Herbicide Resistance Update for Wisconsin

Devin Hammer, Nathan Drewitz, Vince Davis, Shawn Conley, Dave Stoltenberg

University of Wisconsin-Madison, Department of Agronomy

Outline

- Progression of Resistance: Last 5 Years
- Identifying Different Pigweed Species
- Procedure for Herbicide Screening
- Current Research

Images courtesy of University of Missouri Extension

Herbicide Resistance: Horseweed

United States:

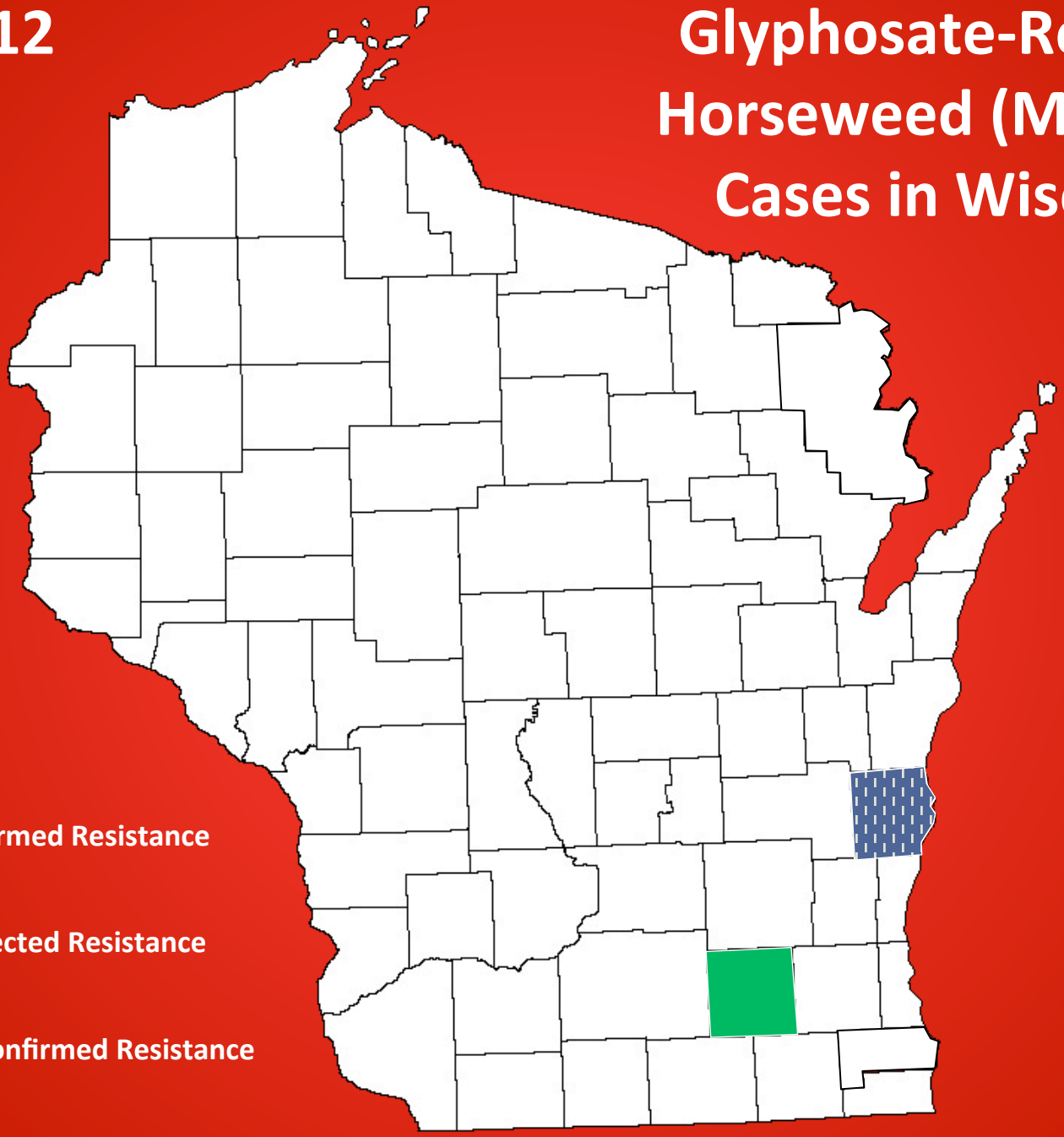
- 23 states
- 4 sites of action
- 5 cases of multiple resistance

Wisconsin:

- Glyphosate-resistant biotypes (2012)

2012

Glyphosate-Resistant Horseweed (Marestail) Cases in Wisconsin



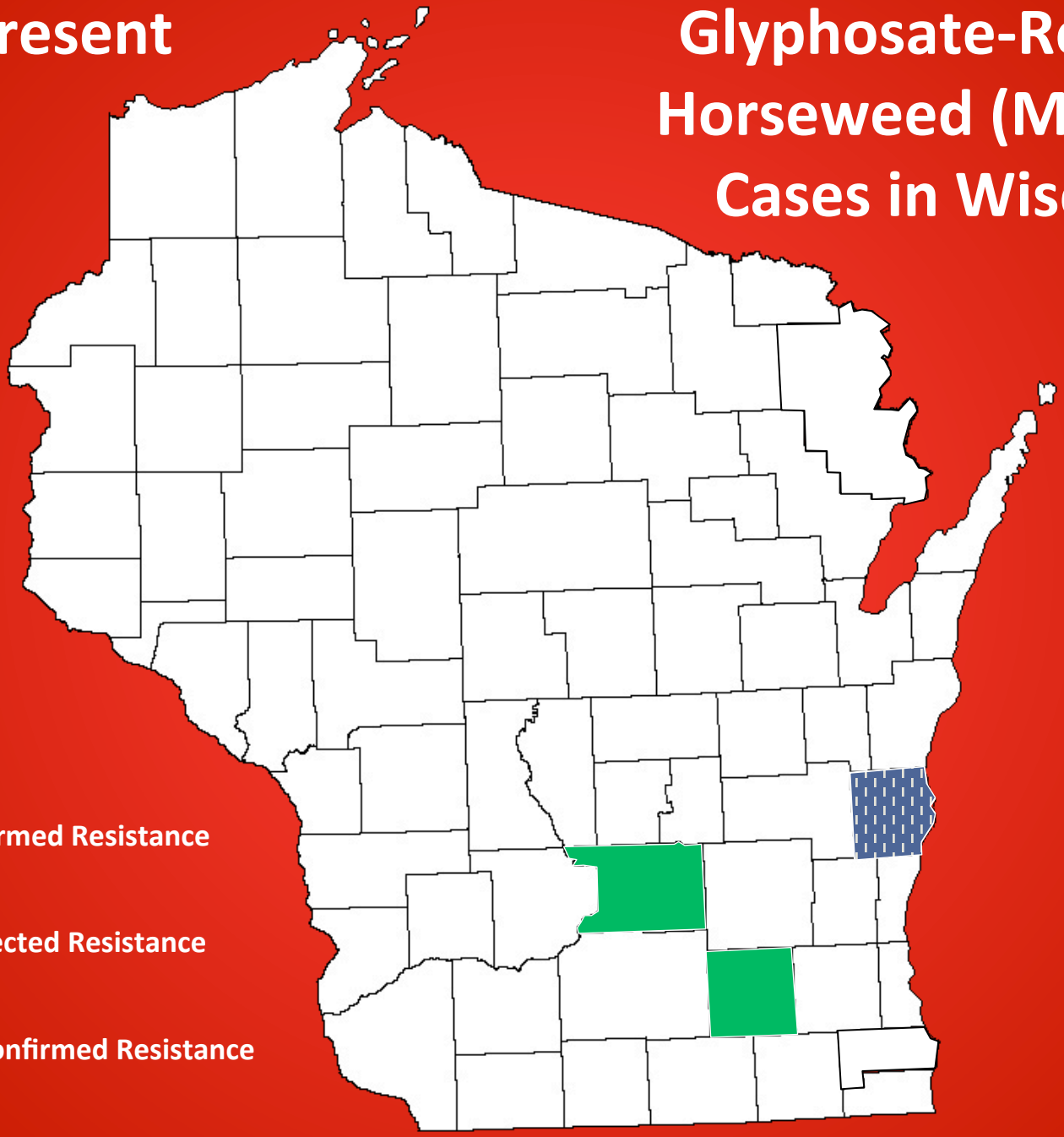
Confirmed Resistance

Suspected Resistance

No Confirmed Resistance

2013-Present

Glyphosate-Resistant Horseweed (Marestail) Cases in Wisconsin



Confirmed Resistance

Suspected Resistance

No Confirmed Resistance

Herbicide Resistance: Giant Ragweed

United States:

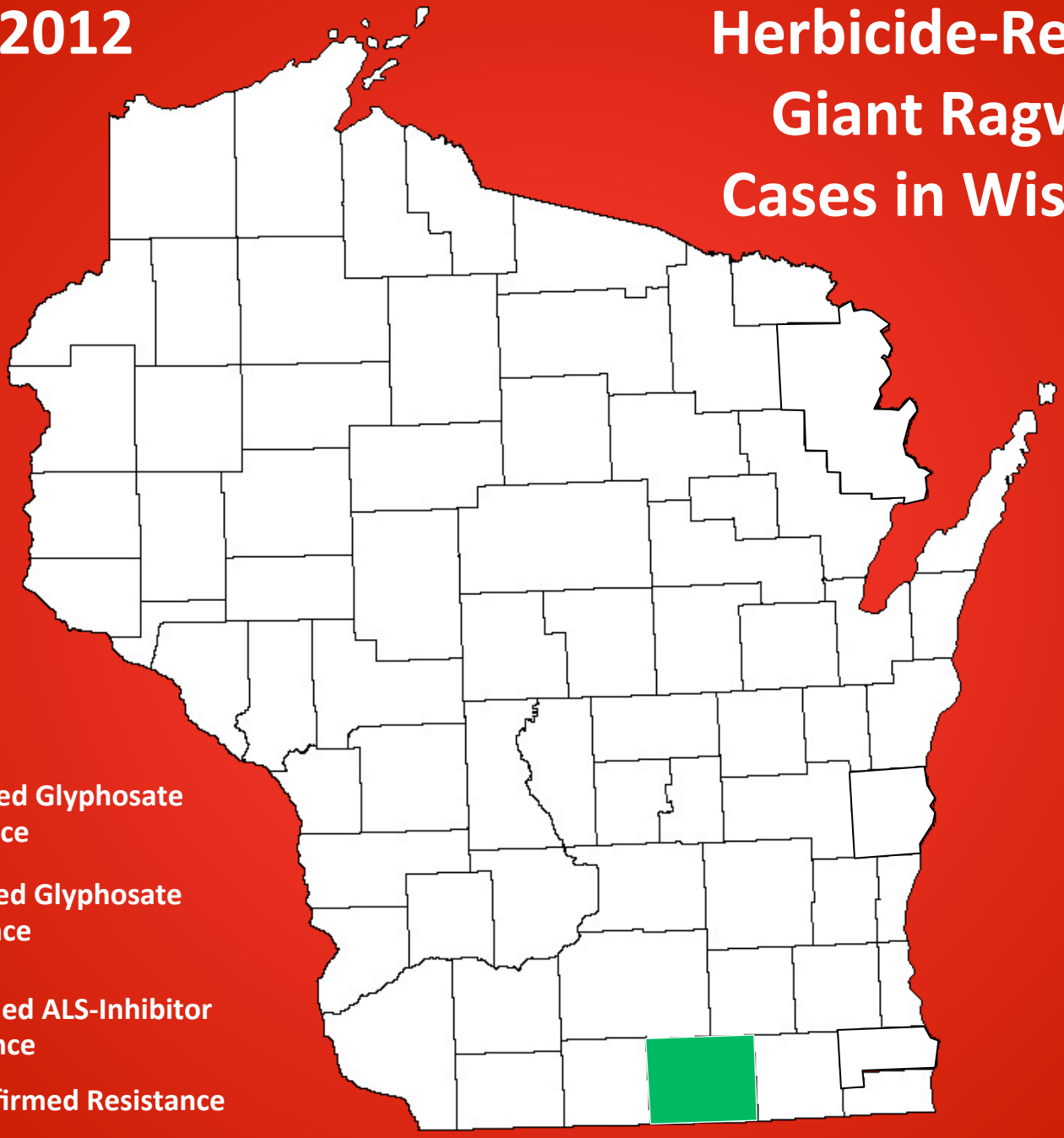
- 13 states
- 2 sites of action
- 3 cases of multiple resistance

Wisconsin:

- Glyphosate-resistant biotypes (2011)
- ALS inhibitor-resistant biotypes (2013)

2011-2012

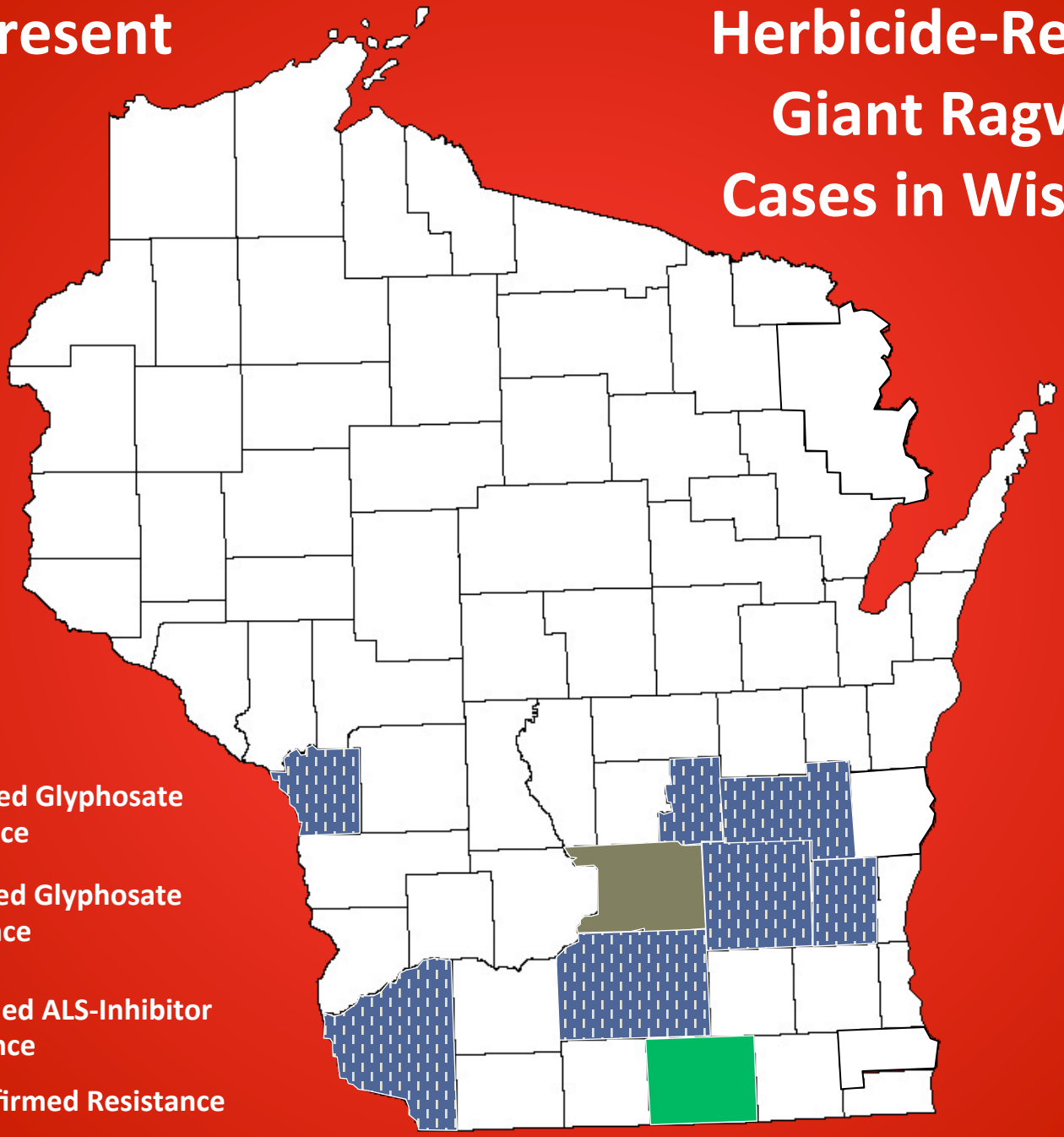
Herbicide-Resistant Giant Ragweed Cases in Wisconsin



- Confirmed Glyphosate Resistance
- Suspected Glyphosate Resistance
- Confirmed ALS-Inhibitor Resistance
- No Confirmed Resistance

2013-Present

Herbicide-Resistant Giant Ragweed Cases in Wisconsin



- Confirmed Glyphosate Resistance
- Suspected Glyphosate Resistance
- Confirmed ALS-Inhibitor Resistance
- No Confirmed Resistance

Herbicide Resistance: Common Ragweed

United States:

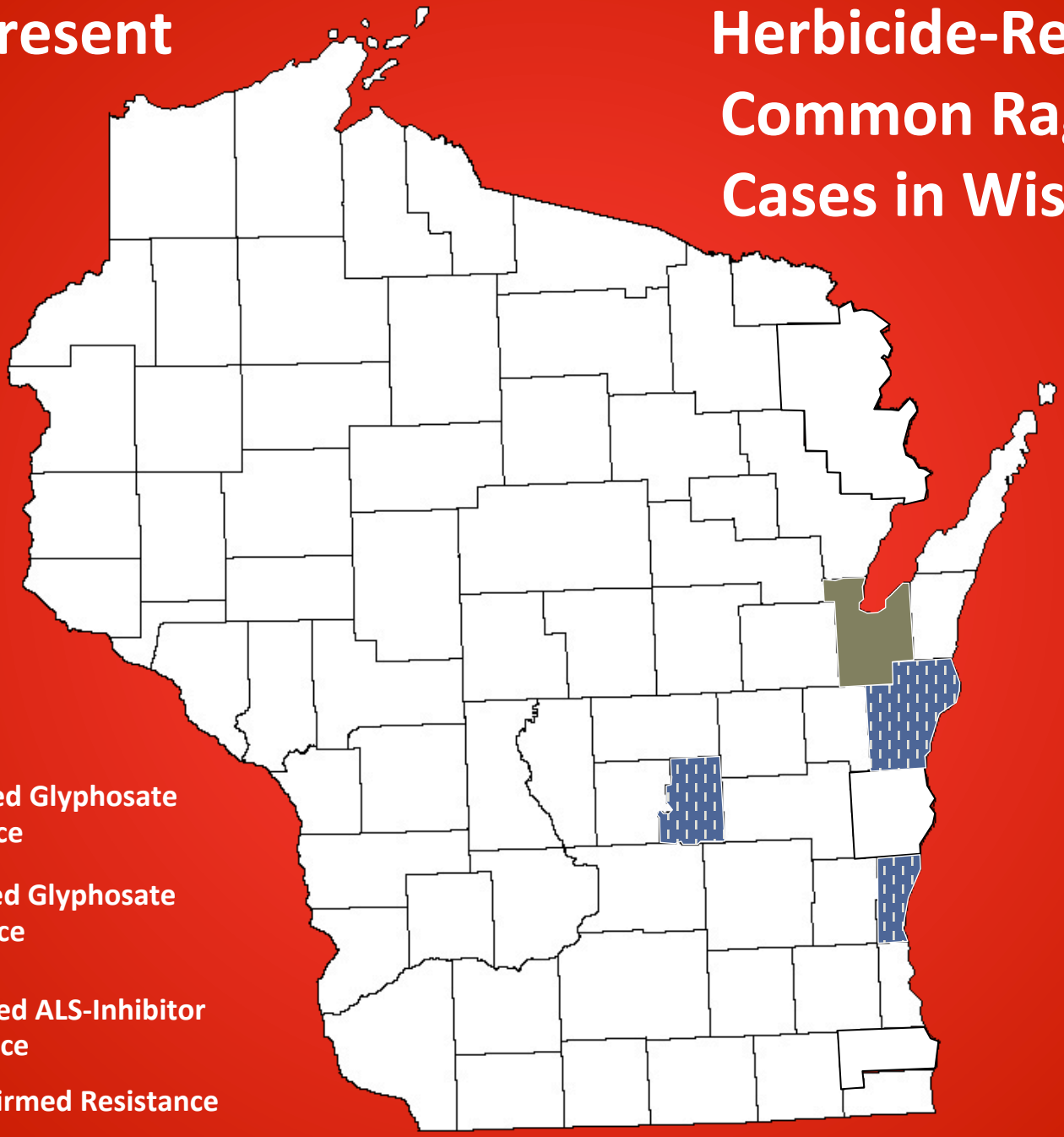
- 20 states
- 4 sites of action
- 4 cases of multiple resistance

Wisconsin:

- ALS inhibitor-resistant biotypes (2013)

2013-Present

Herbicide-Resistant Common Ragweed Cases in Wisconsin



Confirmed Glyphosate Resistance

Suspected Glyphosate Resistance

Confirmed ALS-Inhibitor Resistance

No Confirmed Resistance

Herbicide Resistance: Waterhemp

United States:

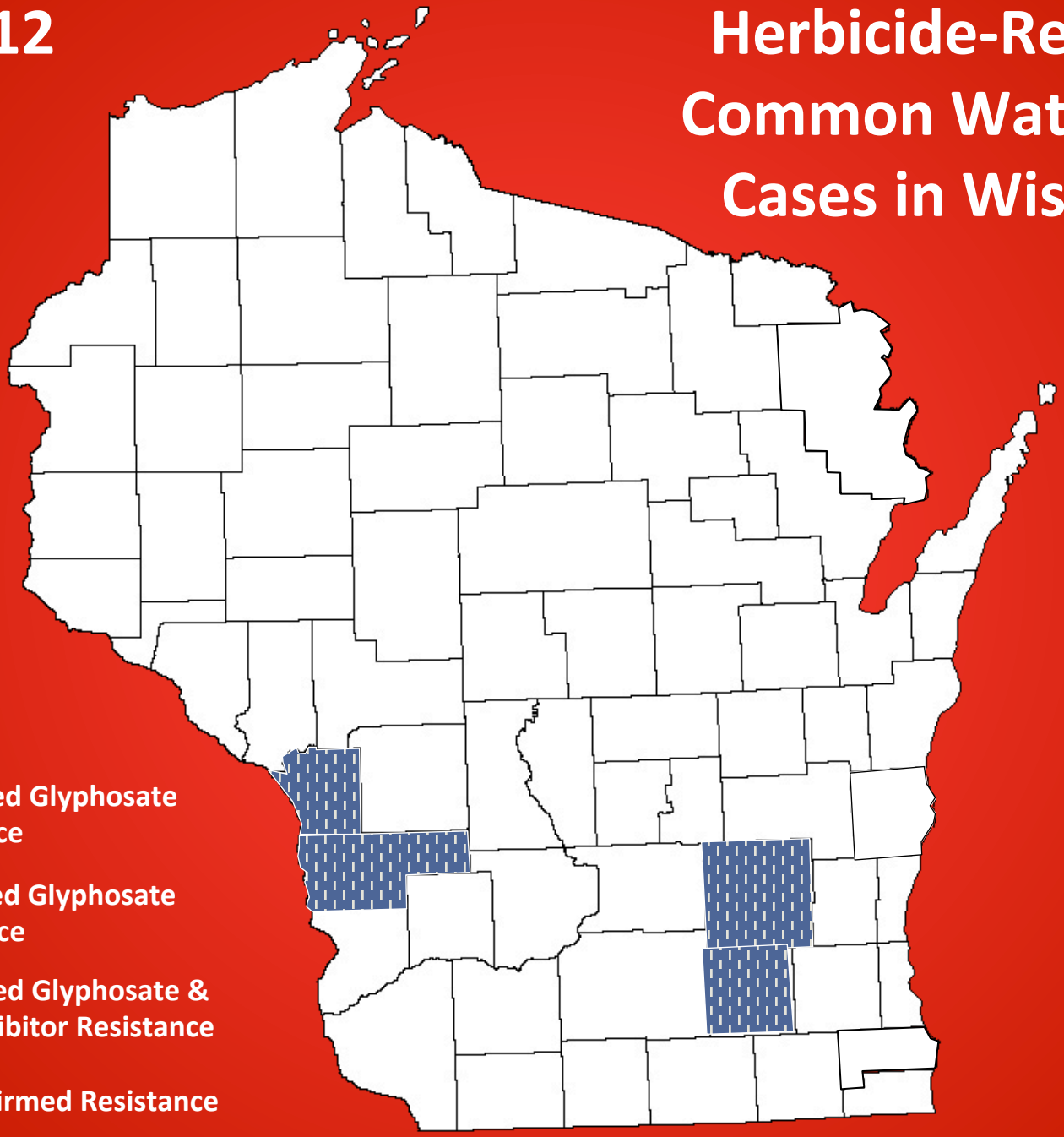
- 19 states
- 6 sites of action
- 11 cases of multiple resistance

Wisconsin:

- ALS inhibitor-resistant biotypes (1999)
- Glyphosate-resistant biotypes (2013)

2012

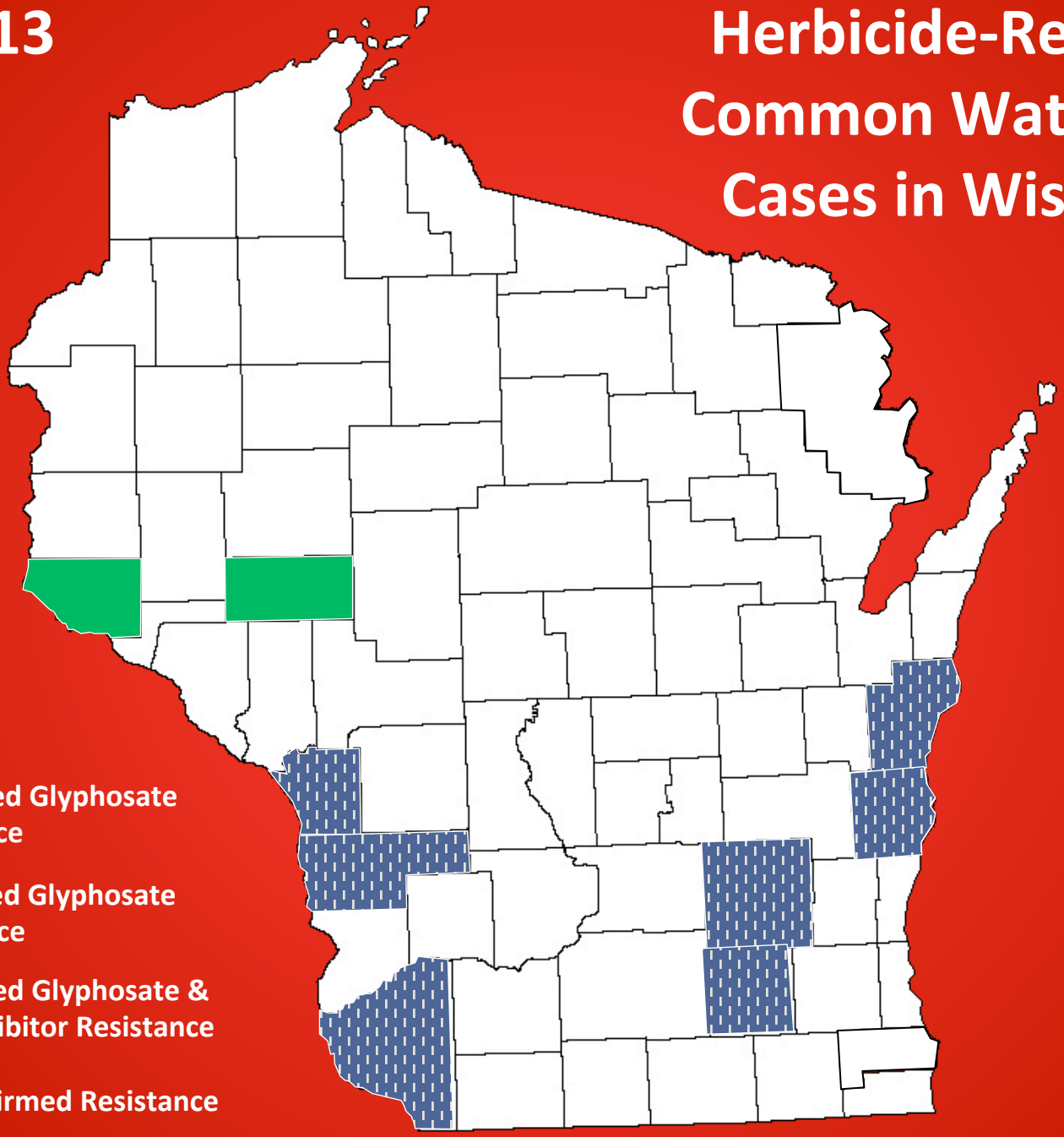
Herbicide-Resistant Common Waterhemp Cases in Wisconsin



- Confirmed Glyphosate Resistance
- Suspected Glyphosate Resistance
- Suspected Glyphosate & PPO-Inhibitor Resistance
- No Confirmed Resistance

2013

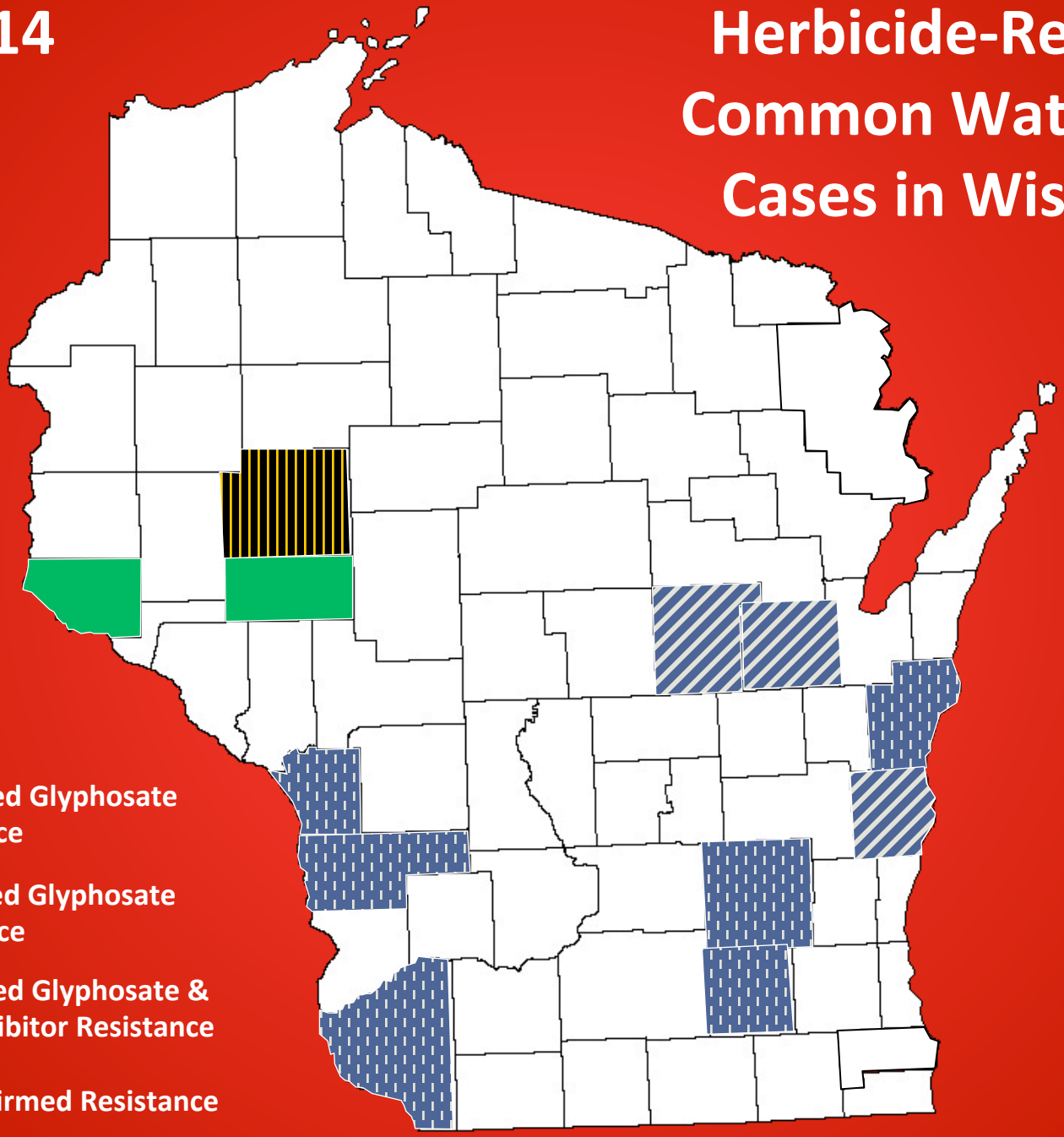
Herbicide-Resistant Common Waterhemp Cases in Wisconsin



- Confirmed Glyphosate Resistance
- Suspected Glyphosate Resistance
- Suspected Glyphosate & PPO-Inhibitor Resistance
- No Confirmed Resistance

2014

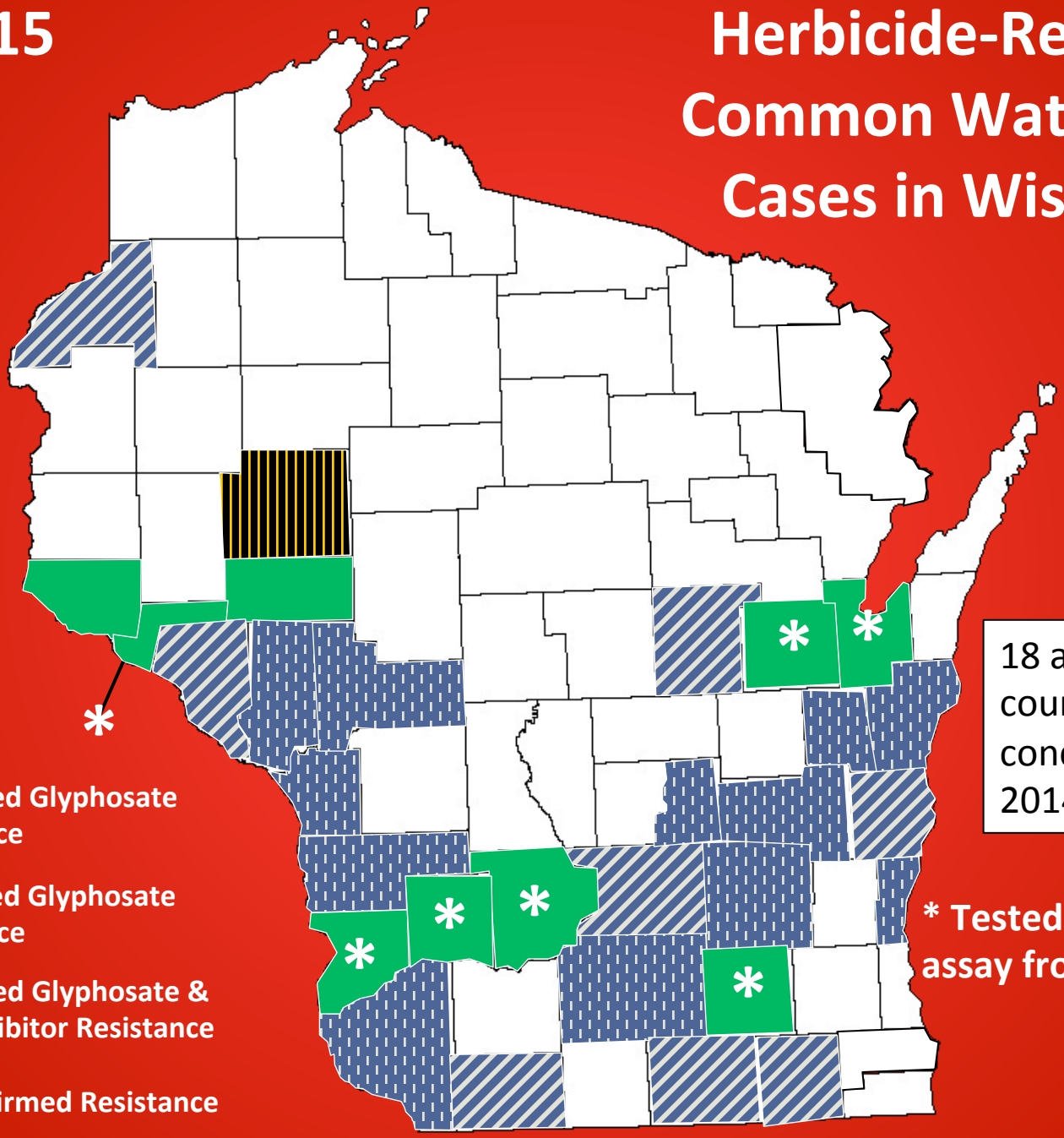
Herbicide-Resistant Common Waterhemp Cases in Wisconsin



- Confirmed Glyphosate Resistance
- Suspected Glyphosate Resistance
- Suspected Glyphosate & PPO-Inhibitor Resistance
- No Confirmed Resistance

2015

Herbicide-Resistant Common Waterhemp Cases in Wisconsin



Confirmed Glyphosate Resistance

Suspected Glyphosate Resistance

Suspected Glyphosate & PPO-Inhibitor Resistance

No Confirmed Resistance

18 additional counties reported concerns 2014-2015!

* Tested by a molecular assay from UIUC

Herbicide Resistance: Palmer Amaranth

United States:

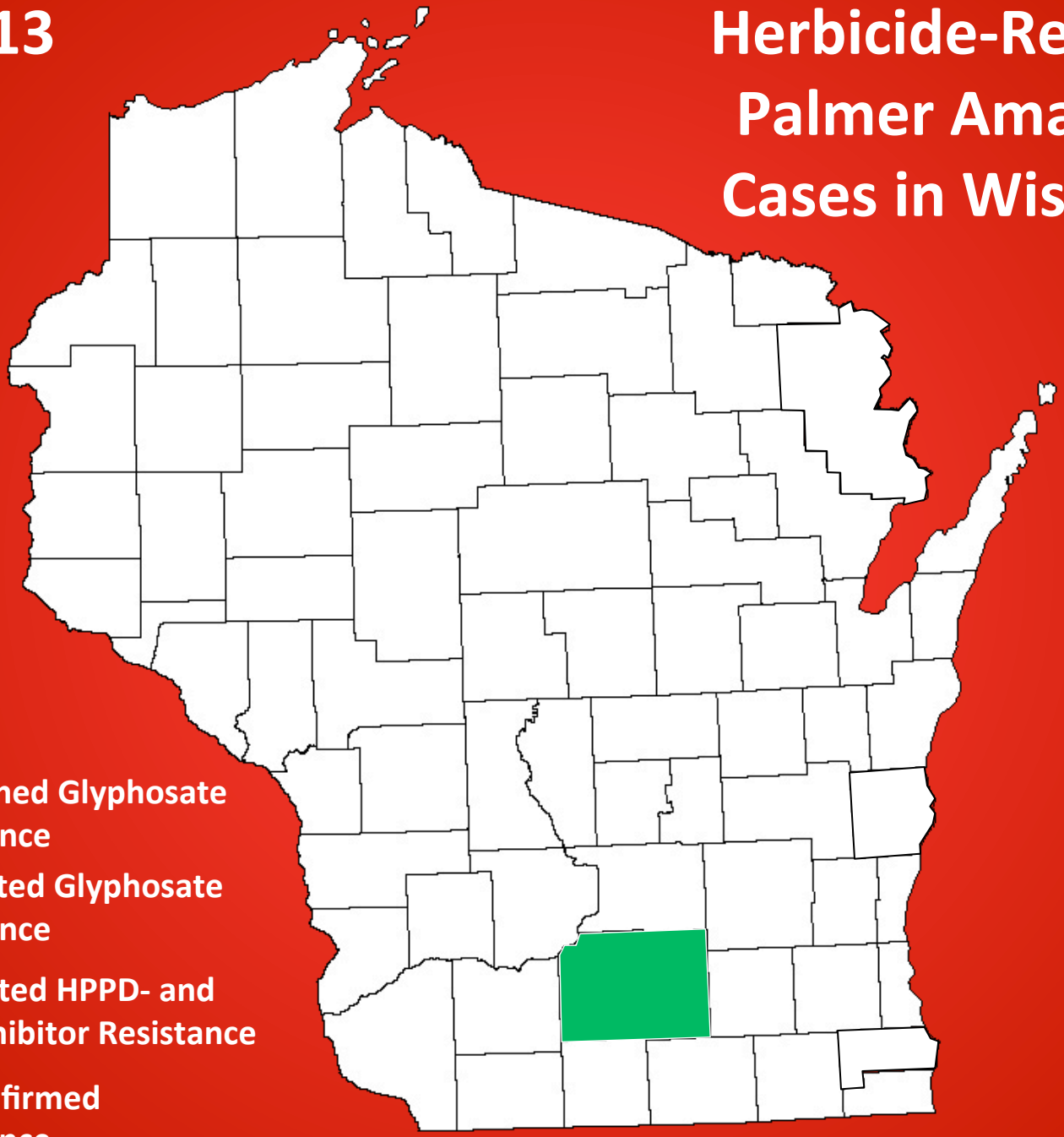
- 26 states
- 6 sites of action
- 11 cases of multiple resistance

Wisconsin:

- Glyphosate-resistant biotypes (2013)

2013

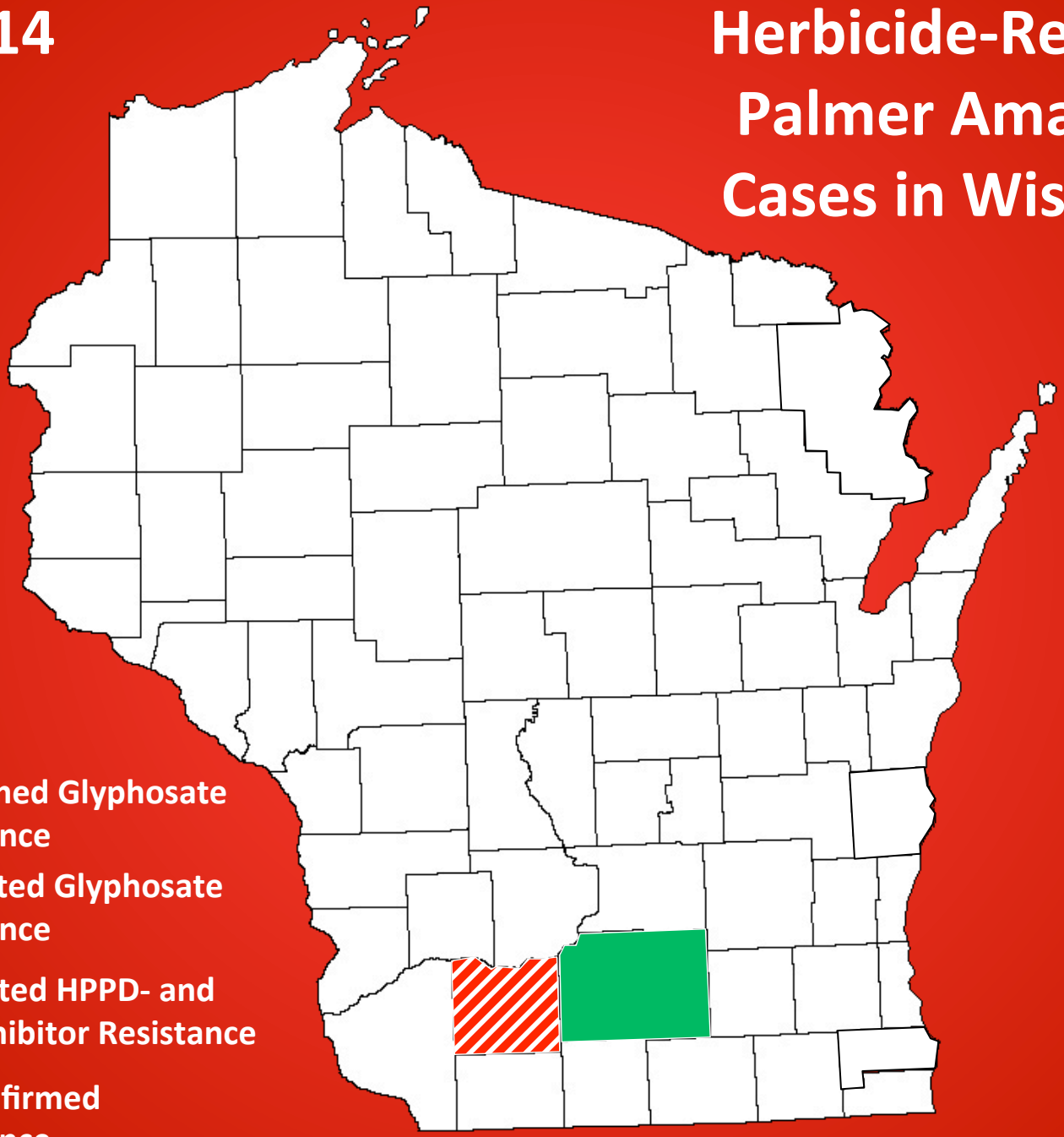
Herbicide-Resistant Palmer Amaranth Cases in Wisconsin



- Confirmed Glyphosate Resistance
- Suspected Glyphosate Resistance
- Suspected HPPD- and ALS-Inhibitor Resistance
- No Confirmed Resistance

2014

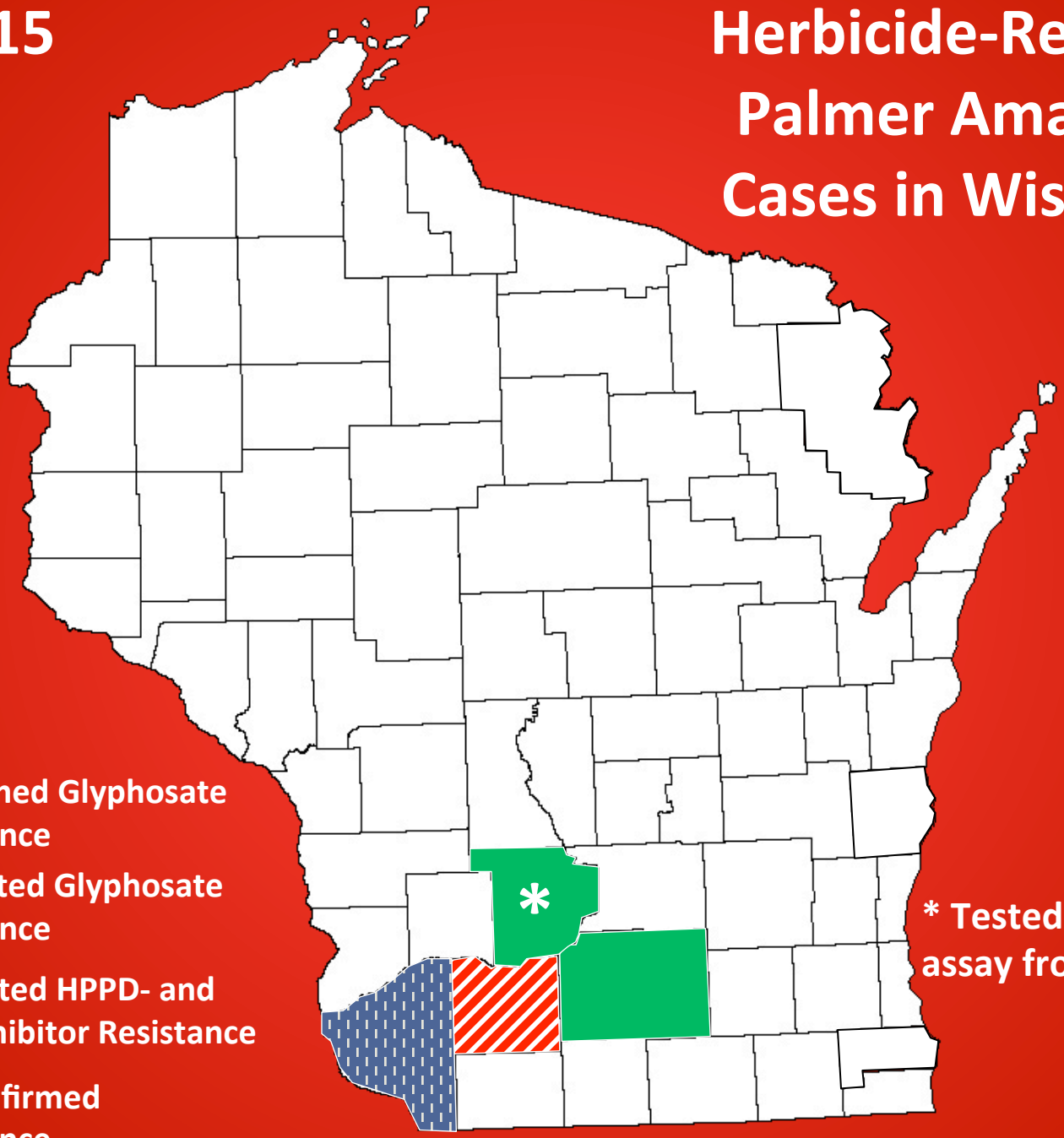
Herbicide-Resistant Palmer Amaranth Cases in Wisconsin



- Confirmed Glyphosate Resistance
- Suspected Glyphosate Resistance
- Suspected HPPD- and ALS-Inhibitor Resistance
- No Confirmed Resistance

2015

Herbicide-Resistant Palmer Amaranth Cases in Wisconsin



Confirmed Glyphosate Resistance

Suspected Glyphosate Resistance

Suspected HPPD- and ALS-Inhibitor Resistance

No Confirmed Resistance

* Tested by a molecular assay from UIUC

Pigweed Identification

Look at the stem

Hairy: redroot pigweed, smooth pigweed, Powell amaranth

Smooth: waterhemp, Palmer amaranth, spiny amaranth

Pigweed Identification

Waterhemp vs. Palmer: vegetative

Waterhemp: leaf is longer; petiole shorter than leaf

Palmer: leaf is more rounded or egg-shaped; petiole generally longer than leaf

Pigweed Identification

Waterhemp vs. Palmer: vegetative

Waterhemp: leaf is longer; petiole shorter than leaf

Palmer: leaf is more rounded or egg-shaped; petiole generally longer than leaf

Pigweed Identification

Waterhemp vs. Palmer: reproductive

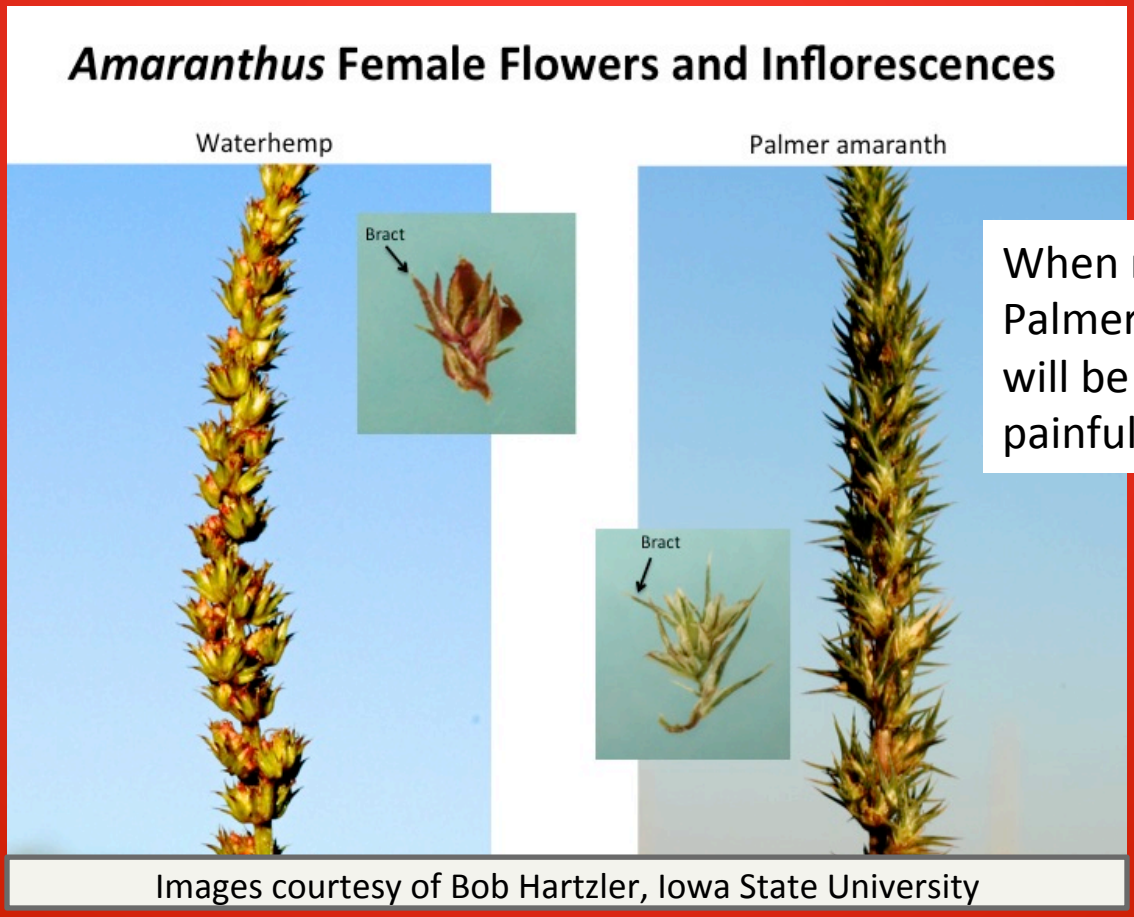
Waterhemp: Thin, more wiry seed heads

Palmer: Thick, long terminal seed heads

Pigweed Identification

Waterhemp vs. Palmer: reproductive

- Both species are dioecious, meaning they have separate male and female plants.



When mature, female Palmer flower bracts will be sharp and painful to handle.

Images courtesy of Bob Hartzler, Iowa State University

Procedure: Herbicide Screening

Procedure: Herbicide Screening

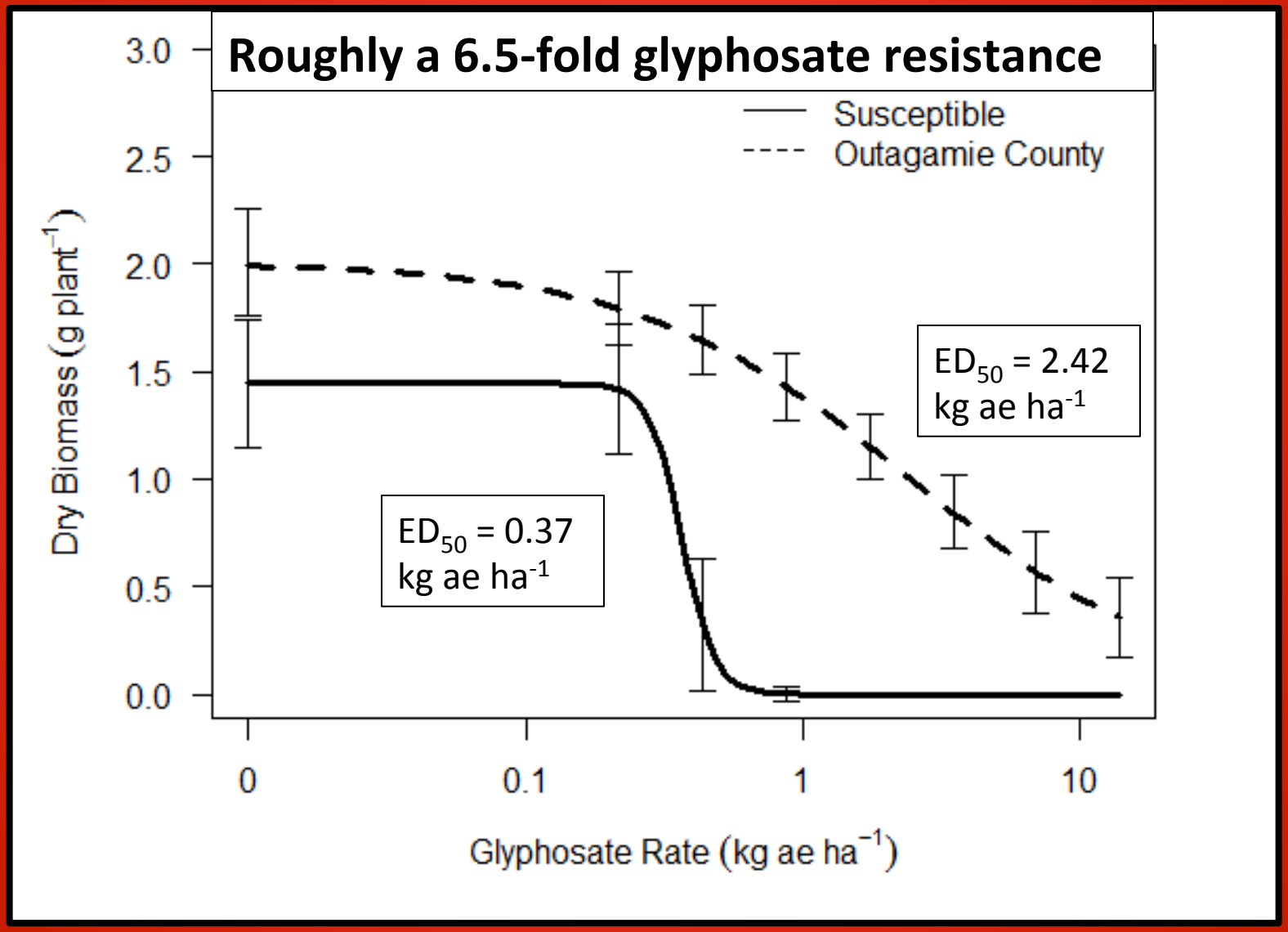
Table 1. List of 8 different glyphosate rates used for the dose response herbicide screening.

Herbicide	Rate							
	1	2	3	4	5	6	7	8
	kg ae ha^{-1}							
glyphosate	0	0.22	0.43	0.87	1.74	3.48	6.96	13.92

Procedure: Results

- Plant shoot biomass collected 28 days after application
- Data analyzed using the dose response model package in R statistical software
- Comparisons based on the estimated effective dose to reduce plant biomass 50% (ED_{50})

Procedure: Results



Procedure: Results

Table 2. Comparison of plant dry biomass 28 days after application between the Outagamie County and known susceptible waterhemp populations at each glyphosate rate.

	Glyphosate Rate (kg ae ha^{-1})							
	0	0.22	0.43	0.87	1.74	3.48	6.96	13.92
Significance	NS	NS	***	***	**	*	***	**

*Significant at α=0.05
**Significant at α=0.01
***Significant at α=0.001

Current Research: USB Systems Study

Current Research: USB Systems Study

POST timing

PRE fb inter-row cultivation

No PRE

Conclusions

- Glyphosate-resistant waterhemp is spreading throughout Wisconsin
  - 9 counties confirmed, 9 more suspected
  - Does not mean every plant is resistant, populations can be segregating
- Palmer amaranth is starting to spread as well

Conclusions

What can we do?

- *Know your weeds*
  - Know differences between pigweed species
- *Manage your fields*
  - Diversify weed management strategies
  - Till/harvest contaminated fields last
  - Clean equipment after use
- *Understand your herbicides*
  - Use a PRE herbicide application, tank-mix multiple modes of action
  - Use labeled rates, proper adjuvants, and apply at correct timings

Thanks to:

- Undergraduate and graduate research assistants for all their help in the field and the greenhouse

- United Soybean Board for funding this research

More Information:

Wisconsin Weeds:

http://wcws.cals.wisc.edu/

Herbicide-Resistant Weed Management:

http://takeactiononweeds.com/

http://weedscience.org/

Questions?