

Preserving the Effectiveness of Herbicides and Herbicide Technology Traits – Especially Glyphosate and RR Crops

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3-20-12

NDSU EXTENSION
SERVICE



Presentation outline

1. Why should we care about weed resistance??
2. The situation
3. Solutions
4. Final reminders

Why should we care about weed resistance?

- No new novel herbicide mode (site / mechanism) of action is expected for the next 5 to 10 years!
 - Last mode of action for row crops was HPPD (27)
 - Must preserve the herbicides and herbicide technology traits currently available
 - Do not rely upon herbicide traits about to be released
 - Some forecasted traits have not made it to market
 - Accuron and GAT
 - The traits that are anticipated already have herbicide resistant weeds
- Reduced profits over time

Why should we care about weed resistance? – Lost profit



\$12.00/A

**Roundup
PowerMAX
(32 / 22 / 22 fl oz/A)**



\$145/A

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

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Why should we care about weed resistance?

2009



Crystal: 90% growers reported Excellent weed control with glyphosate

SMBSC: 76% Excellent

2011

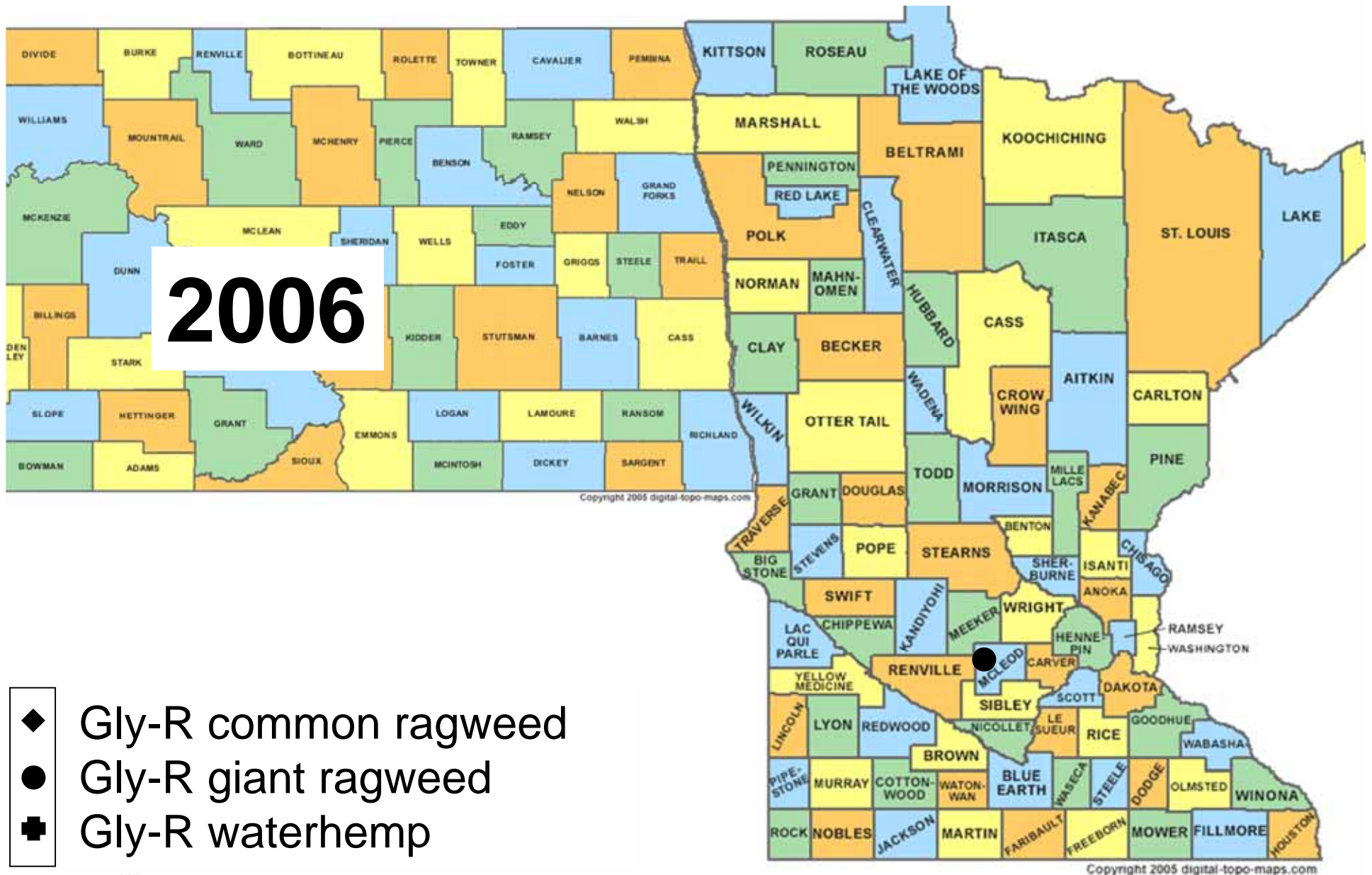
near Prinsburg, MN



Crystal: 81% growers reported Excellent weed control with glyphosate

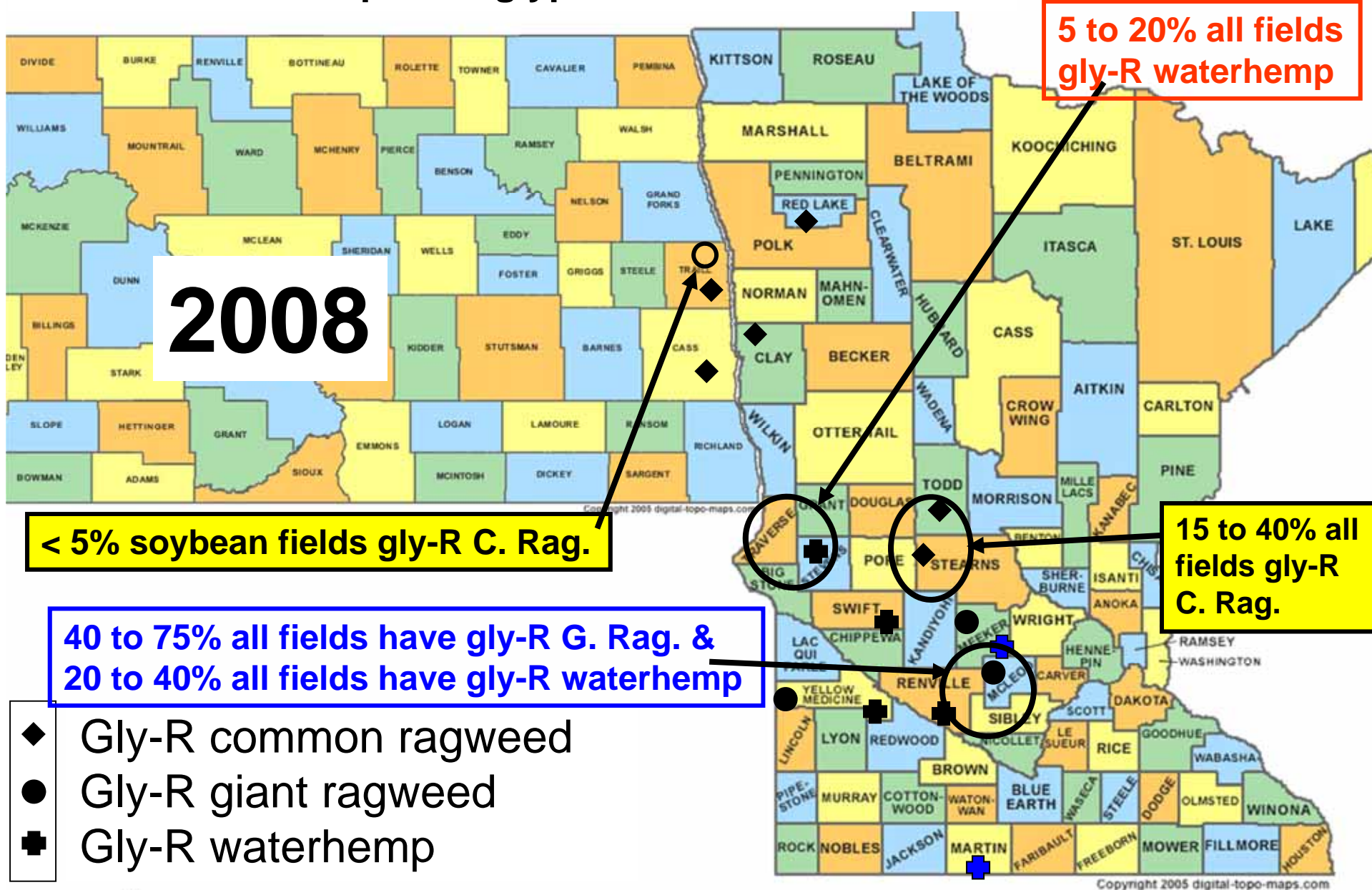
SMBSC: 59% Excellent

Areas and counties of ND and MN having confirmed and suspected glyphosate-resistant weeds

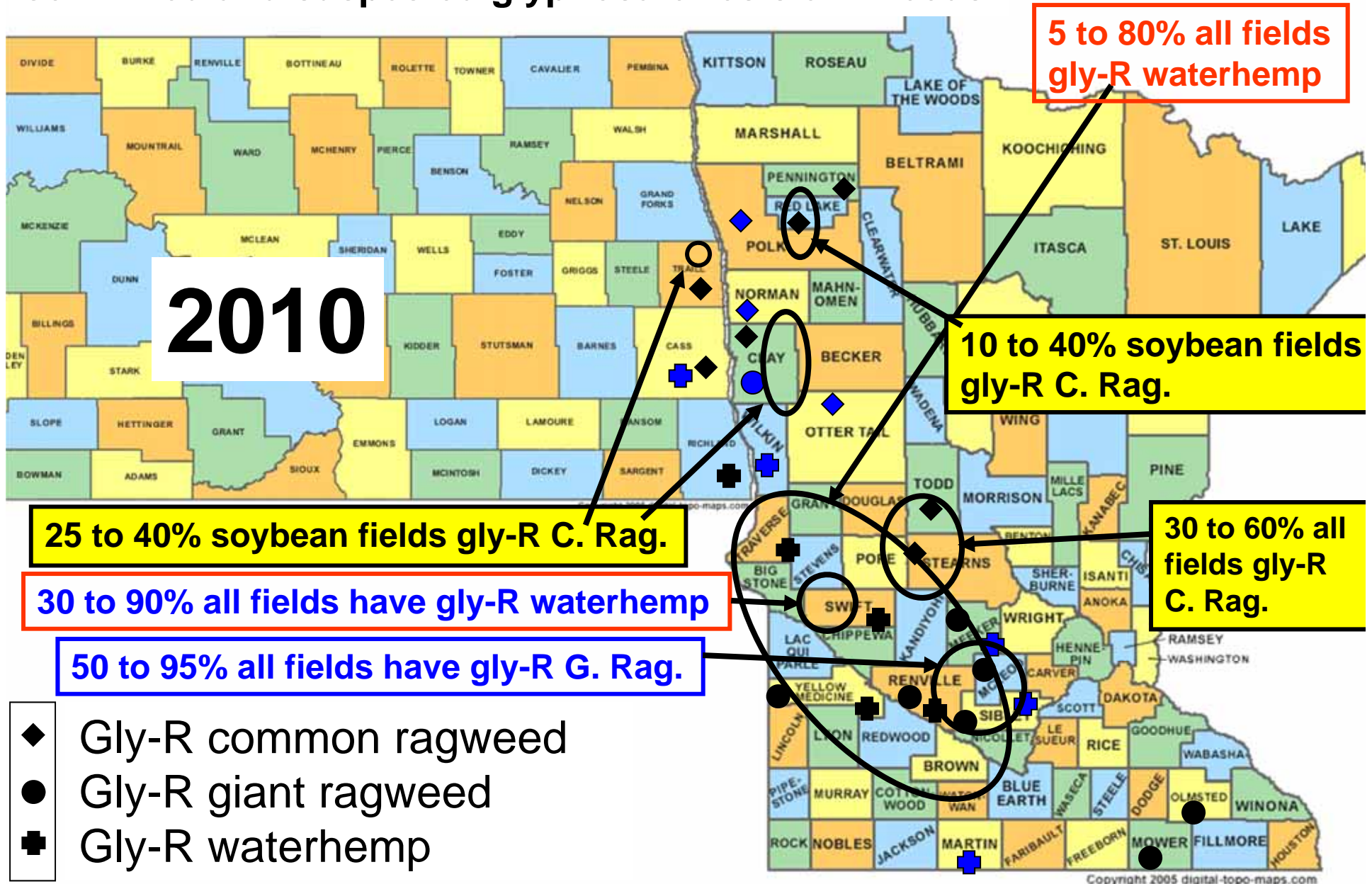


- ◆ Gly-R common ragweed
- Gly-R giant ragweed
- ⊕ Gly-R waterhemp

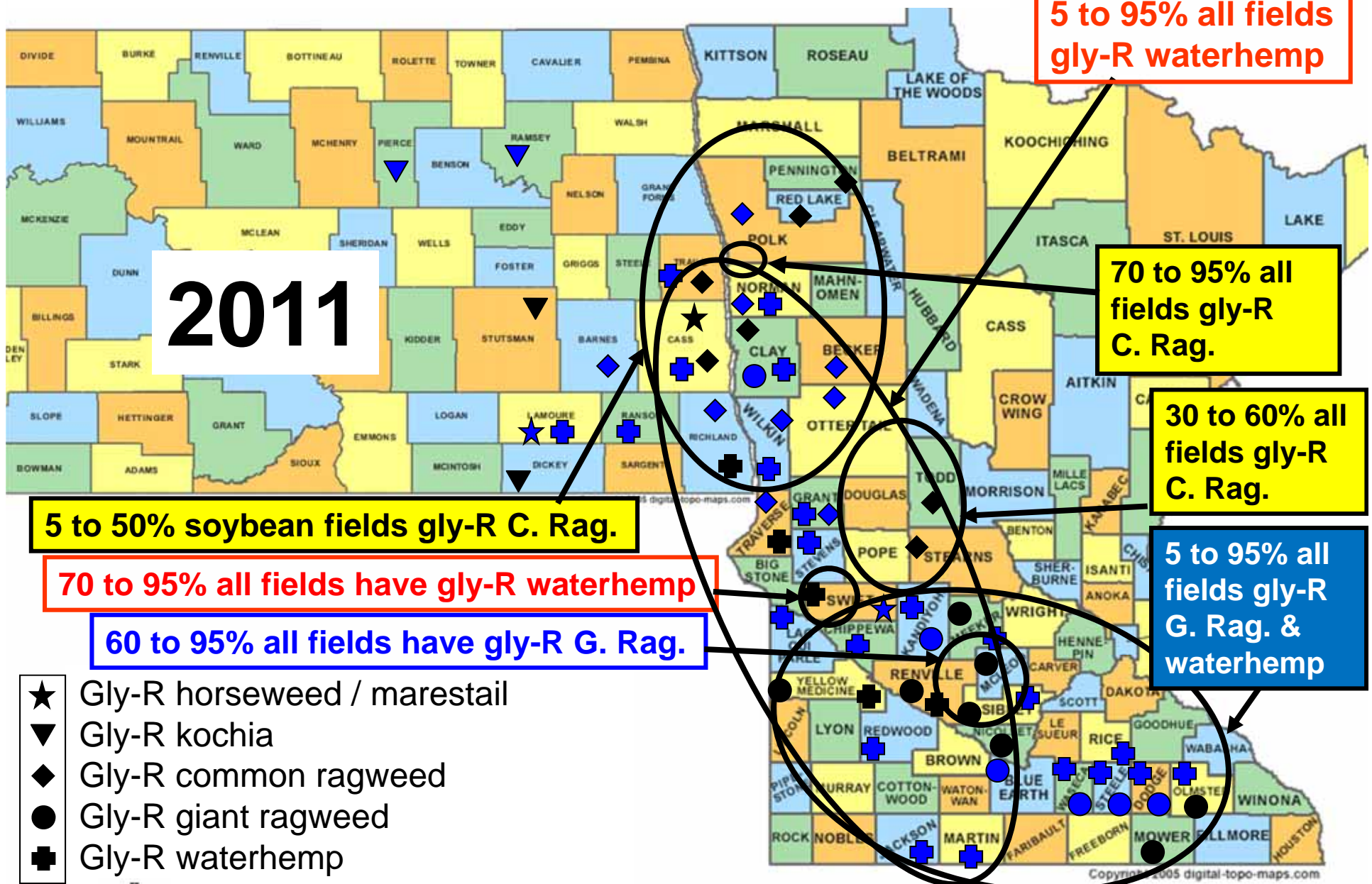
Areas and counties of ND and MN having confirmed and suspected glyphosate-resistant weeds



Areas and counties of ND and MN having confirmed and suspected glyphosate-resistant weeds



Areas and counties of ND and MN having confirmed and suspected glyphosate-resistant weeds



Waterhemp - Holloway, MN – 2010 two glyphosate applications



Waterhemp - Galchutt, ND – 2011 two glyphosate applications



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Waterhemp - Moorhead, MN – 2011 two glyphosate applications



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Waterhemp – Halstad, MN - 2011



Common ragweed - E. of Nielsville, MN - 2011

**Better
management**

**Continuous
RR soybean**



**Continuous
RR soybean**

**Better
management**



Common ragweed - E. of Nielsville, MN – 2011 two glyphosate applications



Glyphosate-resistant horseweed – Cass Co., ND - 2011

Untreated

**Roundup WeatherMAX
(22 fl oz/A) [0.77 lb ae/A]**

**Roundup WeatherMAX
(66 fl oz/A) [2.3 lb ae/A]**



Resistant Check from Ohio

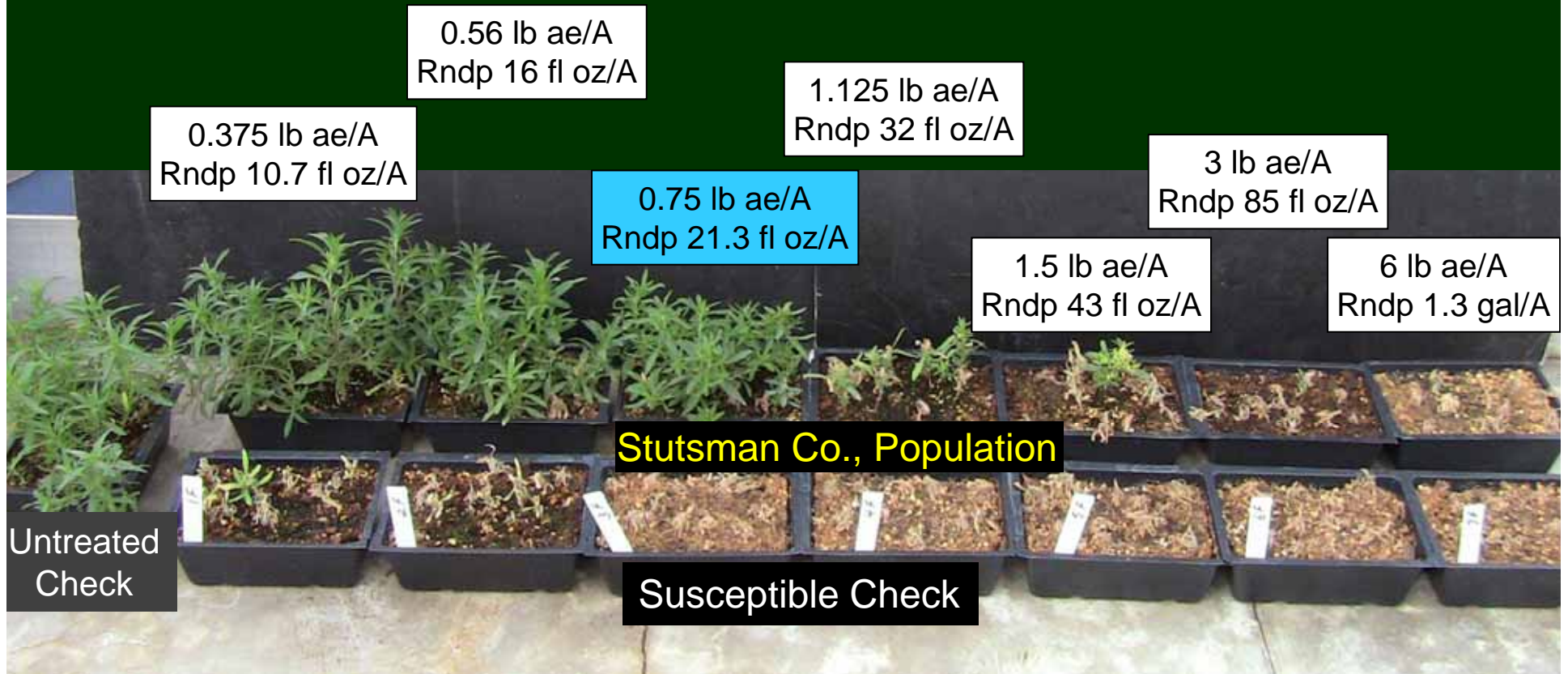


Cass Co., ND



Sensitive Check

Glyphosate-resistant kochia – Stutsman Co., ND - 2011



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).



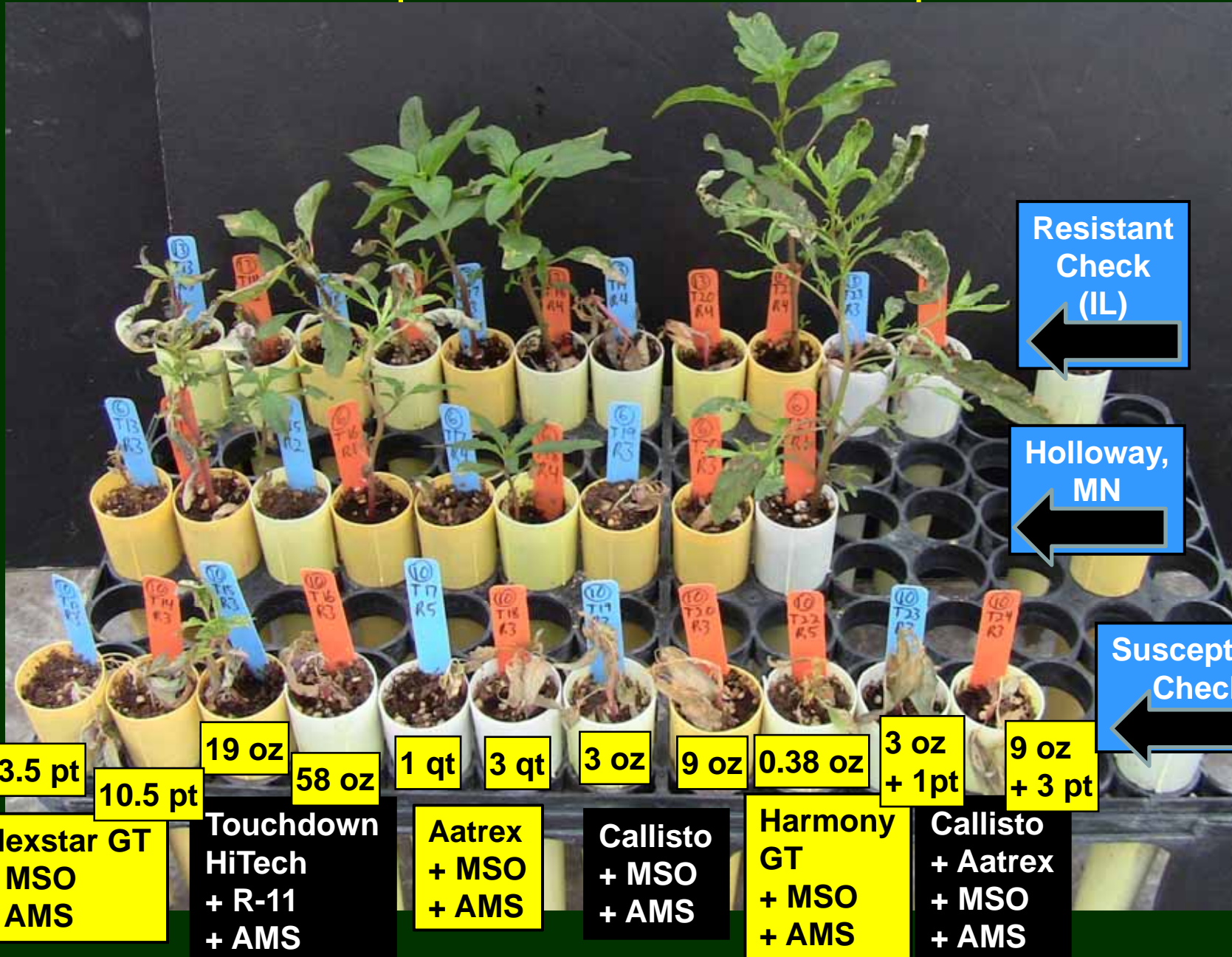
Multiple resistance???
Cobra applied near Holloway, MN



Multiple-resistant waterhemp



Multiple-resistant waterhemp



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)

Mode of Action (MOA)
Pgs 104 & 105
2012 ND Weed Guide

Solutions – Understand weed biology

- Proper identification of weeds

Waterhemp versus redroot pigweed



waterhemp



redroot pigweed



Comparing similar pigweed species



Palmer, Powell, redroot, smooth, waterhemp



Male flowers



Female flowers



**Variability of waterhemp
flower stems**

Solutions – Understand weed biology

- Proper identification of weeds
- Know when weed species emerge and for how long
- Know the best stage to control each species
- Know when weeds begin to flower and how soon they become mature
- Know the impact of weed seed production

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)



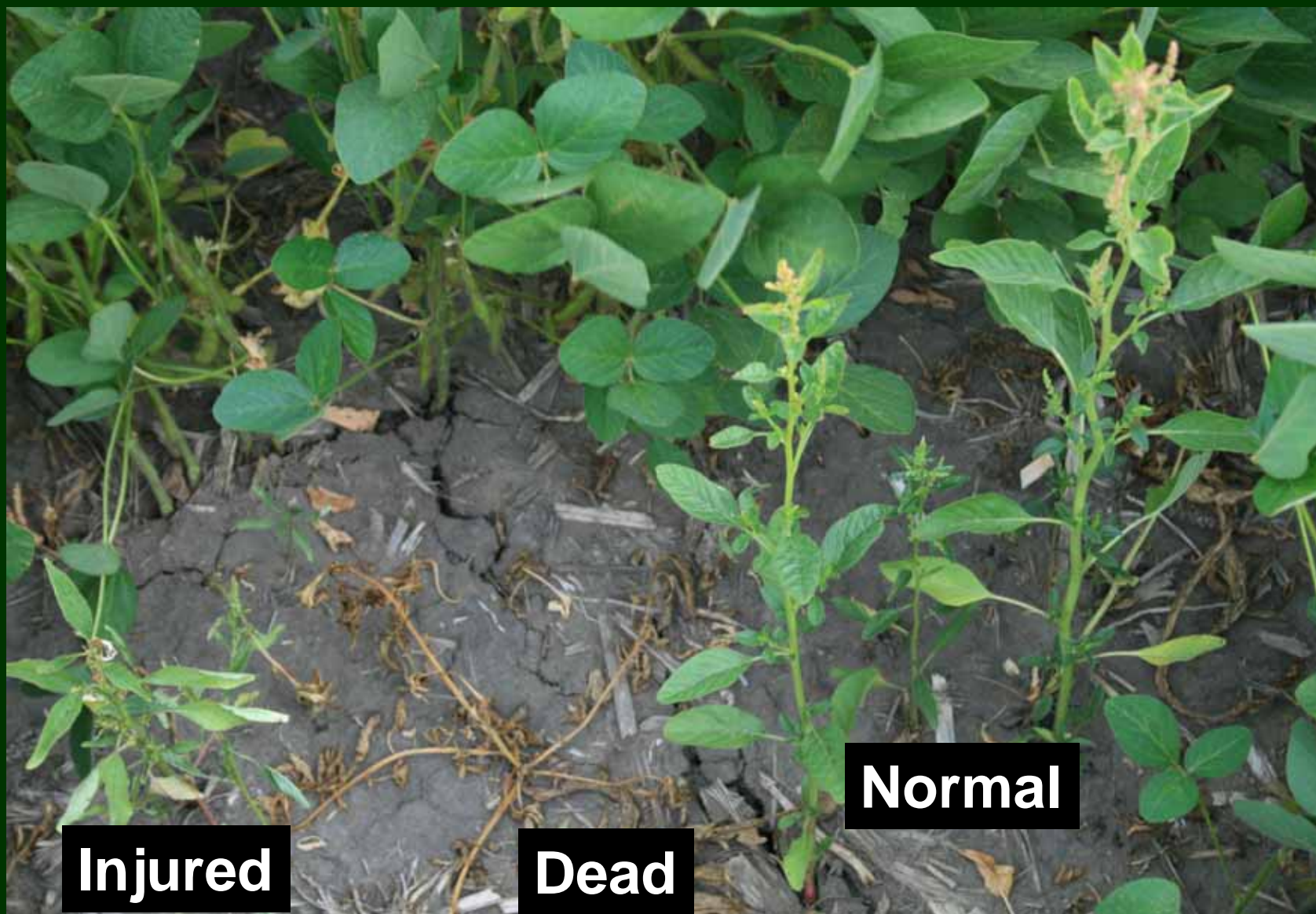
6,250,000 plants/A!! - 2 years later (2013)



Solution – Diligent scouting

- Scout before AND after EACH herbicide application!
 - Know the weed sizes and species prior to application
 - Adjust herbicide combinations and rates accordingly
 - Determine if plants are surviving the herbicide(s) or emerging after the application
 - Be aware of changes in the weed population
 - Scout 5 to 10 days after each application
- Scout late season and prior to harvest

Response of a resistant waterhemp population



Continuous response of common ragweed to glyphosate



Picture from Al Cattanach

Continuous response of kochia to glyphosate



Website address for video “Scouting for Glyphosate Resistance”:

<http://www.ag.ndsu.edu/weeds/herbicide-resistant-weeds>

The screenshot shows a Mozilla Firefox browser window with the following details:

- Browser Title:** Herbicide Resistant Weeds — NDSU - Mozilla Firefox
- Address Bar:** http://www.ag.ndsu.edu/weeds/herbicide-resistant-weeds
- Navigation Menu (Left):**
 - Accessibility
 - Google™ Custom Search
 - NDSU Weed Science
 - Weed Control Guides
 - ND Weed Control Research
 - CDMS Label Search
 - NDSU Extension Publications
 - ND Herbicide / Weed Surveys
 - Herbicide Resistant Weeds
 - Sugarbeet Weed Control
 - NDSU Quick Links
 - Weed of the Year
 - WWW Reg info
- Main Content:**
 - NDSU Weed Science**
 - You are here:** Home → Herbicide Resistant Weeds
 - Herbicide Resistant Weeds**
 - International Survey of herbicide Resistant Weeds**
 - Videos:**
 - Scouting for Glyphosate Resistance** (circled in black)
 - Herbicide Resistant Presentations:**
 - Herbicide Resistant Weeds – 2010 (Stachler)
 - Maps:**
 - ND / MN Glyphosate Resistance
- Footer:** Send this — Print this —

Solution – Practice zero seed rain

- Hand-weeding
 - Remove / destroy 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.



- Or row cultivate and hand-weed

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 – Respond quickly to a changing weed population!



Solution – Understand impact of weed seed movement

- Means of dispersal:
 - Water (especially for waterhemp)
 - Machinery
 - Wind
 - Humans
 - Animals / birds



MPR Photo/Ann Arbor Miller



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Solution – Diversify weed management

1. Rotate crops

- Increase the diversity of crops in rotation
- Each crop causes a different environment for the weeds
- Rotating crops can allow for more herbicide diversity
- Rotate herbicide-resistant crops
 - Include LL crops and other herbicide-resistant crops in the rotation
 - Use LL system correctly
 - » Apply soil-applied herbicide
 - » Plan for two POST applications at maximum rates
 - » Include tank-mixtures, esp. grasses

Verdict (5 fl oz/A) + Outlook (8 fl oz/A) fb
Ignite 280 [Liberty] (22 fl oz/A)



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Solution – Diversify weed management

2. Change herbicide use pattern!

– Rotate herbicide modes of action

- Three or more per season and do not repeat
- Consult pages 104 and 105 in ND Weed Guide
 - Know and understand herbicide mode of action
- Know what active ingredients and rates are in premix herbicides
- Must know what has been used in the past and plan ahead to keep rotating.
 - PPO inhibiting (14) herbicides biggest concern

Solution – Diversify weed management

2. Change herbicide use pattern!

– Use soil-applied herbicides in ALL crops

- Can be called Foundation Weed Control
- Use the most effective herbicide(s) for the most difficult to control / resistant weed species
- Use multiple modes of action
- Use full rates
- Adjust rate for soil type to reduce crop injury
- Know future crops to reduce herbicide carryover
- Reduces plant numbers and plant height
- Reduces risk of resistance to POST herbicides

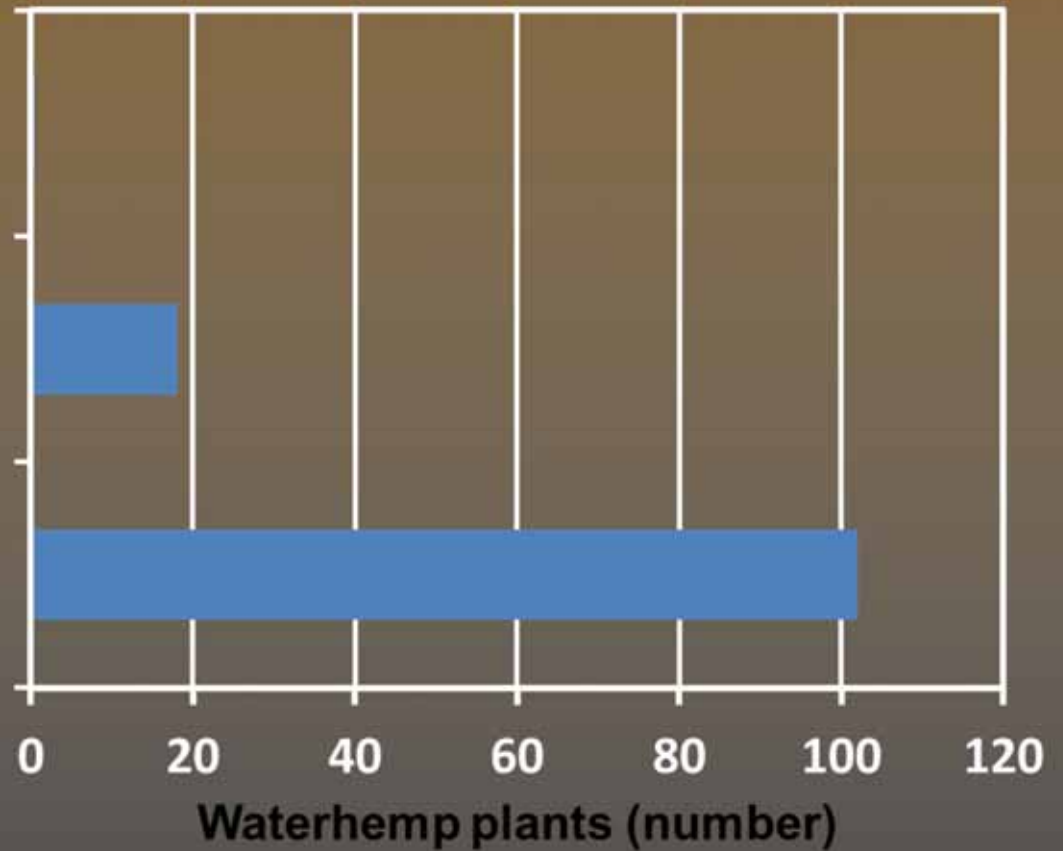
Number of waterhemp plants at LPOST application



Glyphosate EPOST (< 1")

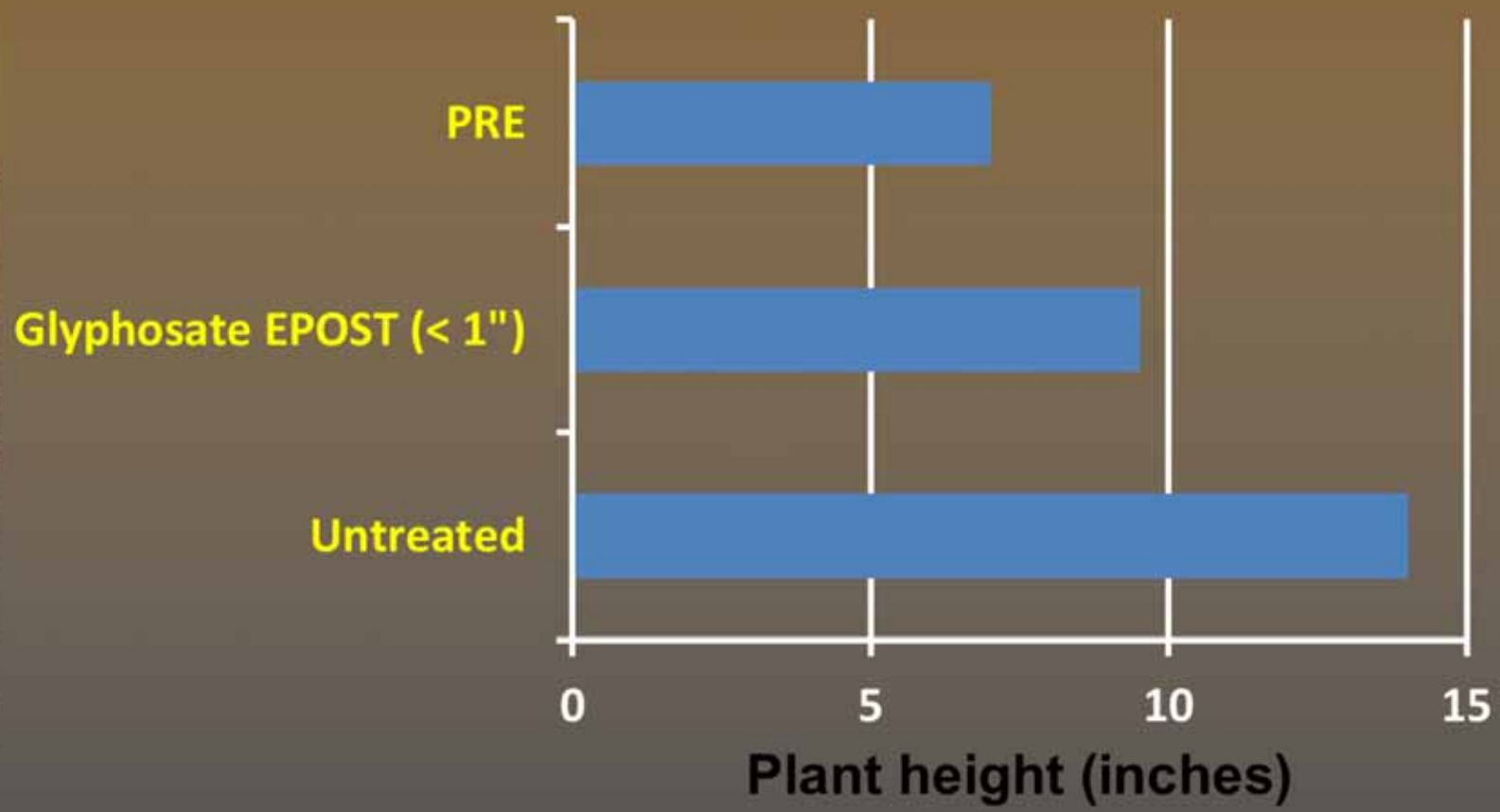
Untreated

PRE





Height of waterhemp plants at LPOST application



Solution – Diversify weed management

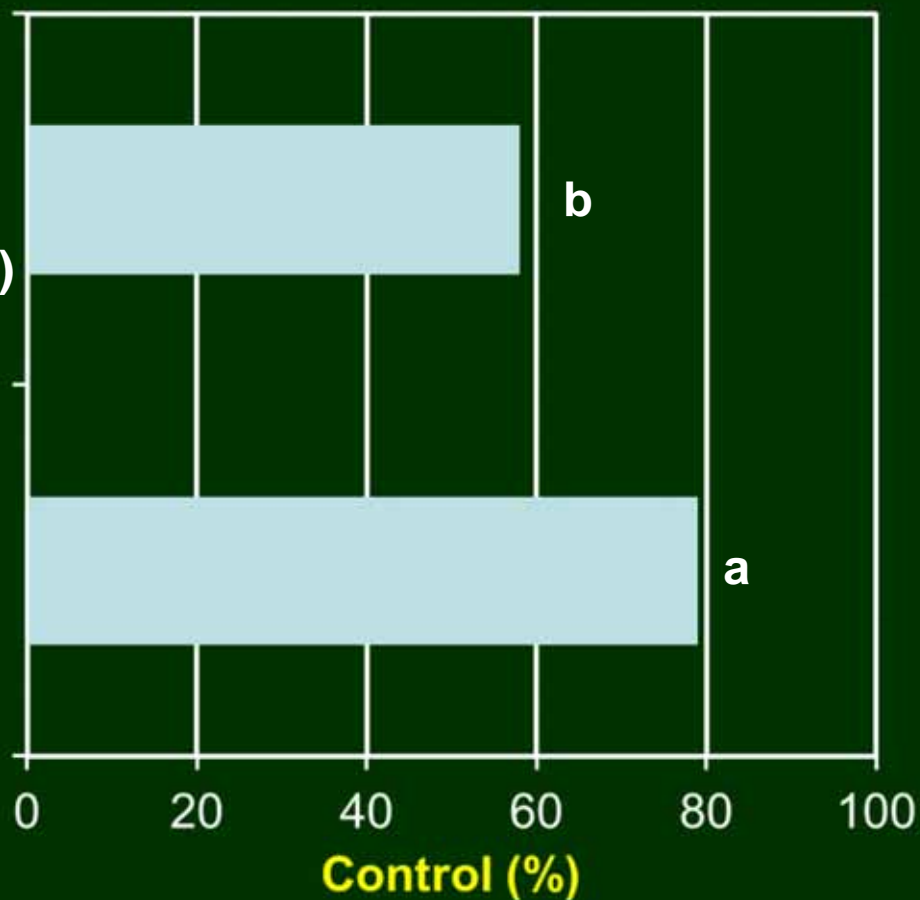
2. Change herbicide use pattern!

- Apply **all** POST herbicides to **small (1 to 3”)** weeds!
- Apply full rates of POST herbicides
- Apply POST herbicide mixtures
 - Apply two or more effective herbicides having different modes of action for the most difficult to control / resistant weed species
 - Each herbicide should be equally effective
 - NOT the most convenient
 - Use full rates
 - Adjust rate for soil type to reduce crop injury
- Start clean in no-tillage crops

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]



Solution – Diversify weed management

3. Maximize cultural weed control

- Maximize plant health

- Crop will compete better with weeds

- Use narrow row spacing

- Plant weediest fields late

- Use multiple tillage passes to remove weeds
- Apply two burndown applications with soil-applied herbicide

- Manage weeds along field perimeters and crop edges

- Other

Field perimeter management (2010)



Ramifications of not managing field perimeter (2011)



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Management of weeds along crop edges



Future problem!



The Goal!

Solution – Diversify weed management

4. Maximize mechanical weed control

- Type of tillage will impact weed species present
 - No-tillage increases perennial and winter annual weeds
 - Reduced tillage increases perennial and summer annual weeds
- Use row cultivation where possible
- Deep plowing can bury weed seeds
 - Maybe use every 5 years??
- Start clean
 - Control all annual weeds prior to planting
- Prefer mowing of weeds along outside field perimeter
- Prefer tillage of weeds along crop edges in field

Solution – Maximize herbicide activity

- Apply most effective herbicide and rate for most difficult to control / resistant weed species
- Apply *all* POST herbicides to **small (1-3")** weeds
- Use correct spray volume
 - **Systemic herbicides (ex. glyphosate, Callisto, Affinity)**
 - 5 to 10 gallons per acre (GPA)
 - **Contact herbicides (ex. Liberty, Flexstar, Atrazine)**
 - ≥ 15 GPA

Solution – Maximize herbicide activity

- Use correct droplet size
 - Systemic herbicides (ex. glyphosate, Callisto, Affinity)
 - Fewer coarse droplets
 - Contact herbicides (ex. Liberty, Flexstar, Atrazine)
 - Numerous fine to medium droplets
 - Be careful with drift
- Use fully operational and calibrated sprayer
 - Replace nozzles on regular basis
 - Reduce travel speeds, especially with contact herbicides

Solution – Maximize herbicide activity

- Apply the most effective adjuvant and rate for herbicide(s) being used
 - MSO for most herbicides
 - AMS + NIS for glyphosate
 - Use the most proven adjuvant with the least antagonism to glyphosate when tank-mixing with glyphosate
 - Must also be the most effective adjuvant for the tank-mix partner
 - Apply oil adjuvants at 1.5 to 2 pt/A
 - This includes high surfactant oil concentrates (HSOC)
- How to maximize glyphosate activity
 - Pgs 69 to 71- 2012 ND Weed Control Guide
 - Pgs 52 & 53 – 2012 Sugarbeet Production Guide

Final reminders

- It's the little things that will make a difference!

Final reminders - 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 discovered, so let's work together to preserve it's effectiveness!



- Thank You!
- 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/>