Herbicide-Resistant Common Waterhemp and Palmer Amaranth in Wisconsin

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Outline

- Pigweed species identification
- Herbicide resistance in waterhemp
- Herbicide resistance in Palmer amaranth
- Herbicide resistance management

Correct identification is key for pigweed management

Start with the stem when identifying pigweeds

Hairy: redroot pigweed, smooth pigweed, Powell amaranth

Smooth: waterhemp, Palmer amaranth, spiny amaranth

Subtle but important differences in leaf morphology

Waterhemp: leaf is longer; petiole shorter than leaf

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

Seed heads can be used for identification later in the season

Palmer Redroot Smooth Waterhemp

Kansas State Extension

Seed heads can be used for identification later in the season

Waterhemp: Thin, wiry seed heads

Palmer: Thick, long terminal seed heads

Separate male and female plants in waterhemp and Palmer amaranth

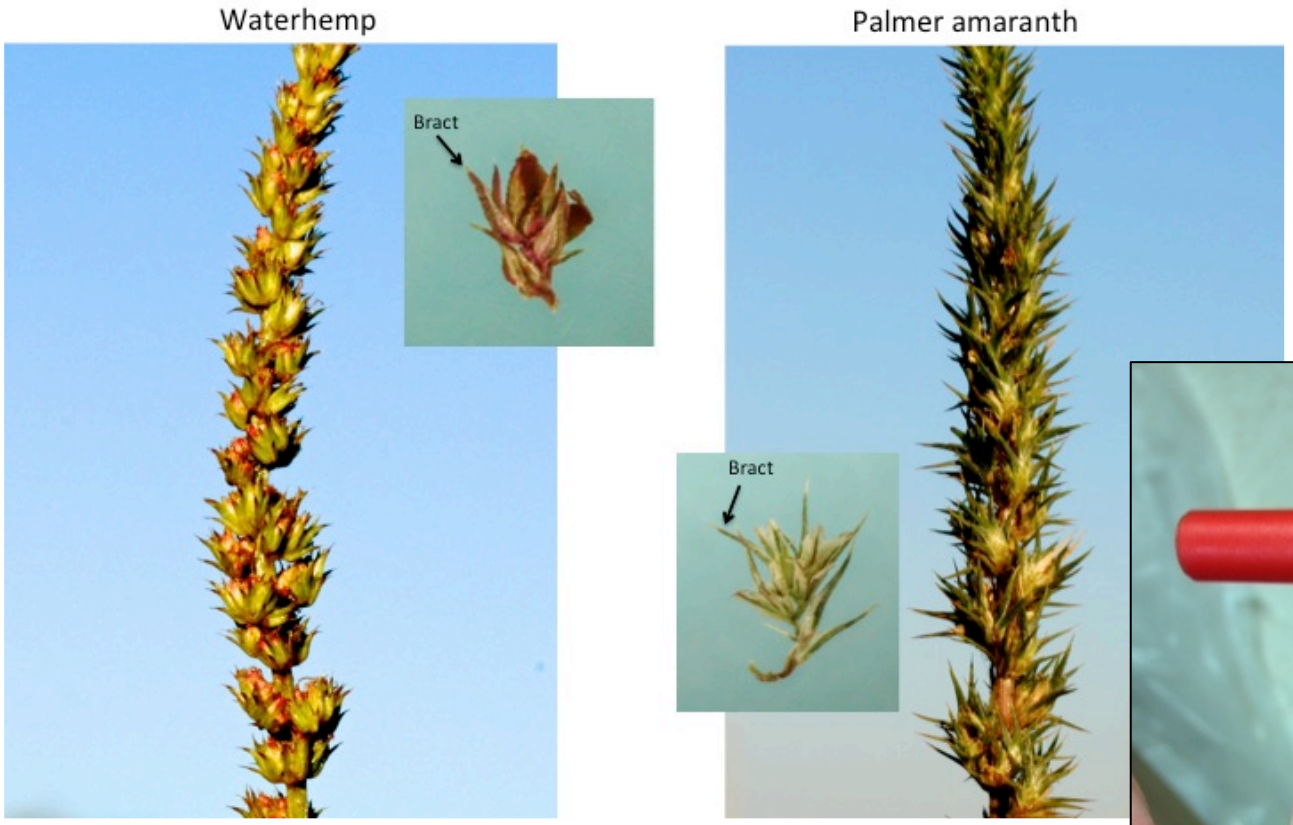
Male plants' flowers only have stamens that produce pollen

Female plants' flowers have stigmas and ovaries

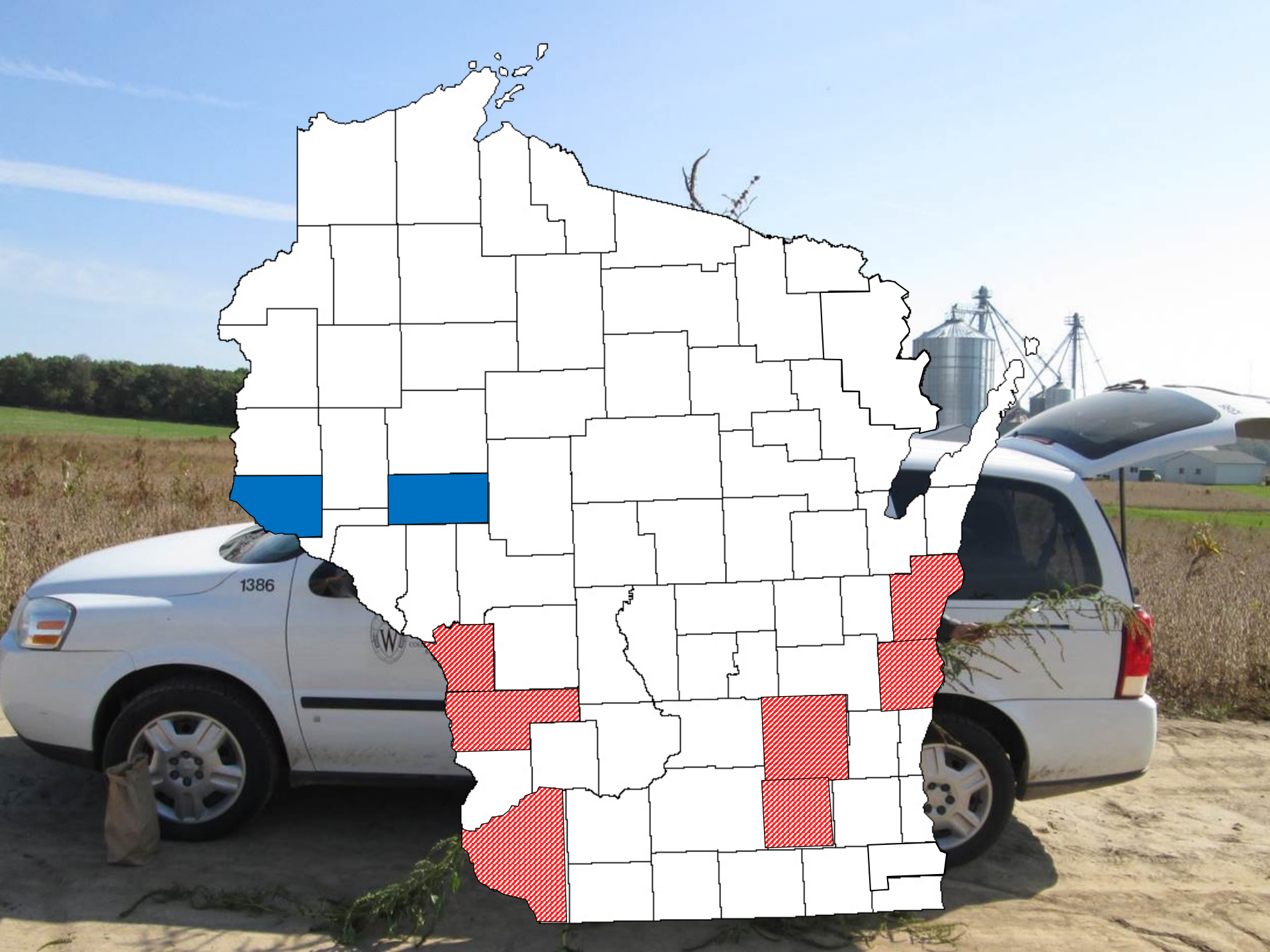
Photos courtesy of Southwest Desert Flora

Female Palmer amaranth flower bracts are sharp when mature

Amaranthus Female Flowers and Inflorescences



Photos courtesy of Bob Hartzler, Iowa State University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Common Waterhemp Seed Collection in 2014 and 2015

- **2014: Six populations sampled in Chippewa, Outagamie, Sheboygan, and Waupaca counties**

- **2015: Five populations sampled in Crawford, Lafayette, and Walworth counties**

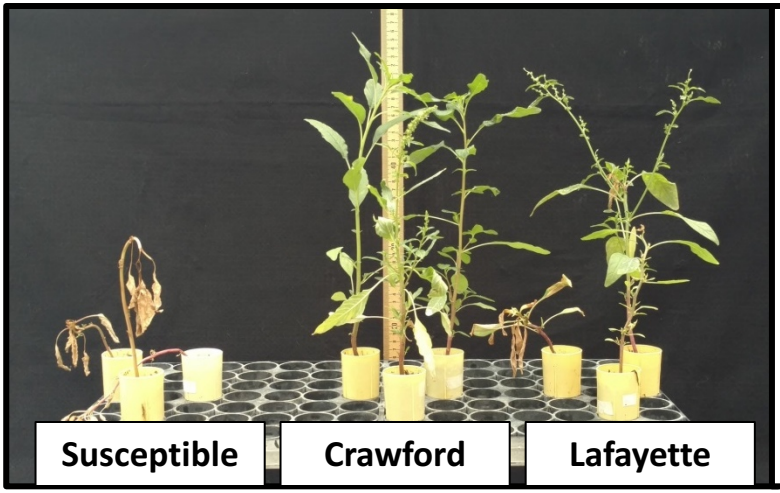
Dose-Response Experiments

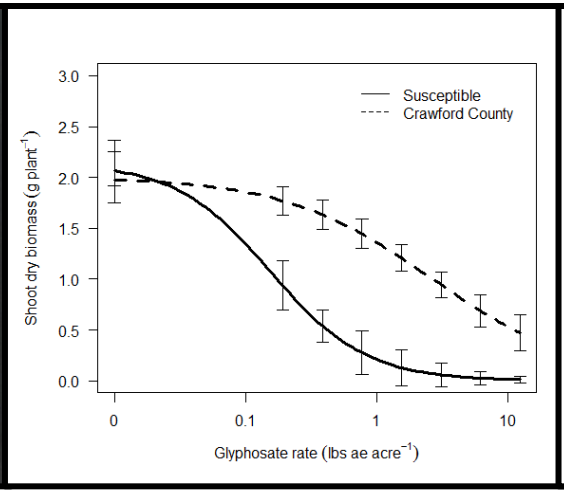
- 5-10 plants from each population were treated with eight rates of glyphosate ranging from 0 to 12.4 lb ae acre^{-1}
- Shoot biomass was collected 28 days after glyphosate application, dried, and weighed
- Comparisons were made based on a predicted dose to reduce biomass by 50% (ED_{50}) to non-treated plants
- Some populations were also tested for resistance at the University of Illinois Plant Clinic

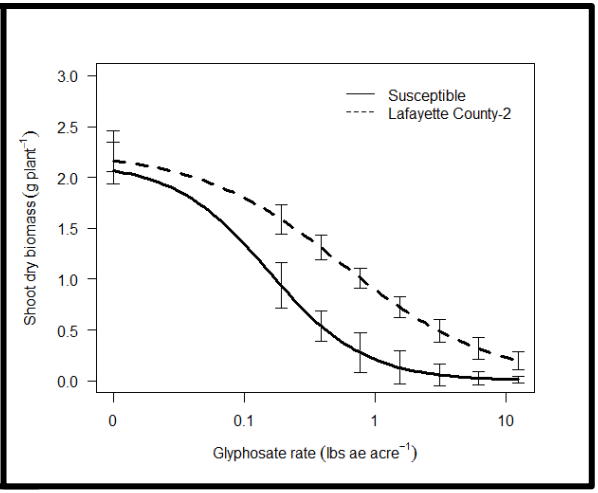
Common Waterhemp Results

Glyphosate effective dose (ED_{50}) values for suspected resistant (R) and known susceptible (S) populations tested in greenhouse dose-response experiments			
Collection Year	**Population**	**ED_{50} [lb ae acre^{-1}]**	**ED_{50} R:S ratio**
2014	Wisc-S	0.34	---
2014	Chippewa-R	0.58	1.7*
2014	Outagamie-R	1.83	5.3*
2014	Sheboygan-R1	0.78	2.3*
2014	Sheboygan-R2	0.79	2.3*
2014	Sheboygan-R3	2.61	7.6*
2014	Waupaca-R	4.15	12.1*
2015	Wisc-S	0.16	---
2015	Crawford-R	2.66	17.0*
2015	Lafayette-R1	1.28	8.2*
2015	Lafayette-R2	0.59	3.8*
2015	Walworth-R1	2.48	15.9*
2015	Walworth-R2	3.42	21.9*

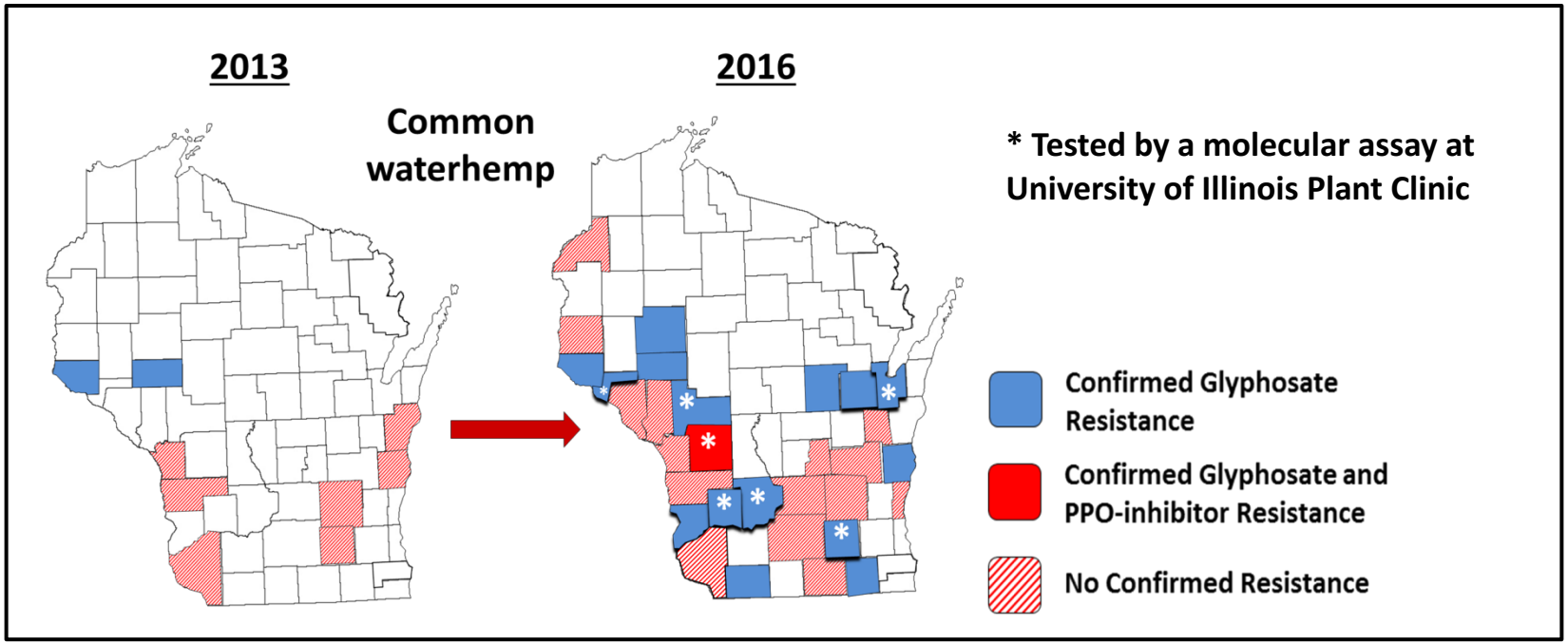
* Significant at α=0.1





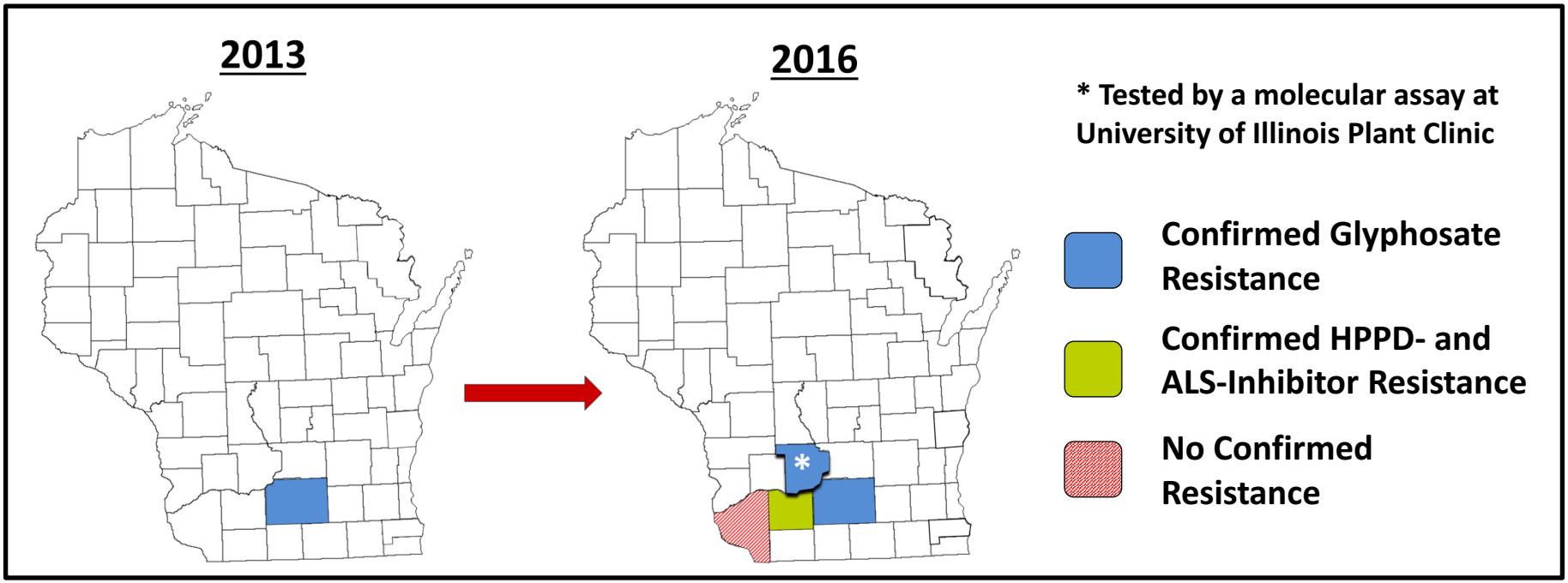


Herbicide Resistance in Common Waterhemp 2013-2016



- Glyphosate resistance confirmed in waterhemp from 16 counties since 2013
- First known waterhemp population in Wisconsin with multiple resistance to glyphosate and PPO inhibitors found in Monroe County
- Waterhemp distribution and extent of herbicide resistance likely greater than shown

Palmer Amaranth in Wisconsin 2013-2016

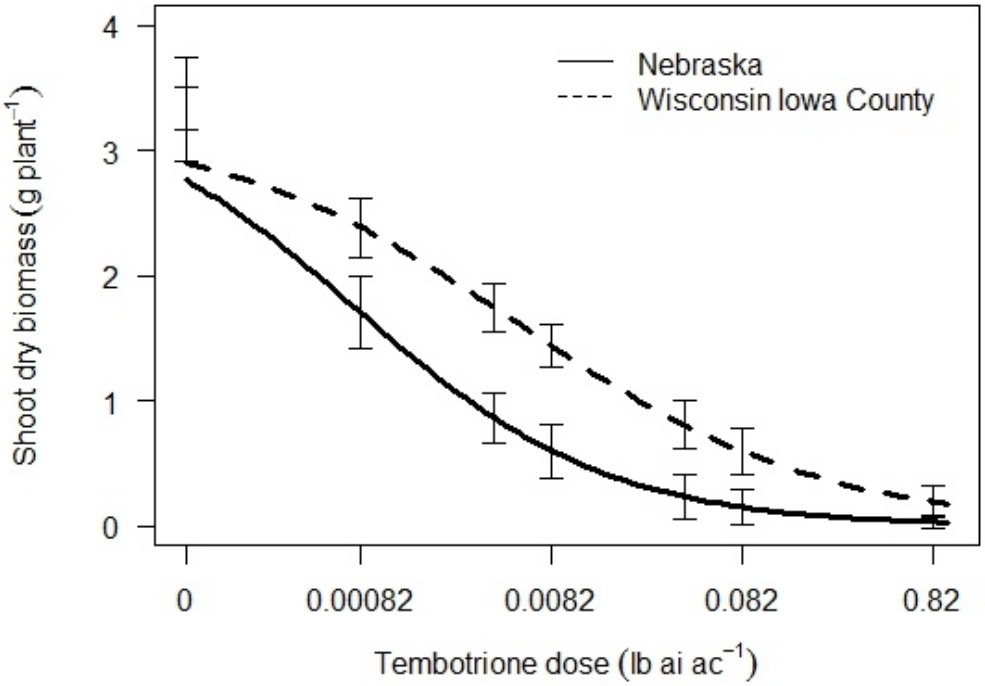


- **First population identified in Dane County in 2013**
  - **Confirmed glyphosate resistance**
- **Three additional populations found since 2013**
  - **Iowa County 2014**
  - **Grant County 2015**
  - **Sauk County 2015**

Dose-Response Experiments

- **Tembotrione**
  - 4- to 6-inch tall plants
  - Seven rates from 0 to 0.82 lb ai acre^{-1}
- **Imazethapyr**
  - 4- to 6-inch tall plants
  - Six rates ranging from 0 to 6.25 lb ai acre^{-1}
- **Thifensulfuron**
  - 4-inch tall plants
  - Seven rates ranging from 0 to 0.039 lb ai acre^{-1}
- **All herbicide treatments included recommended adjuvants**
- **Experiments were conducted three times**

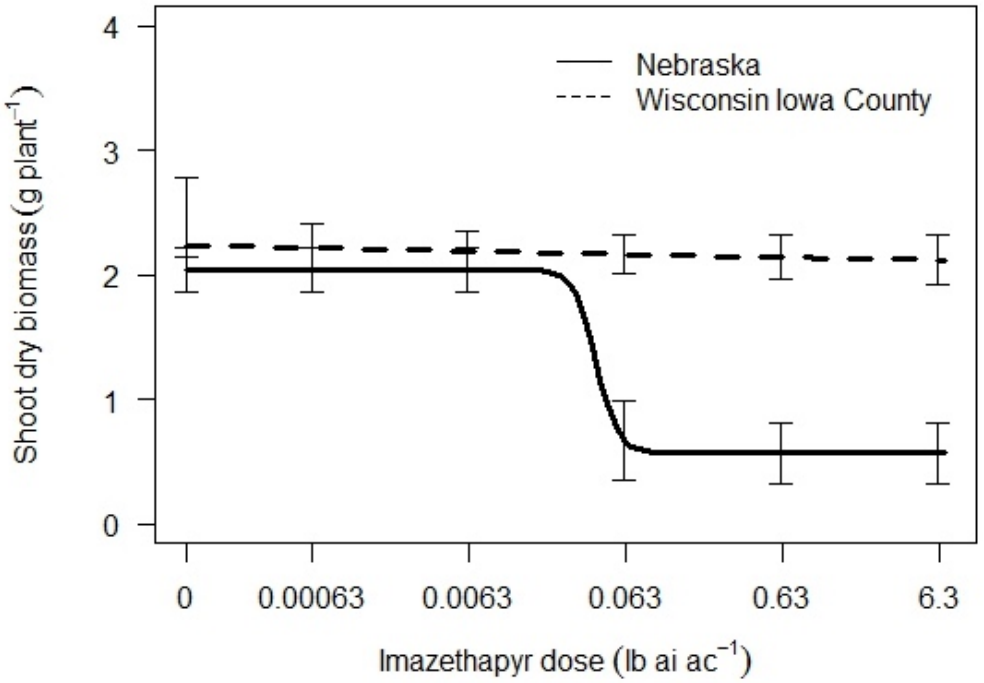
Tembotrione Resistance in Iowa County Palmer Amaranth

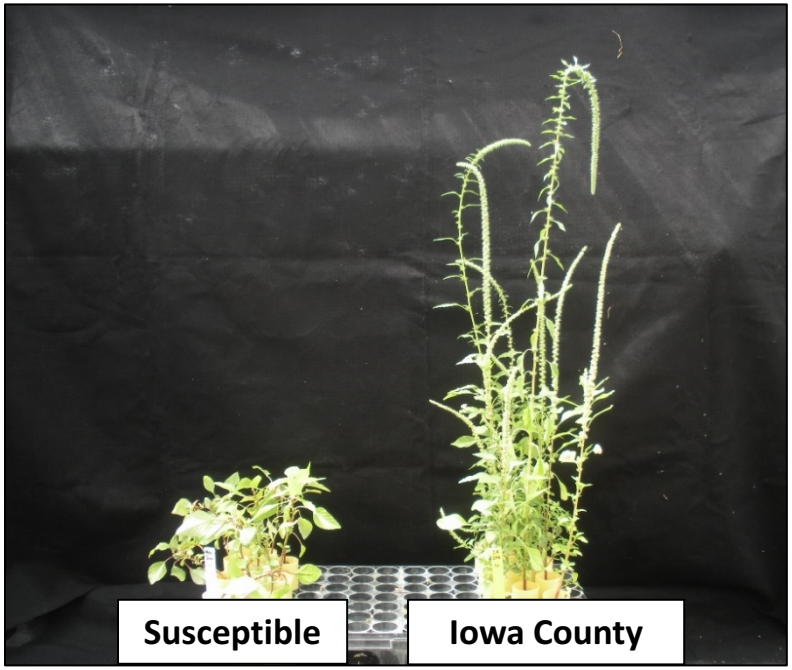


Tembotrione effective dose (ED_{50}) values for suspected resistant (R) and known susceptible (S) populations tested in greenhouse dose-response experiments

Population	ED_{50} (lb ai acre^{-1})	ED_{50} R:S ratio
Nebraska-S	0.0008	---
Iowa County-R	0.0056	7.0

Imazethapyr Resistance in Iowa County Palmer Amaranth

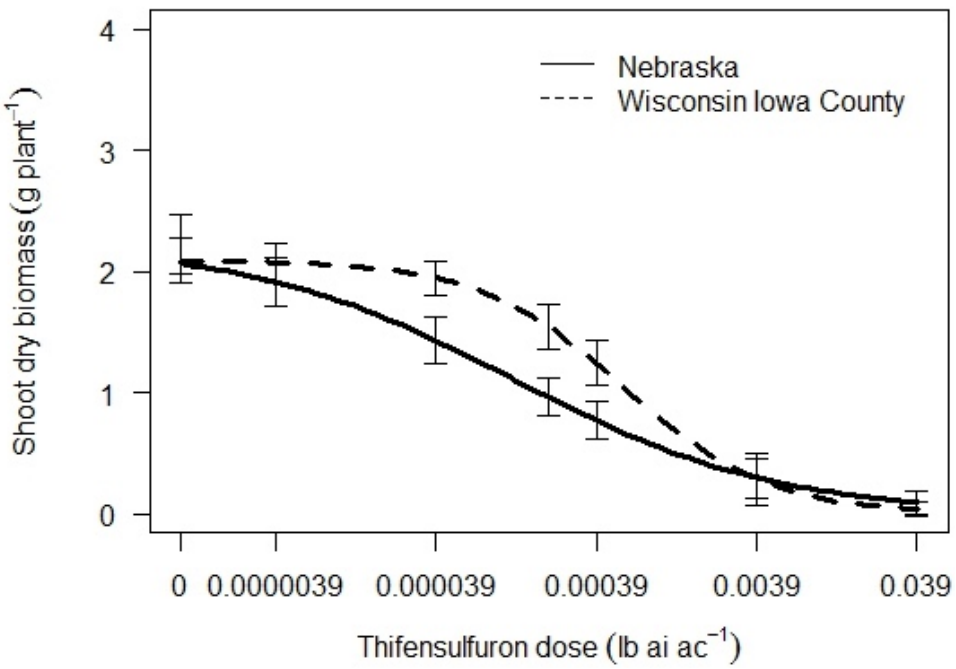




Imazethapyr effective dose (ED_{50}) values for suspected resistant (R) and known susceptible (S) populations tested in greenhouse dose-response experiments

Population	ED_{50} (lb ai acre^{-1})	ED_{50} R:S ratio
Nebraska-S	0.04	---
Iowa County-R	>6.3	>150

Thifensulfuron Resistance in Iowa County Palmer Amaranth



Thifensulfuron effective dose (ED_{50}) values for suspected resistant (R) and known susceptible (S) populations tested in greenhouse dose-response experiments

Population	ED_{50} (lb ai acre^{-1})	ED_{50} R:S ratio
Nebraska-S	0.00012	---
Iowa County-R	0.00058	4.9

Conclusions

- **Distribution of herbicide-resistant common waterhemp has increased rapidly in Wisconsin**
- **Multiple resistance in Palmer amaranth and common waterhemp has serious implications for Wisconsin growers**
- **Using diverse resistance management strategies is critical**

Herbicide Resistance Management

- Know your weeds
- Utilize diverse management practices
- Scout routinely
- Prevent weed seed production

Herbicide Resistance Management

- **Use multiple herbicide modes of action that are effective on target weed species**
  - **Tank mix herbicide modes of action**
  - **Use a preemergence residual herbicide**
  - **Rotate crop traits**
- **Follow the label**

For more information:

takeactiononweeds.com

weedscience.org

TakeACTION HERBICIDE-RESISTANCE MANAGEMENT

Questions?