Effectiveness of Roundup Ready Sugarbeet

Jeff Stachler
Extension Agronomist – Sugarbeet / Weed Science
NDSU and U of MN
2012
Presentation outline

1. The situation
2. Know the enemy - waterhemp
3. Waterhemp, common ragweed, & kochia management
4. Final reminders
The situation

- Can we maintain the effectiveness of glyphosate and RR sugarbeet?
  - Raise your hand if yes
The situation

• What must we do to maintain the effectiveness of RR sugarbeet?
  – Have greater fear for the future impact of weeds.
    • Eliminate weed seed rain (weed seed production).
    • The weed seed bank is powerful!
    • Herbicides have caused us to become complacent!
  – React more quickly to changing weed populations.
    • We blame the weather and other factors too quickly!
    • Herbicides will not stay effective if we do not do our part.
The situation

• What must we do to maintain the effectiveness of RR sugarbeet? (Continued)
  – Maximize herbicide activity at all times.
  – Eliminate weeds in other crops in the rotation.
  – Diversify weed management strategies at all times.
Past versus present weed control in RR sugarbeet

Crystal: 90% growers reported Excellent weed control with glyphosate

SMBSC: 76% Excellent

2011 near Prinsburg, MN

Crystal: 81% growers reported Excellent weed control with glyphosate

SMBSC: 59% Excellent
Areas and counties of ND and MN having confirmed and suspected glyphosate-resistant weeds

- < 5% soybean fields gly-R C. Rag.
- 5 to 20% all fields gly-R waterhemp
- 15 to 40% all fields gly-R waterhemp
- 40 to 75% all fields have gly-R G. Rag. &
- 20 to 40% all fields have gly-R waterhemp

- Gly-R common ragweed
- Gly-R giant ragweed
- Gly-R waterhemp

Black symbols: confirmed resistant cases; Blue: highly suspected

Provided by: Drs. Jeff Stachler and Mike Christoffers
Areas and counties of ND and MN having confirmed and suspected glyphosate-resistant weeds

2010

- Gly-R common ragweed
- Gly-R giant ragweed
- Gly-R waterhemp

5 to 80% all fields gly-R waterhemp

10 to 40% soybean fields gly-R C. Rag.

30 to 60% all fields gly-R C. Rag.

30 to 90% all fields have gly-R waterhemp

50 to 95% all fields have gly-R G. Rag.

Black symbols: confirmed resistant cases; Blue: highly suspected

Provided by: Drs. Jeff Stachler and Mike Christoffers
Areas and counties of ND and MN having confirmed and suspected glyphosate-resistant weeds

5 to 95% all fields gly-R waterhemp

70 to 95% all fields gly-R C. Rag.

30 to 60% all fields gly-R C. Rag.

5 to 95% all fields gly-R G. Rag.

5 to 50% soybean fields gly-R C. Rag.

70 to 95% all fields have gly-R waterhemp

60 to 95% all fields have gly-R G. Rag.

- Gly-R horseweed / marestail
- Gly-R kochia
- Gly-R common ragweed
- Gly-R giant ragweed
- Gly-R waterhemp

Black symbols: confirmed resistant cases; Blue: highly suspected

2011

Provided by: Drs. Jeff Stachler and Mike Christoffers
Waterhemp - Moorhead, MN – 2011
After 2 glyphosate applications
Common ragweed - E. of Nielsville, MN - 2011

Proper management / Continuous RR soybean

Proper management

Continuous RR soybean
Common ragweed - E. of Nielsville, MN – 2011
two glyphosate applications
## Glyphosate-resistant kochia – Stutsman Co., ND - 2011

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<tr>
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Stutsman Co., Population
Trail of kochia plants in a soybean field near Colby, KS in 2007 after spraying three times with glyphosate (from: Phil Stahlman / Dallas Peterson - KSU).
Phillip Co. KS – 2010; grower application at 10 gpa
April 21: 42 oz Buccaneer Plus + 9 oz 2,4-D LVE + AMS + NIS
June 2: 49 oz Buccaneer Plus + 1 oz Sharpen + AMS + NIS (1 DPP)
June 24: 31 oz Buccaneer Plus + 0.7 oz Cadet + COC + Guardian (POST)
(from: Phil Stahlman / Dallas Peterson - KSU).
Multiple –R???
Cobra applied near Holloway, MN
Species known to have multiple resistance

- **Waterhemp**
  - Glyphosate (Group 9) + ALS-inhibitors (2) (many+MN,ND?)
  - PPO inhibitors (14) + Gly (9) + ALS (2) (MO,KS, IL, IA)
  - HPPD inhibitors (27) + Photosystem II (5) + ALS (2) (IL, IA)
  - Gly (9) + ALS (2) + PPO (14) + PS II (5) (IL)

- **Giant ragweed**
  - Gly (9) + ALS (2) (MN, OH, MO, IA)
  - PPO (14) + ALS (2) (OH)

- **Common ragweed**
  - Gly (9) + ALS (2) (MN, OH, MO, IA)
  - PPO (14) + ALS (2) (OH)
  - Gly (9) + PPO (14) + ALS (2) (OH)

Mechanism of Action (MOA)
Pgs 104 & 105
2012 ND Weed Guide
Solution to situation

• Recommend diligent scouting before AND after each herbicide application!
  – Determine if plants are surviving the herbicide(s)
    • Is the population changing in response to the herbicide?
Response of a resistant waterhemp population
Continuous response of common ragweed to glyphosateate

Picture from Al Cattanach
Website address for video “Scouting for Glyphosate Resistance”:
http://www.ag.ndsu.edu/weeds/herbicide-resistant-weeds
Annual beets – seeds planted in 2010 from plants collected from soybean field in Clay, Co., MN in 2009

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<th>Row</th>
<th>Emerg. (%)</th>
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2010
Annual beets – seeds planted in 2010 from plants collected from soybean field in Clay, Co., MN in 2009
The situation

• What is the future impact of a single waterhemp plant remaining at the end of the season?
Single waterhemp plant in 2011 (Clay County, MN)
actual seed number per plant = 142,000
Scenario: seed number on 1 plant in 1 acre = 100,000 seeds
Scenario

- If 25% (40% is possible) of seeds emerge next season (2012)
- Only 10% of emerged plants are resistant
- Same herbicide is applied as previous year
- How many plants may be present in 1 acre at the end of the season (2012)?
2,500 plants/A – 1 year later (2012)
Scenario

- If 2,500 plants produce 100,000 seeds/plant
- 25% of seeds emerge next season (2013)
- Only 10% of emerged plants are resistant
- Same herbicide is applied as previous 2 years
- How many plants may be present in the 1 acre at the end of the season (2013)?
6,250,000 plants/A!! - 2 years later (2013)
The situation

• What may be the cost to manage glyphosate-resistant (R) waterhemp in sugarbeet?
Cost to control glyphosate-R waterhemp in sugarbeet

Roundup PowerMAX (32 / 22 / 22 fl oz/A) - $12.00/A

Ro-Neet (5.3 pt/A) [PPI] fb Betamix (12 / 16 / 24 fl oz/A) + Nortron (4 / 4 / 4 fl oz/A) + Outlook (14 / 10 fl oz/A) + Roundup PowerMAX (32 / 22 / 22 fl oz/A) - $145/A
Solution to situation

• Recommend removing surviving plants by hand from a field, especially when there are just a few!
  – There is no better way to STOP the increase of resistant biotypes.
  – NO novel herbicide(s) are expected to be released for any crop in the next 5 to 10 years!

• Must protect what we have
Solution – Practicing zero seed rain

• 52% of AR cotton hand-weeded in 2011
  – Average cost = $29.43/A (beets = $21.00/A)
  – Proactive hand-weeding - $4-5/A

• 2010 hand-weeding – 110 hours
• 2011 hand-weeding – 5 hours
Solution to situation

• Understand impact of weed seed movement by:
  – Water (especially for waterhemp)
  – Machinery
  – Wind
  – Humans
  – Animals / birds
Management of weeds along crop edges

Future problem!

The Goal!
Field perimeter management (2010)
Ramifications of not managing field perimeter (2011)
Know The Enemy - Waterhemp
Waterhemp biology

• Begins emerging early to mid-May.

• Continues to emerge through early August.
  – Requiring multiple herbicide applications.

• Seed viability:
  – At least 3 to 5 years if near soil surface.
  – Deep burial, may reduce viability.

• Moderate competitor
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Waterhemp, Common Ragweed, and Kochia Management
Overall management

• Choose crop where glyphosate is most critical to manage weeds and protect its use!
  – Reduce glyphosate use to no more than every other year and preferably longer.
  – Adopt LL technology.

• Apply POST herbicides to small (1 to 3”) waterhemp.
Effect of glyphosate timing and rate on control of glyphosate-R waterhemp in soybean – Sept. 27

Rndp PowerMAX (22 fl oz/A) [June 24]
Waterhemp height: 0 to 25” (Ave. = 14”)

Rndp PowerMAX (32 fl oz/A) [< 0.5”] fb
Rndp PowerMAX (32 fl oz/A) [June 24]
Overall management

• PRE followed by (fb) POST system is best.
  – Choose best PRE herbicide(s).
  – Tank-mix PRE’s for greatest control.
  – If RR crop, mix other herbicide(s) with glyphosate.
  – Timing the POST application is more flexible.
  – Scout to determine need for 2\textsuperscript{nd} POST application.
  – PRE herbicides less likely to have resistance.
  – Reduces the number of plants at POST application, reducing risk for resistance.
Effect of PRE herbicide upon number of waterhemp plants at LPOST application
Overall management

- Total POST system **(not recommended)**.
  - Apply to small (1 to 3”) waterhemp.
    - Timing is very critical!
  - Apply a mixture of herbicides.
    - Choose 2 or more of the most effective herbicides having different mechanisms of action.
  - Use the best adjuvant(s) for the mixture.
  - If mixing acetamide herbicides (Warrant, Outlook, Dual) in soybean, apply to small (1”) waterhemp.
  - Scout to determine timing and need for 2nd POST application.
    - Determine need for herbicide mixture.
Corn herbicides to control waterhemp

**PRE/PPI Herbicides**

- **Excellent**
  - Lumax (3 pt/A)
  - Verdict (> 12 fl oz/A)
  - Zemax

- **Good to Excellent**
  - Balance Flexx (ND only)
  - Callisto
  - Harness / Surpass
  - Prequel (ND only)
  - Sharpen (3 fl oz/A)

- **Good**
  - Dual
  - Outlook
  - SureStart / TripleFlex**

**POST Herbicides**

- **Excellent**
  - Callisto + atrazine
  - Capreno
  - Halex GT (RR corn only)
  - Impact + atrazine
  - Laudis + atrazine
  - Lumax

- **Good to Excellent**
  - Atrazine (0.5 lb/A)
  - Callisto
  - Impact
  - Laudis 10-18

- **Good**
  - Banvel / Clarity
  - Status
  - Liberty / Ignite 280 (LL corn only)

> 18 month rotation to sugarbeet; ** > 24 mo. rotation to sugarbeet
Soybean herbicides to control waterhemp

PRE/PPI Herbicides

- **Excellent**
  - Fierce (not labeled)

- **Good to Excellent**
  - Boundary
  - Gangster**
  - Prefix (S. I-94 & E. I-29)
  - Sonalan 13/12" 
  - Treflan 12S/14F/12"
  - Valor

- **Good**
  - Dual
  - Outlook
  - Sencor

POST Herbicides

- **Excellent**
  - None

- **Good to Excellent**
  - Cobra / Phoenix
  - Flexstar (E. US 281 & S. US 2)
  - Flexstar GT 3.5 (RR soy only)

- **Good**
  - Ultra Blazer
  - Liberty / Ignite 280 (LL soy only)

> 18 month rotation to sugarbeet; ** > 30 mo. rotation to sugarbeet
Control of glyphosate-R waterhemp in LL soybean with PRE herbicides

- **Ignite (22 floz) [<1.5”] fb Ignite (22)**
  - Harvest: 90%
  - June 24: 70%
  - Cost: $19.94

- **Prefix (2 pt)**
  - Harvest: 80%
  - June 24: 75%
  - Cost: $13.75

- **Fierce (3.0 oz)**
  - Harvest: 80%
  - June 24: 80%
  - Cost: N/A

- **Valor (2.5 oz)**
  - Harvest: 80%
  - June 24: 80%
  - Cost: $13.75

- **Sharpen+Sencor+Zidua (2 oz)**
  - Harvest: 70%
  - June 24: 70%
  - Cost: N/A

- **Sharpen (1 floz)+Sencor (5.33 oz)**
  - Harvest: 70%
  - June 24: 70%
  - Cost: $10.41

- **Sharpen (1 floz)+Dual MagII (1.7 pt)**
  - Harvest: 70%
  - June 24: 70%
  - Cost: $30.58

- **Verdict (5 floz)+Outlook (8)**
  - Harvest: 70%
  - June 24: 70%
  - Cost: $19.76
Verdict (5 fl oz/A) + Outlook (8 fl oz/A) fb Ignite 280 [Liberty] (22 fl oz/A)
Corn herbicides to control common ragweed

PRE/PPI Herbicides

- **Excellent**
  - **NONE**
- **Good to Excellent**
  - Balance Flex (ND only)
  - Callisto
  - Hornet**
  - Lumax (3 pt/A)
  - Prequel (ND only)
  - Sharpen (3 fl oz/A)
  - SureStart / TripleFLEX**
  - Verdict (> 12 fl oz/A)
- **Good**
  - Zemax

- **POST Herbicides**

  - **Excellent**
    - 2,4-D
    - Halex GT (RR corn only)
    - Lumax (3 pt/A)
  - **Good to Excellent**
    - Banvel / Clarity
    - Buctril
    - Hornet**
    - Liberty / Ignite 280 (LL corn only)
    - Permit**
    - Priority**
    - Status
  - **Good**
    - Capreno 18/24
    - Impact (+ atrazine)
    - Laudis 10-18 (+ atrazine)

- 18 month rotation to sugarbeet
- ** > 24 mo. rotation to sugarbeet
Soybean herbicides to control common ragweed

**PRE/PPI Herbicides**

- **Excellent**
  - NONE
- **Good to Excellent**
  - NONE
- **Good**
  - Authority MTZ**
  - Boundary
  - Enlite** (MN only)
  - FirstRate**
  - Gangster**
  - OpTill**
  - Prefix (S. I-94 & E. I-29)
  - Sencor

**POST Herbicides**

- **Excellent**
  - FirstRate**
- **Good to Excellent**
  - Cobra / Phoenix
  - Liberty / Ignite 280 (LL soy only)
  - Flexstar (E. US 281 & S. US 2)
  - Flexstar GT 3.5 (RR soy only)
- **Good**
  - Blazer
  - Classic** (MN only)
  - Synchrony** (MN only)

> 18 month rotation to sugarbeet; ** > 30 mo. rotation to sugarbeet
Control of glyphosate-R common ragweed in LL soybean with PRE herbicides

Common ragweed height on June 20th
1. Valor (2 oz) = 0.25 to 9” / Ave. 4”
2. Sharpen (1 fl oz) = 0.25 to 8” / Ave. 2.5”
3. Ignite fb Ignite = 0.25 to 2.5” / Av. 1.125”
Verdict (5 fl oz/A) + Zidua (2.5 oz/A) fb Ignite (22 fl oz/A)
Dr. Jeff Stachler

Corn herbicides to control kochia

PRE/PPI Herbicides

• Excellent
  – Atrazine (0.5 lb/A)
  – Balance Flexx (ND only)
  – Verdict (> 12 fl oz/A)

• Good to Excellent
  – Atrazine (0.38 lb/A)
  – Lumax (3 pt/A)
  – Prequel (ND only)
  – Sharpen (3 fl oz/A)

• Good
  – None

POST Herbicides

• Excellent
  – Atrazine (0.38 to 0.5 lb/A)
  – Banvel / Clarity
  – Callisto + atrazine
  – Halex GT (RR corn only)
  – Impact + atrazine
  – Laudis 10-18 + atrazine
  – Liberty / Ignite 280 (LL corn only)
  – Lumax
  – Status

• Good to Excellent
  – Buctril
  – Capreno

• Good
  – None

> 18 month rotation to sugarbeet; ** > 24 mo. rotation to sugarbeet
Soybean herbicides to control kochia

PRE/PPI Herbicides

- **Excellent**
  - Authority Assist**
  - Authority First / Sonic**
  - Authority MTZ**
  - Fierce (not labeled)
  - Spartan**

- **Good to Excellent**
  - Gangster**
  - Valor

- **Good**
  - None

POST Herbicides

- **Excellent**
  - Liberty / Ignite 280 (LL soy only)
  - Flexstar GT 3.5 (RR soy only)

- **Good to Excellent**
  - Flexstar (E. US 281 & S. US 2)

- **Good**
  - None

> 18 month rotation to sugarbeet; ** > 30 mo. rotation to sugarbeet
Weed management in sugarbeet

1. Must achieve near perfect control in other crops in rotation!
   - To reduce weed density in sugarbeet

2. Include at least 1 LL crop in rotation.
   - Soybean most logical
     • Especially if dealing with common ragweed and kochia
Waterhemp management in RR sugarbeet

• Apply a soil-applied herbicide
  – Nortron (PPI / PRE) [$89 for 7.5 pt]
  – Dual Magnum (PRE) [$23 for 1.5 pt]
  – Eptam + Ro-Neet (PPI) [$45 for 2.3 pt + 3.3 pt/A]
  – Ro-Neet (PPI) [$50 for 5.3 pt]
  – Eptam (PPI) [$21 for 3.4 pt]

• Must adjust rate for soil type to reduce injury!
  – The lower the OM and higher sand content, greater injury
Waterhemp management in RR sugarbeet

• POST Option 1 (most effective)
  – Betamix (12 / 16 / 24 fl oz/A) or higher rates (+ no oil) [$45]
  – + Nortron (4 / 4 / 4 fl oz) [$9]
  – + Lay-by
    • Outlook (14 / 10 fl oz) [$34]
  OR
    • Dual Magnum (1.5 / 1 pt) [$37]
    – + Glyphosate (1.125 {Rndp 32} / 0.75 {Rndp 22}/ 0.75 lb ae/A)[$12]
    – + Scout
    – + Hand labor ?
    – fb glyphosate (0.75 lb ae/A {Rndp 22}) [$3] ??

• 1st application to 2 lf sugarbeet
• Add MSO {safe to glyphosate like Destiny HC} (1.5 to 2 pt) + AMS
• 14 to 18 days between applications
Waterhemp management in RR sugarbeet

- **POST Option 2** (only for light infestations)
  - Glyphosate (1.125 {Rndp 32} / 0.75 {Rnpd 22}/ 0.75 lb ae/A) [$12]
  - + Lay-by
    - Outlook (14 / 10 fl oz) [$34]
    - OR
      - Dual Magnum (1.5 / 1 pt) [$37]
        - + Scout
        - + Cultivation
        - + Hand labor
        - fb glyphosate (0.75 lb ae/A {Rnpd 22}) [$3]

- **1st application to 2 lf sugarbeet**
- Add MSO {safe to glyphosate like Destiny HC} (1.5 to 2 pt) + AMS
- 14 to 18 days between applications
Waterhemp management in RR sugarbeet

• POST Option 3 (only useful if limited resistant plants)
  – Glyphosate (1.125 {Rndp 32} / 0.75 {Rndp 22}/ 0.75 lb ae/A) [$12]
  – + Scout
  – + Cultivation
  – + Hand labor
  – fb glyphosate (0.75 lb ae/A {Rndp 22}) [$3]
  – + Hand labor ??

• 1st application at 2 lf sugarbeet
• Could consider adding Nortron (4 fl oz/A) [$9] in 1st 3 apps.
• 14 to 18 days between applications
RR Sugarbeet recommendations – common ragweed

- Apply Stinger (2.5 to 4 fl oz/A) + glyphosate (1.125 lb ae/A) + AMS to 1” common ragweed
- Apply Stinger (2.5 to 4 fl oz/A) + glyphosate (0.75 lb ae/A) + AMS 14 to 21 DAT
- Scout field to determine need for a third application
- Apply Stinger no later than July 18th for Sept. 1 harvest!
- Apply no greater than 10.5 fl oz/A of Stinger for season.
Kochia management in RR sugarbeet

- Apply a soil-applied herbicide
  - Nortron (PPI / PRE) [$89 for 7.5 pt] {F-G}
  - Eptam (PPI) [$21 for 3.4 pt] {F}

- Must adjust rate for soil type to reduce injury!
  - The lower the OM and higher sand content, greater injury
Kochia management in RR sugarbeet

**POST Option 1 (Best strategy)**
- Betamix (12 fl oz / 3 pt / 4 pt) [$92]
- + Nortron (4 / 4 / 4 fl oz) [$9]
- + Lay-by ????
  - Outlook (14 / 10 fl oz) [$34]
  OR
- Dual Magnum (1.5 / 1 pt) [$37]
  - + Glyphosate (1.125 {Rndp 32} / 0.75 {Rndp 22}/ 0.75 lb ae/A)[$12]
  - + Scout
  - + Hand labor ?
  - fb glyphosate (0.75 lb ae/A {Rndp 22}) [$3] ??

**1st application to cotyledon to 2 If sugarbeet**
**Add MSO {safe to glyphosate like Destiny HC} (1.5 to 2 pt) + AMS**
**10 to 14 days between applications**
Kochia management in RR sugarbeet

• POST Option 2 (only useful if limited resistant plants)
  – Glyphosate (1.125 {Rndp 32} / 0.75 {Rndp 22}/ 0.75 lb ae/A) [$12]
  – + Scout
  – + Cultivation
  – + Hand labor
  – fb glyphosate (0.75 lb ae/A {Rndp 22}) [$3]
  – + Hand labor ??

• 1\textsuperscript{st} application to cotyledon to 2 If sugarbeet
• Could consider adding Nortron (4 fl oz/A) [$9] in 1\textsuperscript{st} 3 apps.
• 14 to 18 days between applications
Final reminders

• **Zero** seed rain!
  – Remember the impact of a single plant at end of season!

• Apply **All** POST herbicides to **small (1-3”)** weeds at all times.

• Do not apply glyphosate too soon between applications.
  – Plants must resume growth before next application
    • 14 day interval usually minimum
Final reminders

• Maximize herbicide activity!
  – Of all herbicides at all times
  – For glyphosate consult these references:
    • Pgs 52 & 53 – 2012 Sugarbeet Production Guide
    • Pgs 69 to 71- 2012 ND Weed Control Guide

• It’s the little things that will make a difference.
Final reminders

• Diversify weed management practices!
  – Use PRE herbicides in ALL crops!
    • Foundation weed control
  – Determine where glyphosate is most vital in the crop rotation and limit its use.
  – Incorporate LL technology into the crop rotation.
    • Do it right! – plan: PRE fb Liberty (29 fl oz/A-soy) twice
  – Use the most effective herbicides, especially in tank-mixtures!
    • NOT the most convenient
    • NOT the cheapest (pay a little know or pay a lot later)
  – Adjust crop rotation
  – Maximize cultural practices
Leave a Legacy

• The future success of your farming operation depends upon the weed control practices you choose today!

• Glyphosate is the most effective herbicide ever used in sugarbeet, so why not protect/preserve its effectiveness for sugarbeet.

THE Goal!
• Thank You!
  – SBREB
  – Lenny Luecke and many others

• ANY questions?

• Contact information
  – jeff.stachler@ndsu.edu
  – 701-231-8131 (Office)
  – 218-790-8131 (Cell)

• Resources
  – http://www.ag.ndsu.edu/weeds/
  – http://www.sbreb.org/