Weeds Management in Sugarbeet

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North Dakota State University and the University of Minnesota
Sugarbeet Weed Control Team

• Aaron Carlson
  – Farm background from Central MN dairy country
  – Crop and Weed major at NDSU from 2000 - 2004
  – MS Weed Science 2006 under Dr. Alan Dexter
  – Research Specialist in Extension Sugarbeet Program
  – Enjoys hunting, sports and spending time
    with wife, Katie, and 3 boys, Austin, Ben and Cody
Weed control summary according to the 2014 growers survey

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of in-season glyphosate applications</th>
<th>Glyphosate applied (lb/A)</th>
<th>Ave. glyphosate use rate (lb/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>2.3</td>
<td>2.19</td>
<td>0.97</td>
</tr>
<tr>
<td>2013</td>
<td>2.2</td>
<td>2.11</td>
<td>0.96</td>
</tr>
<tr>
<td>2012</td>
<td>2.0</td>
<td>2.32</td>
<td>1.16</td>
</tr>
<tr>
<td>2011</td>
<td>2.4</td>
<td>2.21</td>
<td>0.92</td>
</tr>
<tr>
<td>2010</td>
<td>2.4</td>
<td>2.09</td>
<td>0.87</td>
</tr>
<tr>
<td>2009</td>
<td>2.2</td>
<td>1.85</td>
<td>0.84</td>
</tr>
</tbody>
</table>

- Sugarbeet farmers make between 2 and 3 sequential glyphosate applications
- Total pounds of glyphosate active are trending greater
- Average glyphosate use rate is increasing
Satisfaction to RR Sugarbeet system, 2014 growers survey

<table>
<thead>
<tr>
<th>Year</th>
<th>No Response</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>7</td>
<td>59</td>
<td>29</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>2013</td>
<td>6</td>
<td>70</td>
<td>22</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2012</td>
<td>23</td>
<td>59</td>
<td>12</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>2011</td>
<td>9</td>
<td>74</td>
<td>11</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2010</td>
<td>9</td>
<td>72</td>
<td>14</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2009</td>
<td>10</td>
<td>78</td>
<td>10</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

- Growers are reporting excellent results with the RR Sugarbeet system.
- Percent growers reporting good results is increasing. Why?
There are tough-to-control weeds in sugarbeet depending on where you farm...

- Common ragweed
- Kochia
- Waterhemp
- Giant ragweed
- Lambsquarters
INTRODUCTION – the problem

**Waterhemp**
- Amaranthus sp.
- Extended germination
- Rapid growth
- Tremendous seed production
- 13% of 2013 survey respondents’ “worst weed”
- 44% in 2014
MATERIALS & METHODS

- Waterhemp control in sugarbeet
- Trials at 3 locations, Lake Lillian, Herman and Moorhead, MN
- Herman, MN - 3 experiments
  - Planted May 30, 2014
  - ‘Crystal 981RR’ in 22” rows
  - Treat center 4 rows of 6 row plots
  - 8002XR nozzles - 3 mph - 40 psi - 17 gpa
  - PPI treatments incorporated with rotary tiller
  - PRE treatments applied May 30
  - Three POST applications
### POSTEMERGENCE Application

<table>
<thead>
<tr>
<th>Date</th>
<th>Application 1</th>
<th>Application 2</th>
<th>Application 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugarbeet</td>
<td>June 23</td>
<td>July 2</td>
<td>July 10</td>
</tr>
<tr>
<td>4 - 6 if</td>
<td>7 - 9 if</td>
<td>10 - 12 if</td>
<td></td>
</tr>
<tr>
<td>Waterhemp</td>
<td>2.5 inch</td>
<td>5 inch</td>
<td>11 inch</td>
</tr>
</tbody>
</table>

**All treatments applied with adjuvants:**

1. **PowerMax + Ethofumesate or Betamix or UpBeet** = AMS 8.5 lb/100gal + HSMOC 1.5 pt/A

2. **PowerMax alone or + Stinger** = AMS 8.5 lb/100gal + NIS 0.25%v/v
Roundup PM + NIS + AMS applied sequentially at 28 to 32oz/A, Herman MN
Roundup PM + NIS + AMS applied sequentially at 28 to 32oz/A at Herman MN
Roundup PM + NIS + AMS applied sequentially at 28 to 32oz/A at Herman MN.
RESULTS - Postemergence

Waterhemp Control - Aug. 27, 2014

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerMax 28/28/22 fl oz</td>
<td>c</td>
</tr>
<tr>
<td>+ Betamix 10/16/24 fl oz</td>
<td>a</td>
</tr>
<tr>
<td>+ Ethofumesate 4/4/4 fl oz</td>
<td>a</td>
</tr>
<tr>
<td>+ UpBeet 0.75/0.75 oz</td>
<td>ab</td>
</tr>
<tr>
<td>+ Stinger 2/2/2 fl oz</td>
<td>c</td>
</tr>
</tbody>
</table>
glyphosate - 14 dat

glyphosate + ethofumesate - 14 dat
What is going on?

- Biotypes are genetically the same
- Biotypes may have the same appearance (but not always)
- Biological traits in some plants that are not common to the population as a whole

- Weed shifts occur when glyphosate controls some biotypes but not all
- Over time, the resistant biotypes become the predominant waterhemp in the field
Emergence of four annual weed species. Adapted from Norby, Hartzler and Bradley, 2007
What can one learn about the biology of the weed that will impact control strategy

Think like a weed

- Understand its life cycle, summer annual
- Growth habit, 4-5 feet tall
- Reproductive habit, dioecious, male and female flowers on separate plants
- Longevity in soil, 6 years
- When does it germinate, Early June through July
- How did it respond to tillage, light and temperature responsible for germination/dormancy
- Shallow or deep, at our near the soil surface
- Seed production, prolific, 142,000
Weed seed survival in soil: Burnside et. al., Weed Sci: 44; 74-85

<table>
<thead>
<tr>
<th>Species</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>8</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green foxtail</td>
<td>99</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Common lambsquarters</td>
<td>28</td>
<td>53</td>
<td>43</td>
<td>40</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td>Kochia</td>
<td>100</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Redroot pigweed</td>
<td>66</td>
<td>69</td>
<td>38</td>
<td>40</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Waterhemp</td>
<td>40</td>
<td>42</td>
<td>39</td>
<td>24</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Russian thistle</td>
<td>73</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
# LAY-BY

<table>
<thead>
<tr>
<th></th>
<th>Application 1</th>
<th>Application 2</th>
<th>Application 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>June 23</td>
<td>July 2</td>
<td>July 10</td>
</tr>
<tr>
<td>Sugarbeet</td>
<td>4 - 6 lf</td>
<td>7 - 9 lf</td>
<td>10 - 12 lf</td>
</tr>
<tr>
<td>Waterhemp</td>
<td>2.5 inch</td>
<td>5 inch</td>
<td>11 inch</td>
</tr>
</tbody>
</table>

- All treatments applied with adjuvants:
  1. PowerMax + Ethofumesate = AMS 8.5 lb/100gal + HSMOC 1.5 pt/A
  2. PowerMax alone or + other herbicide = AMS 8.5 lb/100gal + NIS 0.25%v/v

- Lay-by herbicides applied in application 1
RESULTS – Lay-by

Waterhemp Control – Aug. 27, 2014

PowerMax 28/28/22 fl oz

Dual Magnum 1 pt

Warrant 3 pt

Outlook 0.75 pt

Outlook 0.75 pt + Warrant 2.25 pt
RESULTS – Lay-by

Waterhemp Control – Aug. 27, 2014

- PowerMax
- Dual Magnum
- Warrant
- Outlook
- Outlook+

+ Ethofumesate 4 / 4 / 4 fl oz
PowerMax +
Outlook - 48 dat

PowerMax +
Outlook +
Ethofumesate - 48 dat
<table>
<thead>
<tr>
<th>Date</th>
<th>PPI / PRE</th>
<th>glyphosate 1</th>
<th>glyphosate 2</th>
<th>glyphosate 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugarbeet</td>
<td>May 30</td>
<td>June 23</td>
<td>July 2</td>
<td>July 10</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>4 - 6 lf</td>
<td>7 - 9 lf</td>
<td>10 - 12 lf</td>
</tr>
<tr>
<td>Waterhemp</td>
<td>-</td>
<td>2.5 inch</td>
<td>5 inch</td>
<td>11 inch</td>
</tr>
</tbody>
</table>

- All POST PowerMax treatments applied with AMS at 8.5 lb/100gal + NIS at 0.25% v/v
RESULTS – PRE & PPI

Waterhemp Control – Aug. 27, 2014

Dual Magnum
0.5 pt PRE

Dual 0.5 pt
+ Etho 3 pt PRE

Dual Magnum
1 pt PRE

Dual 1 pt
+ Etho 3 pt PRE

PowerMax
28/28/22 fl oz

Legend:
c, abc, a, ab, e

Note: The bar chart shows the percentage of waterhemp control for different treatments on August 27, 2014.
RESULTS – PRE & PPI

Sugarbeet stand
Percent of ‘glyphosate only’ treatment – June 23, 2014

- PowerMax 28/28/22: a
- Dual Magnum 0.5 pt PRE: ab
- Dual 0.5 pt + Etho 3 pt PRE: abc
- Dual Magnum 1 pt PRE: abc
- Dual 1 pt + Etho 3 pt PRE: d
RECOMMENDATION TO GROWERS

1. Waterhemp as a minor weed
   a. glyphosate 0.98 / 0.98 / 0.77 (PowerMax 28/28/22 fl oz)** + ethofumesate 4 / 4 / 4 fl oz + AMS + HSMOC Known resistance, but low to moderate infestation
   b. glyphosate 0.98 / 0.98 / 0.77** + ethofumesate 4 / 4 / 4 fl oz + AMS + HSMOC + lay-by herbicide (2 fl sgbt)

2. Known resistance, moderate to heavy infestation
   a. PRE Dual Magnum 0.75 pt fb glyphosate 0.98 / 0.98 / 0.77** + ethofumesate 4 / 4 / 4 fl oz + AMS + HSMOC

** glyphosate at 1.125 lb/A (PowerMax 32 fl oz) if one application before V8 sugarbeet stage
Kochia

- Extremely competitive weed; a few plants can cause yield reduction
- Many document examples of herbicide resistance
  - 2,4-D and MCPA
  - ALS
  - glyphosate
- The power of the crop sequence, herbicides in small grains
- Spray weeds postemergence when they are small
- Kochia seeds loose viability after one year
- Equipment cleanout; a hygienics approach
Kochia control in sugarbeet

1. Light to moderate infestations of kochia; glyphosate susceptible kochia
   • Roundup PowerMax at 28 fl oz/A plus ethofumesate at 4 fl oz/A and AMS plus HSMOC
   • Make a repeat application approximately 14 days following the first application

2. Moderate infestations of kochia, glyphosate resistant kochia
   • Roundup PowerMax at 28 fl oz/A + ethofumesate at 4 fl oz/A + Betamix at 8 fl oz to 32 fl oz/A depending on infestation and sugarbeet growth stage
   • Apply with AMS plus HSMOC
   • Make a repeat application approximately 14 days following the first application.

3. Moderate to heavy kochia
   • Ethofumesate applied preemergence at 6 to 7.5 pt/A followed by PowerMax at 28 fl oz/A plus ethofumesate at 4 fl oz/A
   • Scout and determine if Betamix should be added to the tank-mix
   • Apply with AMS plus HSMOC
   • Make a repeat application approximately 14 days following the first application
Sugarbeet injury and control of common ragweed, Mayville, ND, 2014

Up to one inch common ragweed

<table>
<thead>
<tr>
<th>Herbicide Treatment(^1)</th>
<th>Rate</th>
<th>July 7 sgbt inj</th>
<th>July 14 cora cntl</th>
<th>July 25 cora cntl</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>fl oz/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMax / PMax / PMax</td>
<td>28 / 28 /22</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMax+Stinger / PMax+Stinger / PMax</td>
<td>28+2 / 28+2 / 22</td>
<td>3</td>
<td>89</td>
<td>88</td>
</tr>
<tr>
<td>PMax+Stinger / PMax+Stinger / PMax</td>
<td>28+4 / 28+4 / 22</td>
<td>9</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td></td>
<td>10</td>
<td>14</td>
<td>11</td>
</tr>
</tbody>
</table>

\(^1\)All treatments were applied with N-Pak AMS at 2.5% v/v and Prefer 90 NIS at 0.25% v/v

\(^2\)PMax is Roundup PowerMax
Sugarbeet injury and control of common ragweed, Mayville, ND, 2014

Up to two inch common ragweed

<table>
<thead>
<tr>
<th>Herbicide Treatment¹</th>
<th>Rate</th>
<th>July 7 sgbt inj</th>
<th>July 7 cora cntl</th>
<th>July 14 cora cntl</th>
<th>July 25 cora cntl</th>
</tr>
</thead>
<tbody>
<tr>
<td>fl oz/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMax / PMax / PMax</td>
<td>28 / 28 / 22</td>
<td>11</td>
<td>81</td>
<td>76</td>
<td>75</td>
</tr>
<tr>
<td>PMax+Stinger / PMax+Stinger / PMax</td>
<td>28+2 / 28+2 / 22</td>
<td>14</td>
<td>84</td>
<td>83</td>
<td>89</td>
</tr>
<tr>
<td>PMax+Stinger / PMax+Stinger / PMax</td>
<td>28+4 / 28+4 / 22</td>
<td>10</td>
<td>84</td>
<td>84</td>
<td>93</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td></td>
<td>10</td>
<td>14</td>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

¹All treatments were applied with N-Pak AMS at 2.5% v/v and Prefer 90 NIS at 0.25% v/v
²PMax is Roundup PowerMax
Sugarbeet injury and control of common ragweed, Mayville, ND, 2014

Greater than two inch common ragweed

<table>
<thead>
<tr>
<th>Herbicide Treatment(^1)</th>
<th>Rate</th>
<th>July 7 sgbt inj</th>
<th>July 7 cora cntl</th>
<th>July 14 cora cntl</th>
<th>July 25 cora cntl</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>fl oz/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMax / PMax / PMax</td>
<td>28 / 28 / 22</td>
<td>-</td>
<td>64</td>
<td>68</td>
<td>82</td>
</tr>
<tr>
<td>PMax+Stinger / PMax+Stinger / PMax</td>
<td>28+2 / 28+2 / 22</td>
<td>-</td>
<td>59</td>
<td>72</td>
<td>84</td>
</tr>
<tr>
<td>PMax+Stinger / PMax+Stinger / PMax</td>
<td>28+4 / 28+4 / 22</td>
<td>-</td>
<td>63</td>
<td>76</td>
<td>91</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td></td>
<td>-</td>
<td>14</td>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

\(^1\)All treatments were applied with N-Pak AMS at 2.5% v/v and Prefer 90 NIS at 0.25% v/v

\(^2\)PMax is Roundup PowerMax
Control of common ragweed, one inch or less

- PowerMax plus Stinger, 28 fl oz + 2 fl oz fb
- PowerMax plus Stinger, 28 fl oz + 2 fl oz fb
- PowerMax, 22 fl oz

- PowerMax, 28 fl oz fb
- PowerMax, 28 fl oz fb
- PowerMax, 22 fl oz
Control of common ragweed, two inches or less

PowerMax plus Stinger, 28 fl oz + 4 fl oz fb
PowerMax plus Stinger, 28 fl oz + 4 fl oz fb
PowerMax, 22 fl oz

PowerMax, 28 fl oz fb PowerMax, 28 fl oz fb
PowerMax, 22 fl oz
Recommendations for common ragweed control

• For common ragweed control less than one-inch tall
  – Roundup PowerMax at 28 fl oz/A plus Stinger at 2 fl oz/A
  – Make a repeat application approximately 14 days following the first application.

• For common ragweed control less than two-inches tall
  – Roundup PowerMax at 28 fl oz/A plus Stinger at 3 fl oz/A
  – Make a repeat application approximately 14 days following the first application.

• For common ragweed control in fields that are up to four-inches tall
  – Roundup PowerMax at 28 fl oz/A plus Stinger at 4 fl oz/A or
  – Roundup PowerMax at 28 fl oz/A plus Stinger at 2 fl oz/A plus either ethofumesate at 4 fl oz/A, UpBeet at 0.5 oz/A or Betamix at 12 fl oz/A
  – Make a repeat application approximately 14 days following the first application.

**Use AMS at 8.5-17 lb per 100 gallon and NIS surfactant at 0.25% v/v; use HSMOC at 1.5 pt/A with ethofumesate or Betamix**
Spring-seeded cereal cover crops offer several purposes to sugarbeet growers

- Reduce stand loss from wind and blowing soil
- Phosphorus credits in exchanging for operating the factory at SMBSC
- Suppress weeds
- Improve soil health
Weed Control with Cover Crop

- Cover crops used on 35 – 40% of ND & MN beet acres in 2013
- Conflict between maintaining cover crop and controlling weeds with soil herbicides
## Weed Control with Cover Crop

<table>
<thead>
<tr>
<th>Treatment &amp; Rate</th>
<th>1 bu/a Oat Stand 6/5/13</th>
<th>3 bu/a Oat Stand 6/5/13</th>
<th>Herman Wahe cntl 9/5/13</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Soil Herbicide</td>
<td>#/ ¼ m² 28</td>
<td>#/ ¼ m² 81</td>
<td>1 bu/a 83</td>
</tr>
<tr>
<td>Dual Magnum 1 pt/a</td>
<td>31</td>
<td>81</td>
<td>100</td>
</tr>
<tr>
<td>Ethofumesate 4SC 3 pt/a</td>
<td>22 -20%</td>
<td>48 -40%</td>
<td>99</td>
</tr>
<tr>
<td>Ethofumesate 4SC 7 pt/a</td>
<td>12 -55%</td>
<td>23 -70%</td>
<td>100</td>
</tr>
<tr>
<td>LSD 5%</td>
<td>12</td>
<td>12</td>
<td>6</td>
</tr>
</tbody>
</table>

1All treatments received PowerMax 32 / 24 / 22 fl oz/a + AMS 8.5 lb/100 gal + NIS 0.25% v/v
Ground cover as a percent of counts in untreated control, across locations and cereals species, 19 to 27 DAP

<table>
<thead>
<tr>
<th>Rate (pt/A)</th>
<th>Foxhome</th>
<th>Crookston</th>
<th>Herman</th>
<th>Lake Lillian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Magnum</td>
<td>0.5</td>
<td>86%</td>
<td>79%</td>
<td>79%</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>58%</td>
<td>71%</td>
<td>61%</td>
</tr>
<tr>
<td>ethofumesate</td>
<td>2</td>
<td>32%</td>
<td>33%</td>
<td>28%</td>
</tr>
<tr>
<td>ethofumesate</td>
<td>3</td>
<td>32%</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td></td>
<td>14%</td>
<td>19%</td>
<td>13%</td>
</tr>
</tbody>
</table>
Herbicide treatments applied over wheat and barley at Crookston and Foxhome, 2014

Dual Magnum, 0.5 pt/A

ethofumesate, 2 pt/A
Sugarbeet as a percent of stand counts, across locations, 19 to 27 DAP

<table>
<thead>
<tr>
<th>Rate (pt/A)</th>
<th>Foxhome</th>
<th>Crookston</th>
<th>Herman*</th>
<th>Lake Lillian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Magnum</td>
<td>0.5</td>
<td>96</td>
<td>102</td>
<td>100</td>
</tr>
<tr>
<td>Dual Magnum</td>
<td>1</td>
<td>105</td>
<td>101</td>
<td>100</td>
</tr>
<tr>
<td>Ethofumesate</td>
<td>2</td>
<td>69</td>
<td>108</td>
<td>100</td>
</tr>
<tr>
<td>ethofumesate</td>
<td>3</td>
<td>80</td>
<td>98</td>
<td>100</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

* Visual assessment due to variation from excessive rainfall
Questions, Future Trial Considerations

1. Can spring seeded cover crops consistently suppress weeds?
2. Why did spring seeded cover crops respond differently to herbicides?
3. What is the impact of timing of soil-applied herbicide application?
4. What if Dual Magnum, Outlook or Warrant are applied lay-by over cover crops?
5. Is the timing correct for when cover crops are stopped?
A Systems Approach to Weeds Management
Weeds Management Systems Approach

• Scout and identify weeds; map fields
• Learn about the biology of weeds
• Develop a strategy
  – crop sequences
  – Herbicides from herbicide families
• 100 percent weed control in crops in the sequence is paramount
• Manage the RR chip
Use at least two and preferably three crops in the sequence; rotate to a different crop each year

Crops in the sequence...
- Have different planting and harvest dates
- Are planted at different row spacing and at different densities
- Have unique tillage needs; depth and timing of tillage
- Plant residue is managed differently
- Use a perennial sod crop if it fits your enterprise

Discuss with landlords and bankers about the necessity for implementing special practices or rotating into other crops

- Think strategy. Pick fields or a percent (i.e., 10%) of the operation to be targeted for special treatment
Sugarbeet - a component of the cropping sequence in fields

• The 2014 sugarbeet growers survey indicates sugarbeet follow
  – wheat, 54%
  – corn, 22%
  – soybean / drybean, 12%

• Sugarbeet is planted in a crop sequence in fields every third and fourth and fifth year, opinion\(^1\) vs. survey\(^2\)
  – 3\(^{rd}\) year, 60% 24%
  – 4\(^{th}\) year, 30% 37%
  – 5\(^{th}\) year, 10% 19%

\(^{1}\) Derived from dinner conversation with T Grove, S Poindexter, C Halfmann and M Khan
\(^{2}\) Results from ACS survey
Objective

Waterhemp control in fields planted to corn and soybean; fields that share the crop sequence with sugarbeet; a systems approach to weeds management

- provides greater than 90% visual waterhemp control; season-long control
- herbicides and herbicide families that compliment herbicides for sugarbeet
- Herbicides with residues that do not extend into the next season
- Cost per acre including cost of the seed (profitability)
## Weed control in corn, Herman, MN and Barney, ND, 2014

<table>
<thead>
<tr>
<th>Herbicide treatment¹</th>
<th>Appli</th>
<th>Herbicide rate (pt or fl oz/A)</th>
<th>19 Sep amata</th>
<th>14 Jul setvi</th>
<th>11 Jul cheal</th>
<th>11 Jul amare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harness + Sharpen</td>
<td>Pre</td>
<td>2 pt + 3 oz</td>
<td>98</td>
<td>100</td>
<td>94</td>
<td>100</td>
</tr>
<tr>
<td>Harness + Clarity/</td>
<td>Pre /</td>
<td>2 pt + 1 pt/</td>
<td>100</td>
<td>100</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Laudis + atrazine</td>
<td>Post</td>
<td>3 oz + 12 oz</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harness + atrazine /</td>
<td>2 pt +12 oz / 7.5 oz</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>Pre / Post</td>
<td>3 oz / 7.5 oz</td>
<td>96</td>
<td>95</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Sharpen / Status</td>
<td>Pre / Post</td>
<td>15 oz / 7.5 oz</td>
<td>100</td>
<td>99</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Laudis + atrazine</td>
<td>Post</td>
<td>3 oz + 12 oz</td>
<td>99</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

¹Laudis, atrazine and Status applied with MSO at 1.5 pt/A plus N-Pak AMS at 2.5% v/v
²no data
Application timing, cost per acre\(^1\), herbicide site of action\(^1\), and crop rotational restrictions\(^1\), corn herbicides

<table>
<thead>
<tr>
<th>Herbicide treatment(^1)</th>
<th>Appli</th>
<th>Herbicide rate (pt or fl oz/ A)</th>
<th>Cost/ A</th>
<th>SoA Families</th>
<th>Crop rotation(^2)</th>
<th>sgbt</th>
<th>soyb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harness + Sharpen</td>
<td>Pre</td>
<td>2 pt + 3 oz</td>
<td>$43.90</td>
<td>15, 14</td>
<td>NCS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harness + Clarity/Laudis + atrazine</td>
<td>Pre / Post</td>
<td>2 pt + 1 pt/ 3 oz + 12 oz</td>
<td>$54.00</td>
<td>15, 4 / 27, 5</td>
<td>10</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Harness + atrazine / Status</td>
<td>Pre / Post</td>
<td>2 pt + 12 oz / .5 oz</td>
<td>$56.00</td>
<td>15, 5 / 4, 19</td>
<td>NCS</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Sharpen / Status</td>
<td>Pre / Post</td>
<td>3 oz / 7.5 oz</td>
<td>$43.65</td>
<td>14 / 4, 19</td>
<td>6</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Verdict / Status</td>
<td>Pre / Post</td>
<td>15 oz / 7.5 oz</td>
<td>$53.75</td>
<td>14, 15 / 4, 19</td>
<td>NCS</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Laudis + atrazine</td>
<td>Post</td>
<td>3 oz + 12 oz</td>
<td>$18.75</td>
<td>5, 27</td>
<td>10</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)From 2015 North Dakota Weed Control Guide
\(^2\)NCS = next crop season, number of months
Weed control in soybean, Herman, MN and Barney, ND, 2014

<table>
<thead>
<tr>
<th>Herbicide treatment¹</th>
<th>Appli</th>
<th>Herbicide rate (pt or fl oz/A)</th>
<th>14 Jul glynmx</th>
<th>19 Sep amata</th>
<th>11 Jul cheal</th>
<th>11 Jul amare</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>% inj</td>
<td></td>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Dual + Valor / Liberty</td>
<td>Pre / Post</td>
<td>2 pt + 3 oz / 29 oz</td>
<td>4</td>
<td>96</td>
<td>98</td>
<td>100</td>
</tr>
<tr>
<td>Sharpen + Valor / Liberty</td>
<td>Pre / Post</td>
<td>1 oz + 3 oz / 29 oz</td>
<td>0</td>
<td>95</td>
<td>100</td>
<td>99</td>
</tr>
<tr>
<td>Verdict / Basagran / Basagran</td>
<td>Pre / Post / Post</td>
<td>5 oz / 1 pt / 1pt</td>
<td>0</td>
<td>84</td>
<td>76</td>
<td>95</td>
</tr>
<tr>
<td>Cobra / Cobra</td>
<td>Post / Post</td>
<td>10 oz / 10 oz</td>
<td>37</td>
<td>69</td>
<td>15</td>
<td>100</td>
</tr>
<tr>
<td>Basagran + Cadet / Basagran + Cadet</td>
<td>Post / Post</td>
<td>0.5 pt + 0.7 oz / 0.5 pt + 0.7 oz</td>
<td>29</td>
<td>61</td>
<td>63</td>
<td>91</td>
</tr>
<tr>
<td>Liberty / Liberty²</td>
<td>Post / Post</td>
<td>29 oz / 29 oz</td>
<td>2</td>
<td>81</td>
<td>97</td>
<td>100</td>
</tr>
</tbody>
</table>

¹Liberty applied with N-Pak ammonium sulfate at 3 lb/A, Cadet, Basagran and Cobra applied with MSO at 1.5 pt/A.
²Experiment was planted to Liberty Tolerant soybean.
Application timing, cost per acre\(^1\), herbicide site of action\(^1\), and crop rotational restrictions\(^1\), corn herbicides

<table>
<thead>
<tr>
<th>Herbicide treatment(^1)</th>
<th>Appli</th>
<th>Herbicide rate (pt or fl oz/ A)</th>
<th>Cost/ A</th>
<th>SoA Families</th>
<th>Crop rotation(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual + Valor / Liberty</td>
<td>Pre/ Post</td>
<td>2 pt + 3 oz / 29 oz</td>
<td>$68.75</td>
<td>15, 14 / 10</td>
<td>5</td>
</tr>
<tr>
<td>Sharpen + Valor / Liberty</td>
<td>Pre / Post</td>
<td>1 oz + 3 oz / 29 oz</td>
<td>$44.25</td>
<td>14, 14 / 10</td>
<td>4</td>
</tr>
<tr>
<td>Verdict /Basagran / Basagran</td>
<td>Pre / Post / Post</td>
<td>5 oz / 1 pt / 1pt</td>
<td>$34.90</td>
<td>14, 15 / 6 / 6</td>
<td>NCS 1</td>
</tr>
<tr>
<td>Cobra / Cobra</td>
<td>Post / Post</td>
<td>10 oz / 10 oz</td>
<td>$31.26</td>
<td>14 / 14</td>
<td>0</td>
</tr>
<tr>
<td>Basagran + Cadet / Basagran + Cadet</td>
<td>Post / Post</td>
<td>0.5 pt + 0.7 oz / 0.5 pt + 0.7 oz</td>
<td>$29.46</td>
<td>6, 14 / 6, 14</td>
<td>0</td>
</tr>
<tr>
<td>Liberty / Liberty</td>
<td>Post / Post</td>
<td>29 oz / 29 oz</td>
<td>$38.50</td>
<td>10 / 10</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^1\)From 2015 North Dakota Weed Control Guide
\(^2\)NCS = next crop season, number of months
Manage the seed bank…it’s a “Numbers Game”

Minimize "Deposits" and Maximize “Withdrawals”

Single waterhemp plant in 2011 (Clay County, MN) estimate of the actual seed number per plant = 142,000

Photo from J Bond, Mississippi State Univ
The Weed Seedbank

- Germination – 3-40% of first year seed that enter into the seedbank germinates
- Rapid turnover – approximately 2/3 of seedbank lost annually
- Seedbank can be depleted by 25% per year of good weed management in cultivated soils (data from Nebraska)
- Seedbank can be replenished with a single year of bad control (Burnside et al., 1986)
Weeds are prolific producers of seeds

Weeds produce tens or hundreds of thousand seed per plant while crop plants only produce several hundred seeds per plant

• Giant foxtail -10,000
• Common ragweed – 30,000
• Purslane -52,000
• Lambsquarters – 72,000
• Redroot pigweed -117,000
• Waterhemp – 142,000
• Palmer amaranth – 460,000
Common predators of weed seeds....

• Seeds are a source for energy for insects and rodents
• Greater than 5% per day loss when on soil surface
• Total losses range from 20 to 90%
• Tillage after harvest can greatly reduce predation since predators don’t dig for seed
There is a weed that......

- Has a growth rate of greater than 2 inches/day
- Emerges in fields from May to August
- Produces more than 1 million seeds/plant
- Seed is viable after 6 years

We don’t have it and we don’t want it!

Palmer amaranth

Unbranched flowering structures
Thank You

• We thank the Sugarbeet Research & Education Board for funding our program in 2014
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• 701-231-8131 (office)
• 218-790-8131 (mobile)