA 9, 14 / 9)

**Roundup PowerMax** 32 oz/a + **Cobra** 12.5 oz/a + **COC** 1 pt/a + **N-Pa-K AMS** 3 qt/a

**POST I** (2” weeds) sprayed 6/13/14

**Roundup PowerMax** 32 oz/a + **N-Pa-K AMS** 3qt/a

**LATE POST IV** sprayed 7/03/14

**98% Control**
Trt. 25 (SOA 14, 15 / 9, 14)

**Verdict** 5.0 oz/a + **Dual II Magnum** 1.33 pt/a  
**PRE** sprayed 5/21/14

*Cobra* 12.5 oz/a + **Roundup PowerMax** 32 oz/a + **COC** 1 pt/a + **N-Pa-K AMS** 3 qt/a  
**POST I** (2” weeds) sprayed 6/13/14

---

**June 16, 2014**

71% Injury

**July 28, 2014**

97% Control  

88% Control
Trt. 25 (SOA 14, 15 / 9, 14)

**Verdict** 5.0 oz/a + **Dual II Magnum** 1.33 pt/a  
PRE sprayed 5/21/14

**Cobra** 12.5 oz/a + **Roundup PowerMax** 32 oz/a + **COC** 1 pt/a + **N-Pa-K AMS** 3 qt/a  
POST I (2” weeds) sprayed 6/13/14

85% Control

35 bu/a
Trt. 26 (SOA 14, 15 / 9, 14,15)

Verdict 5.0 oz/a

PRE sprayed 5/21/14

Dual II Magnum 1.33 pt/a + Cobra 12.5 oz/a +
Roundup PowerMax 32 oz/a + COC 0.5 pt/a + N-Pa-K AMS 3 qt/a

POST I (2” weeds) sprayed 6/13/14

71% Injury

June 16, 2014  97% Control  July 28, 2014  85% Control
Trt. 26 (SOA 14, 15 / 9, 14,15)

Verdict 5.0 oz/a  PRE sprayed 5/21/14
Dual II Magnum 1.33 pt/a + Cobra 12.5 oz/a +
Roundup PowerMax 32 oz/a + COC 0.5 pt/a + N-Pa-K AMS 3 qt/a
POST I (2” weeds) sprayed 6/13/14

AUG 11, 2014  81% Control

33 bu/a

Sept 5, 2014
Trt. 27 (SOA 14, 15 / 9, 14, 15 / 14)
Verdict 5 oz/a PRE sprayed 5/21/14
Dual II Magnum 1.33 pt/a + Cobra 12.5 oz/a +
Roundup PowerMax 32 oz/a + COC 0.5 pt/a + N-PaK AMS 3 qt/a
POST I (2” weeds) sprayed 6/13/14
Cobra 12.5 oz/a + COC 0.5 pt/a + N-PaK AMS 3 qt/a
LATE POST IV sprayed 7/03/14

June 16, 2014 73% Injury 95% Control
July 7, 2014 60% Injury 99% Control
Trt. 27 (SOA 14, 15 / 9, 14, 15 / 14)
Verdict 5 oz/a  PRE sprayed 5/21/14
Dual II Magnum 1.33 pt/a + Cobra 12.5 oz/a +
Roundup PowerMax 32 oz/a + COC 0.5 pt/a + N-PaK AMS 3 qt/a
POST I (2” weeds) sprayed 6/13/14
Cobra 12.5 oz/a + COC 0.5 pt/a + N-PaK AMS 3 qt/a
LATE POST IV sprayed 7/03/14

AUG 11, 2014
98% Control

43 bu/a

Sep 5, 2014
Not on my Farm?

• Farmers will find a reason to not do IPM with weeds.

• Unfortunately, farmers seem reluctant to implement a proactive system until failure occurs on their farm.

• Even then, the tactic of choice tends to be another herbicide, rather than an integrated system that includes non-chemical approaches.
Does glyphosate work as well today as it did when you first used it?*

*\(n\) = 2009 (185), 2010 (745), 2011 (214), 2012 (717), 2013 (1,035), 2014 (610).

Stahl, Behnken, Brietenbach, Miller, Nicolai, University of MN 2014
Do you think you have glyphosate resistant weeds on your farm?

- 2008: 31%
- 2010: 35%
- 2012: 53%
- 2014: 66%
Do you think you have glyphosate resistant weeds on your farm?

- 2008 = 31%
- 2010 = 35%
- 2012 = 53%
- 2014 = 66%
<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Setaria viridis var. major (=var. robusta-alba, var. robustapurpurea) Giant Green Foxtail</th>
<th>ACCase inhibitors (A/1)</th>
<th>fenoxaprop-P-ethyl, fluazifop-P-butyl</th>
<th>Jeffrey Gunsolus</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1999</td>
<td><strong>Setaria viridis var. major (=var. robusta-alba, var. robustapurpurea)</strong> Giant Green Foxtail</td>
<td>ACCase inhibitors (A/1)</td>
<td>fenoxaprop-P-ethyl, fluazifop-P-butyl, sethoxydim</td>
<td>Jeffrey Gunsolus</td>
</tr>
<tr>
<td>13</td>
<td>1999</td>
<td>Ambrosia trifida Giant Ragweed</td>
<td>EPSP synthase inhibitors (G/9)</td>
<td>glyphosate</td>
<td>Jeffrey Gunsolus, Jeff Stachler</td>
</tr>
<tr>
<td>14</td>
<td>2006</td>
<td>Amaranthus tuberculatus (=A. rudis) Tall Waterhemp</td>
<td>EPSP synthase inhibitors (G/9)</td>
<td>glyphosate</td>
<td>Jeffrey Gunsolus, Jeff Stachler</td>
</tr>
<tr>
<td>15</td>
<td>2007</td>
<td>Amaranthus tuberculatus (=A. rudis) Tall Waterhemp</td>
<td><strong>Multiple Resistance: 2 Sites of Action</strong> ALS inhibitors (B/2) EPSP synthase inhibitors (G/9)</td>
<td>glyphosate, imazapyr, thifensulfuron-methyl</td>
<td>Jeffrey Gunsolus, Jeff Stachler</td>
</tr>
<tr>
<td>16</td>
<td>2007</td>
<td>Ambrosia artemisiifolia Common Ragweed</td>
<td>EPSP synthase inhibitors (G/9)</td>
<td>glyphosate</td>
<td>Jeffrey Gunsolus, Mike Christoffers, Jeff Stachler</td>
</tr>
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<td>17</td>
<td>2008</td>
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<td><strong>Multiple Resistance: 2 Sites of Action</strong> ALS inhibitors (B/2) EPSP synthase inhibitors (G/9)</td>
<td>cloransulam-methyl, glyphosate</td>
<td>Jeffrey Gunsolus, Jeff Stachler</td>
</tr>
<tr>
<td>18</td>
<td>2008</td>
<td>Ambrosia artemisiifolia Common Ragweed</td>
<td><strong>Multiple Resistance: 2 Sites of Action</strong> ALS inhibitors (B/2) EPSP synthase inhibitors (G/9)</td>
<td>cloransulam-methyl, glyphosate, imazapyr</td>
<td>Jeffrey Gunsolus, Mike Christoffers, Jeff Stachler</td>
</tr>
</tbody>
</table>
Ideas to Ponder

• Delay planting
• Manage seedbank?
• Tillage?
• Map weed populations?
• What are we leaving for the next generation
• Waterhemp or ragweed?
• Attend Jared Goplen’s presentation tomorrow.
Looking for a Christmas gift for your kids?