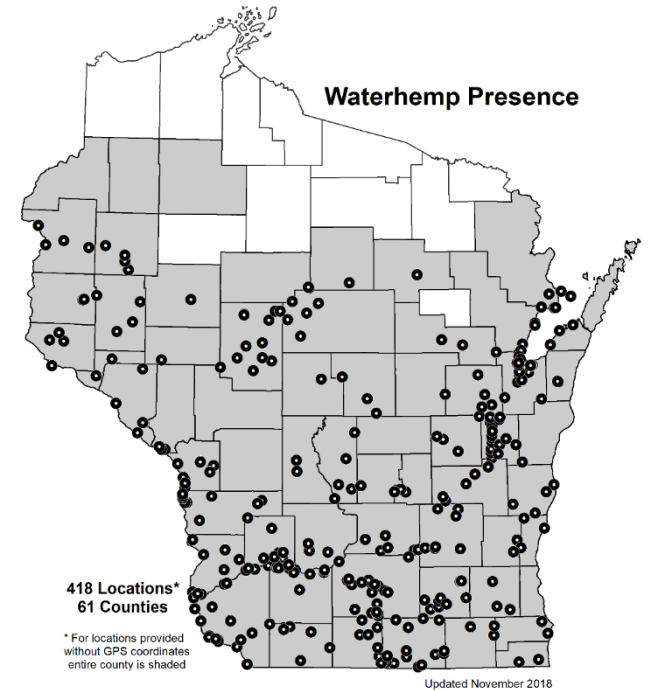


# WATERHEMP IDENTIFICATION AND MANAGEMENT IN ESTABLISHED ALFALFA



Extension

UNIVERSITY OF WISCONSIN-MADISON

Mark Renz

Extension Weed Specialist

# 13 Pigweed species (*Amaranthus*) found in Wisconsin

2017 Weed Identification Series

- 6 of agricultural importance

1. Red-root pigweed
2. Smooth pigweed
3. Prostrate pigweed
4. Powell's amaranth
5. Common/tall waterhemp\*
6. Palmer Amaranth\*



## Tall/Common Waterhemp

**Annual broadleaf** that germinates April – August. Commonly found in agronomic and horticultural crops as well as highly disturbed areas.

**Leaves:** Lance or spearhead shaped, 3-6 in long that alternate on the stem. Petiole is shorter than the length of the leaf blade.

**Stem:** Typically, 4-5 ft tall, but can grow > 10 ft. Lacks hair on the stem.

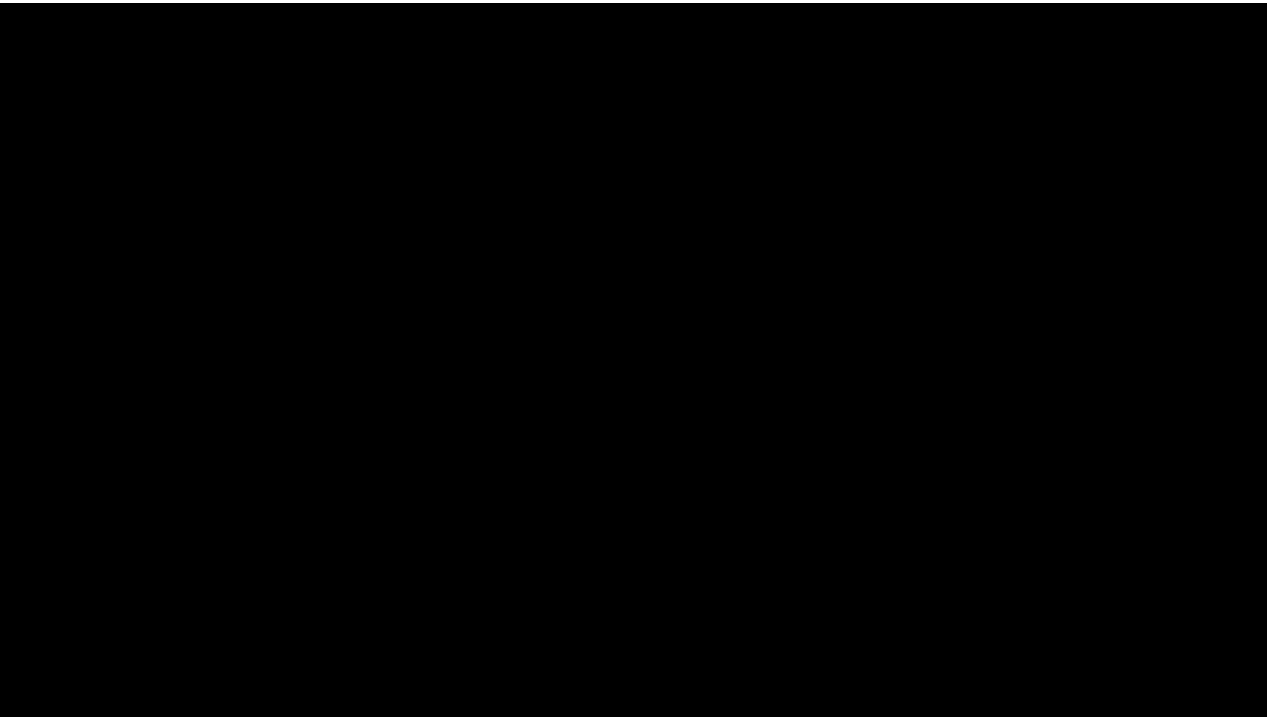
**Flowers:** Many small green flowers form an inflorescence in July-September. While the terminal inflorescence can be > 1 ft long, many wiry lateral branches occur throughout the inflorescence. Male and female flowers found on separate plants, and can on occasion turn pink – red as they mature.

**Similar Plants:** This plant is often confused with other common pigweeds, especially palmer and spiny amaranth as they also have no hairs on stems. Palmer amaranth can be differentiated by the petiole as it is longer than its leaf blade unlike Waterhemp. Spiny amaranth has distinct spines below leaves. For more information including a video see visit the [report-a-pigweed link](#) below.

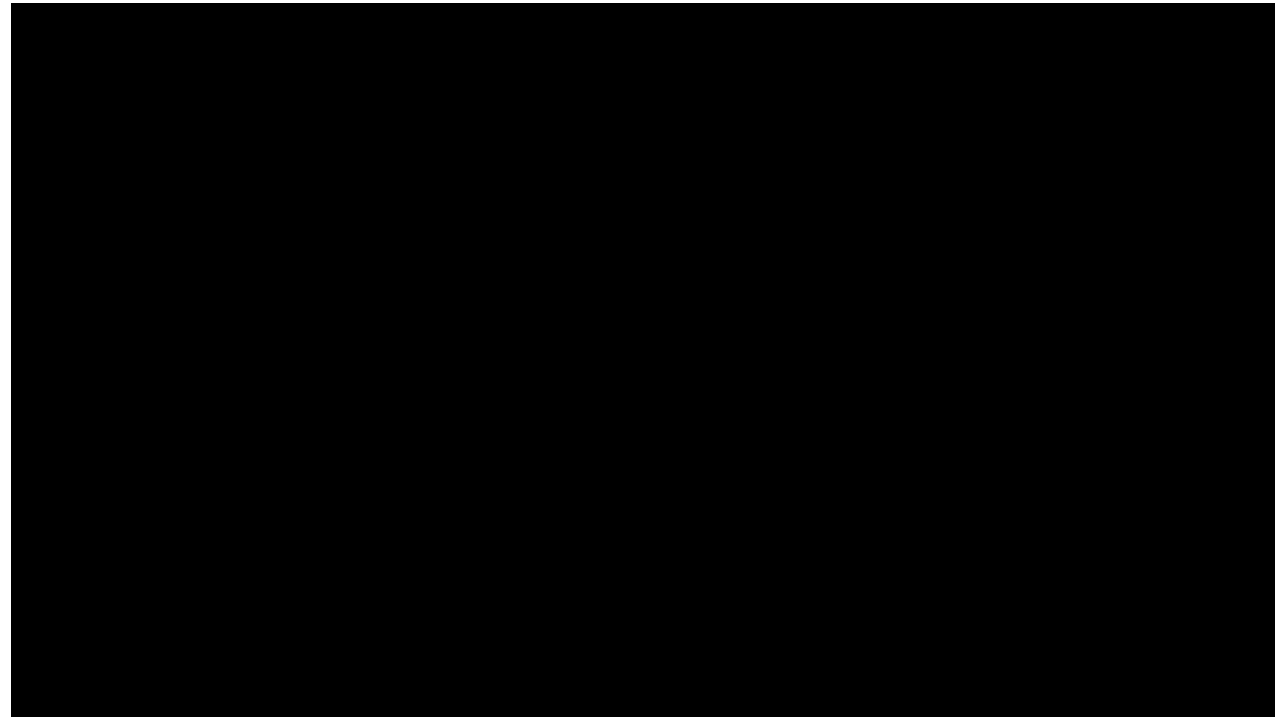
**Herbicide Resistance:**  
In Wisconsin resistance to glyphosate has been confirmed in 16 counties and resistance to glyphosate and PPO-inhibitors in one county. It is also believed that many populations are also resistant to ALS herbicides but few have been tested. In nearby states much higher levels of resistance to these and other modes of actions of herbicides have been detected. Currently nearby states have Waterhemp populations resistant to five different herbicide modes of action.

# For more identification info see videos

**Vegetative characteristics**



**Flowering characteristics**





# Why are we concerned about waterhemp?

1. Rapidly spreading throughout WI
2. Potential to develop herbicide resistance
3. More competitive than common weeds





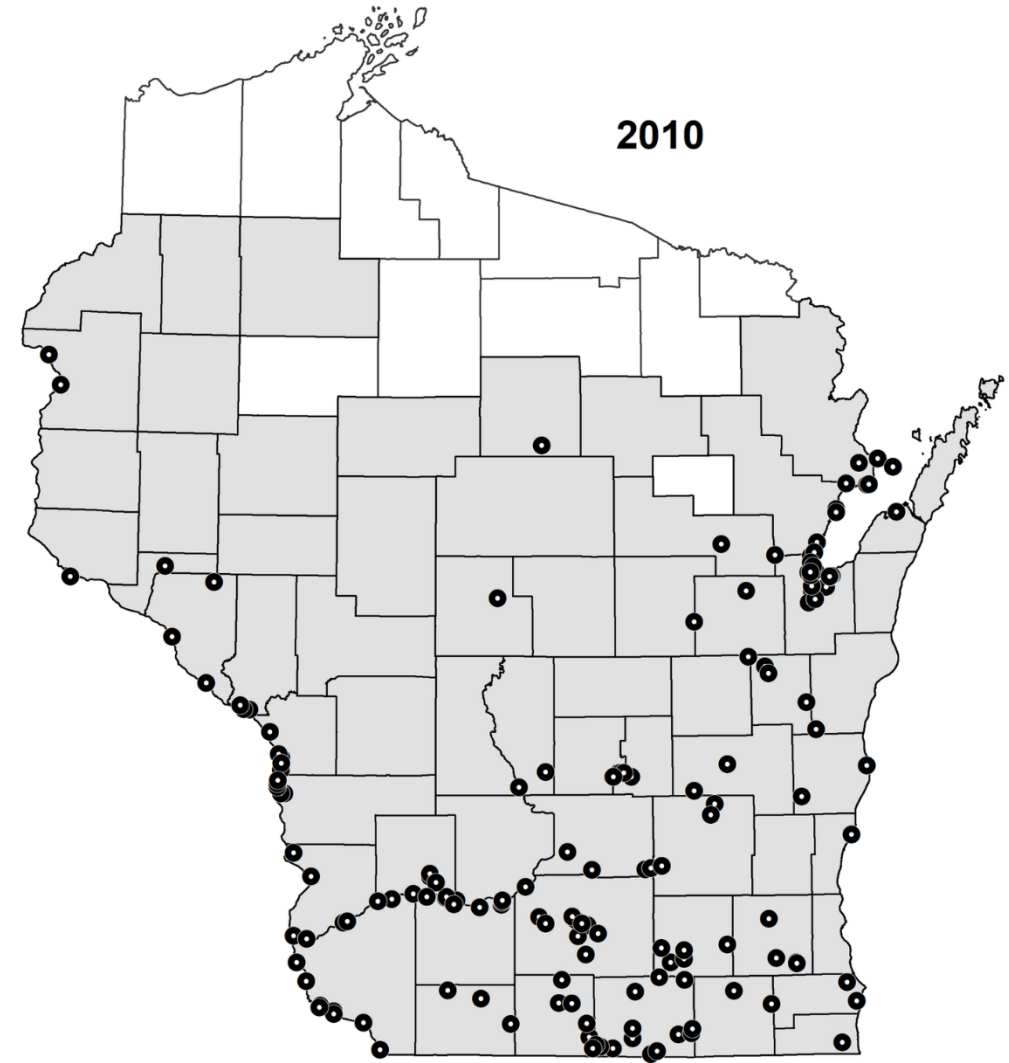
# Waterhemp

- Native to WI
- Recent rapid expansion
- Surveys corn/soy suggest between 2-6% of fields infested
  - 2012-2013 UW: 5 % of fields
  - 2016 DATCP: 6 % of fields
  - 2017 DATCP: 6 % of fields
  - 2018: DATCP: 2 % of fields



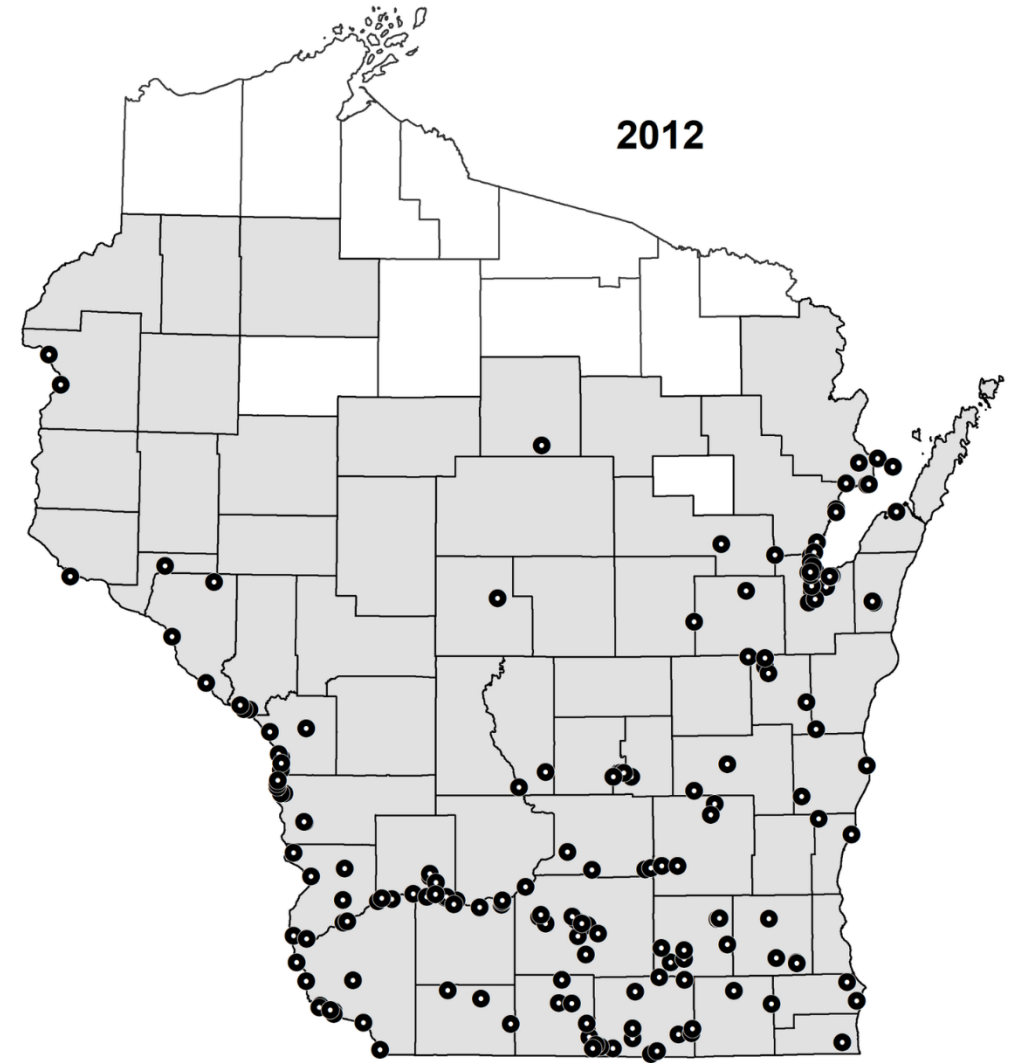
# Waterhemp distribution in Wisconsin

- Historically
  - Mississippi & Wisconsin rivers
  - Southern WI
  - Green Bay
- Expanding
  - Western
  - Central
  - Eastern



# Waterhemp distribution in Wisconsin

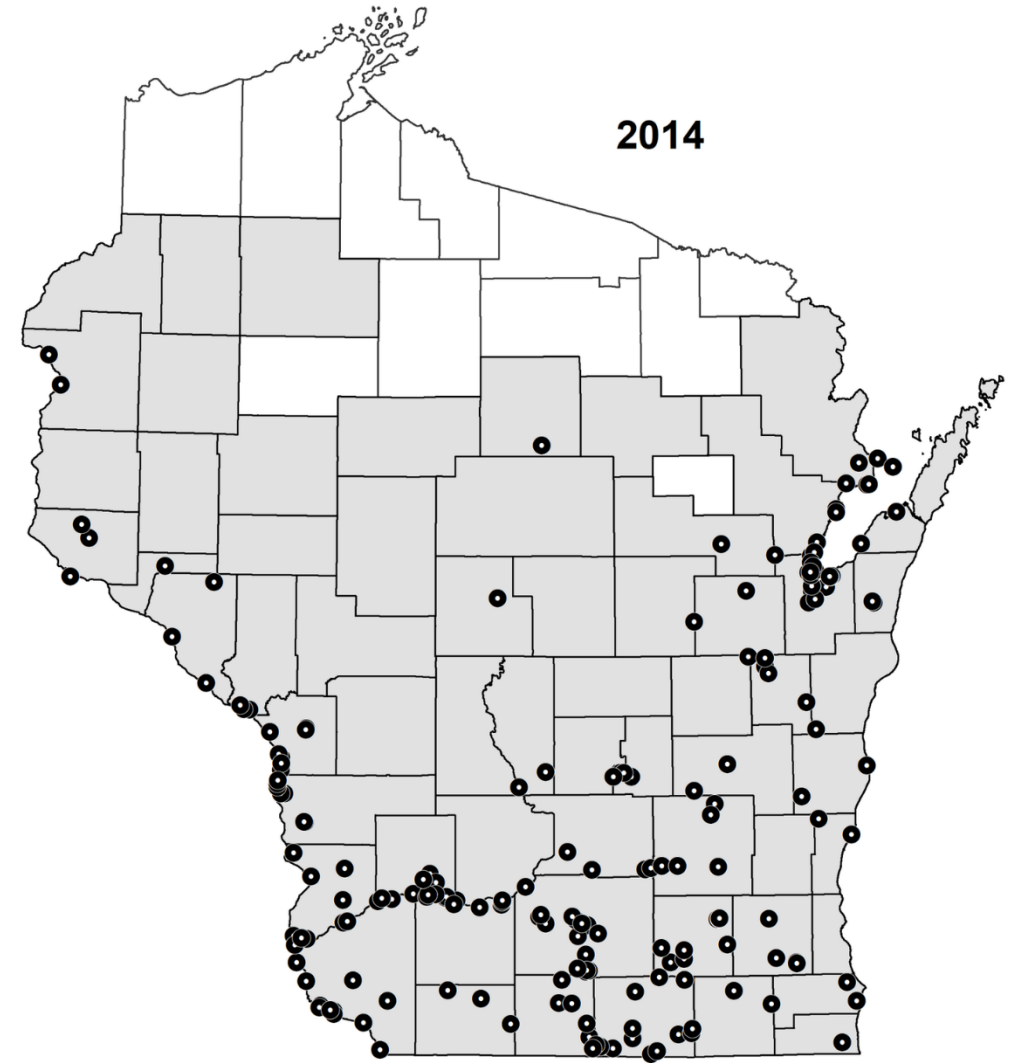
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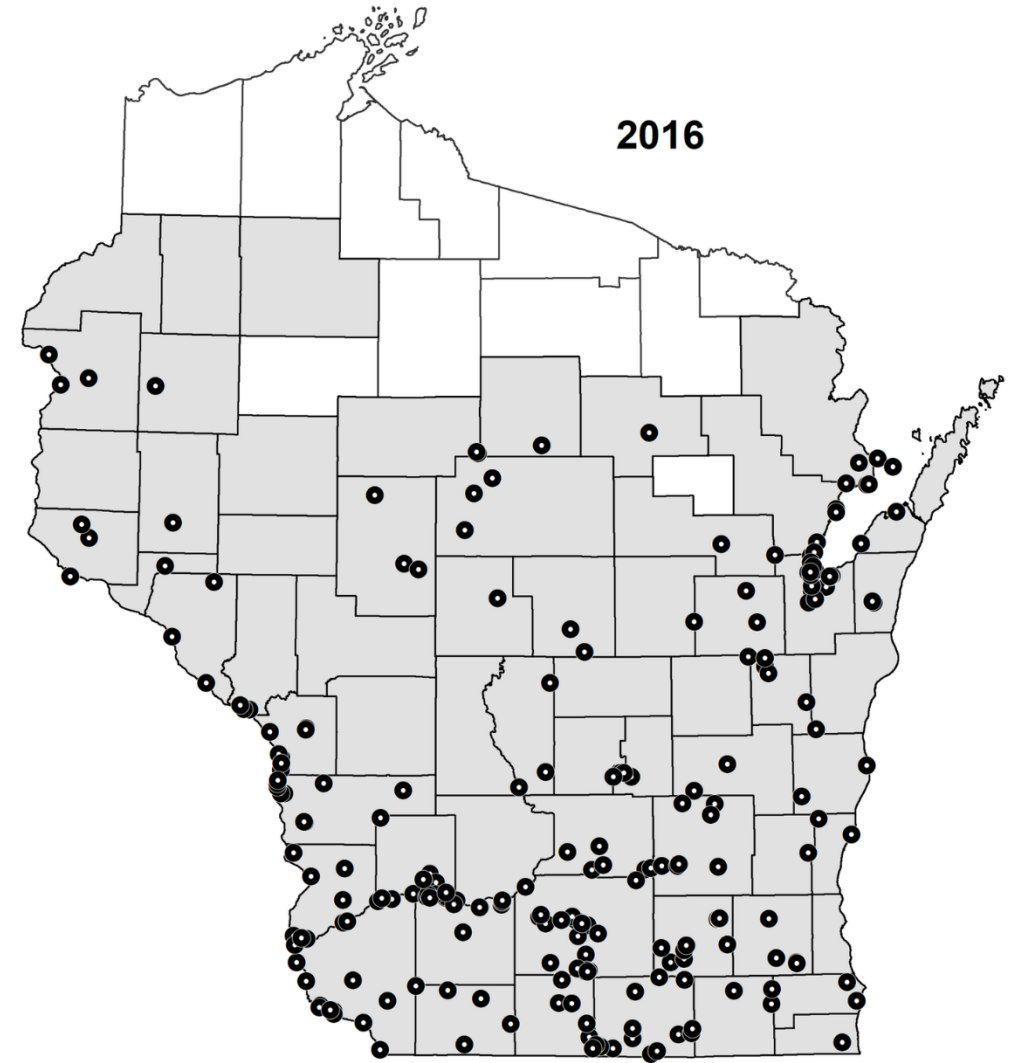
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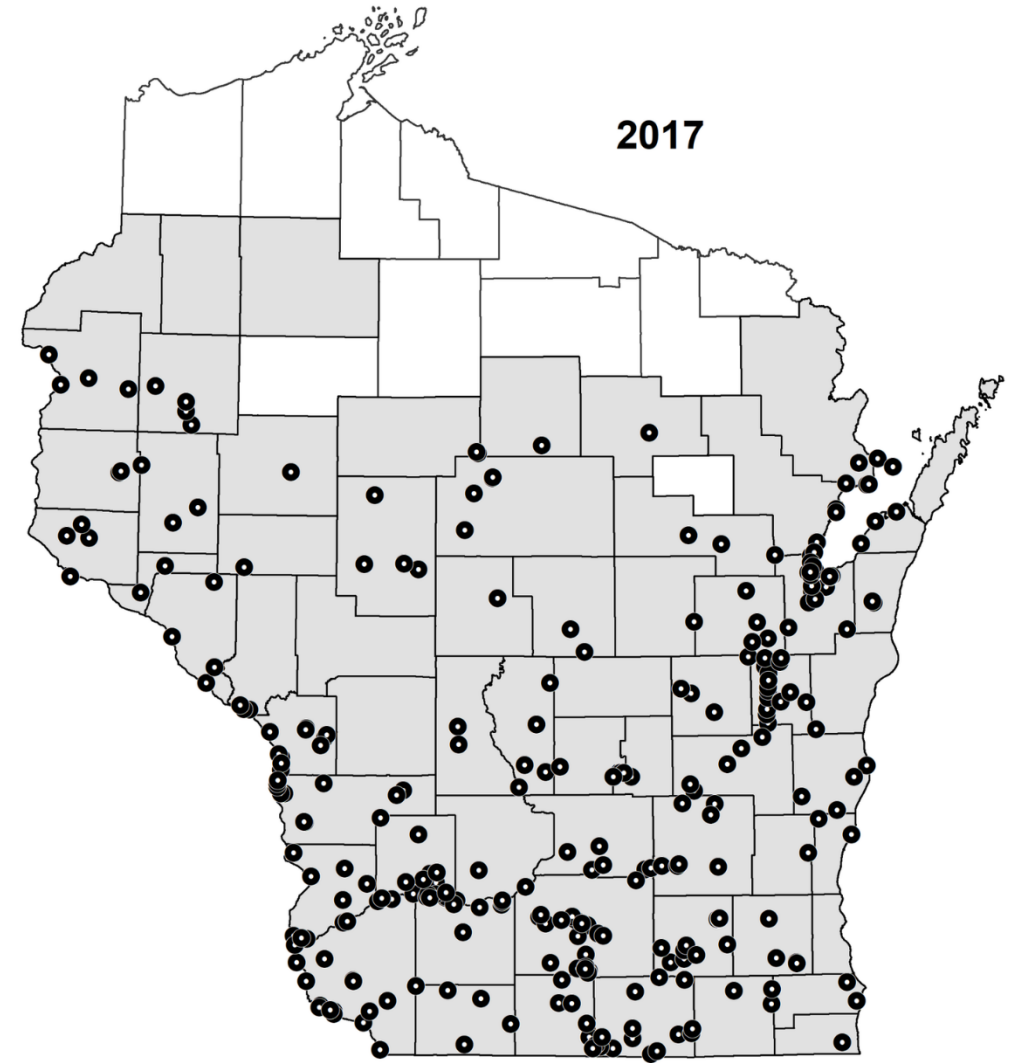
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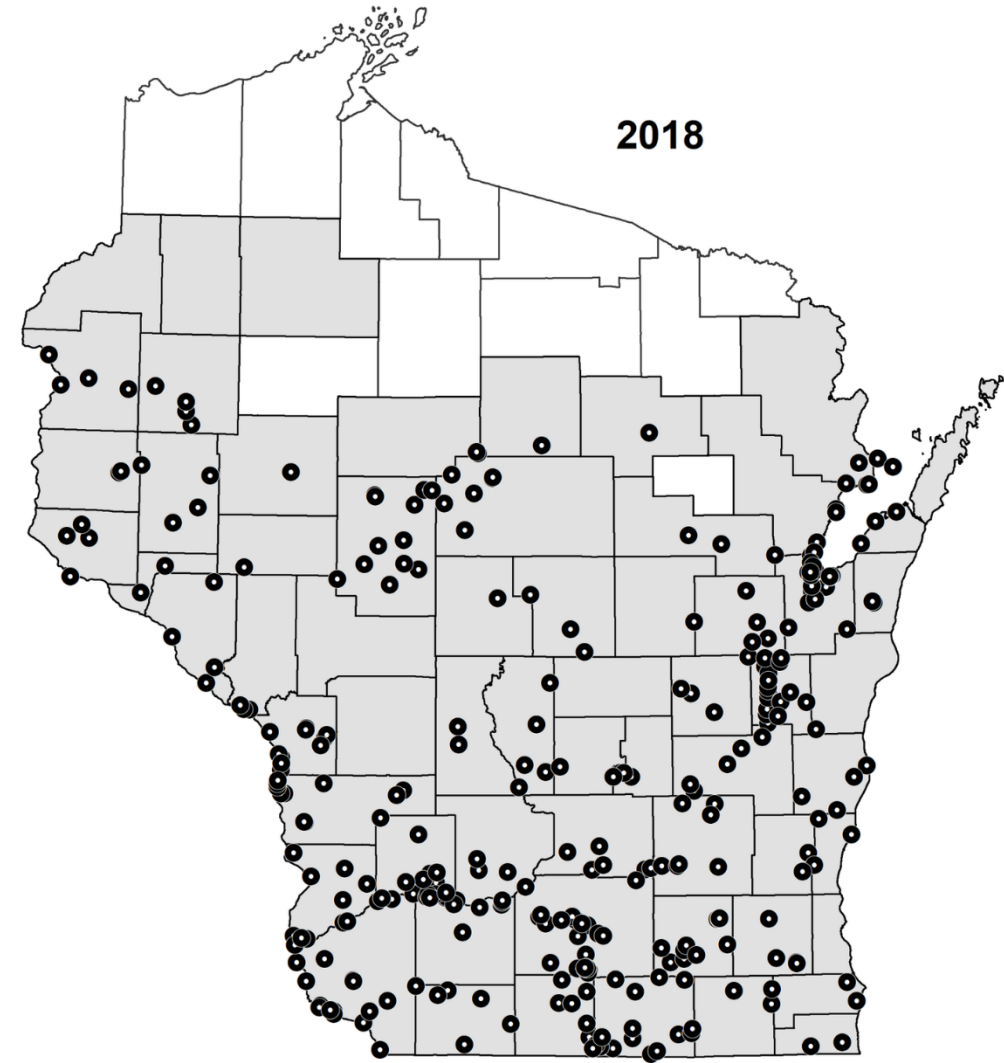
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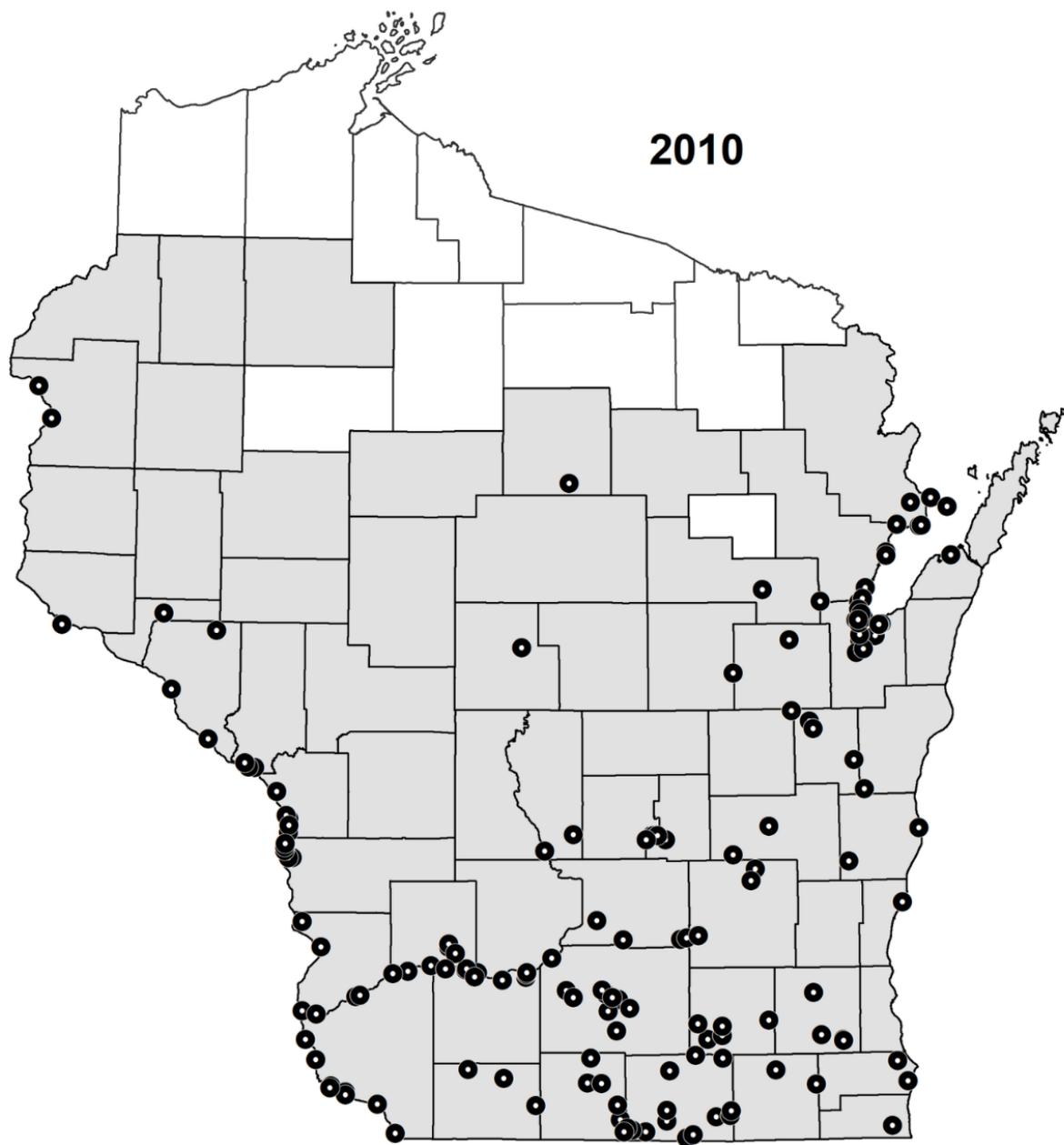


# Waterhemp distribution in Wisconsin

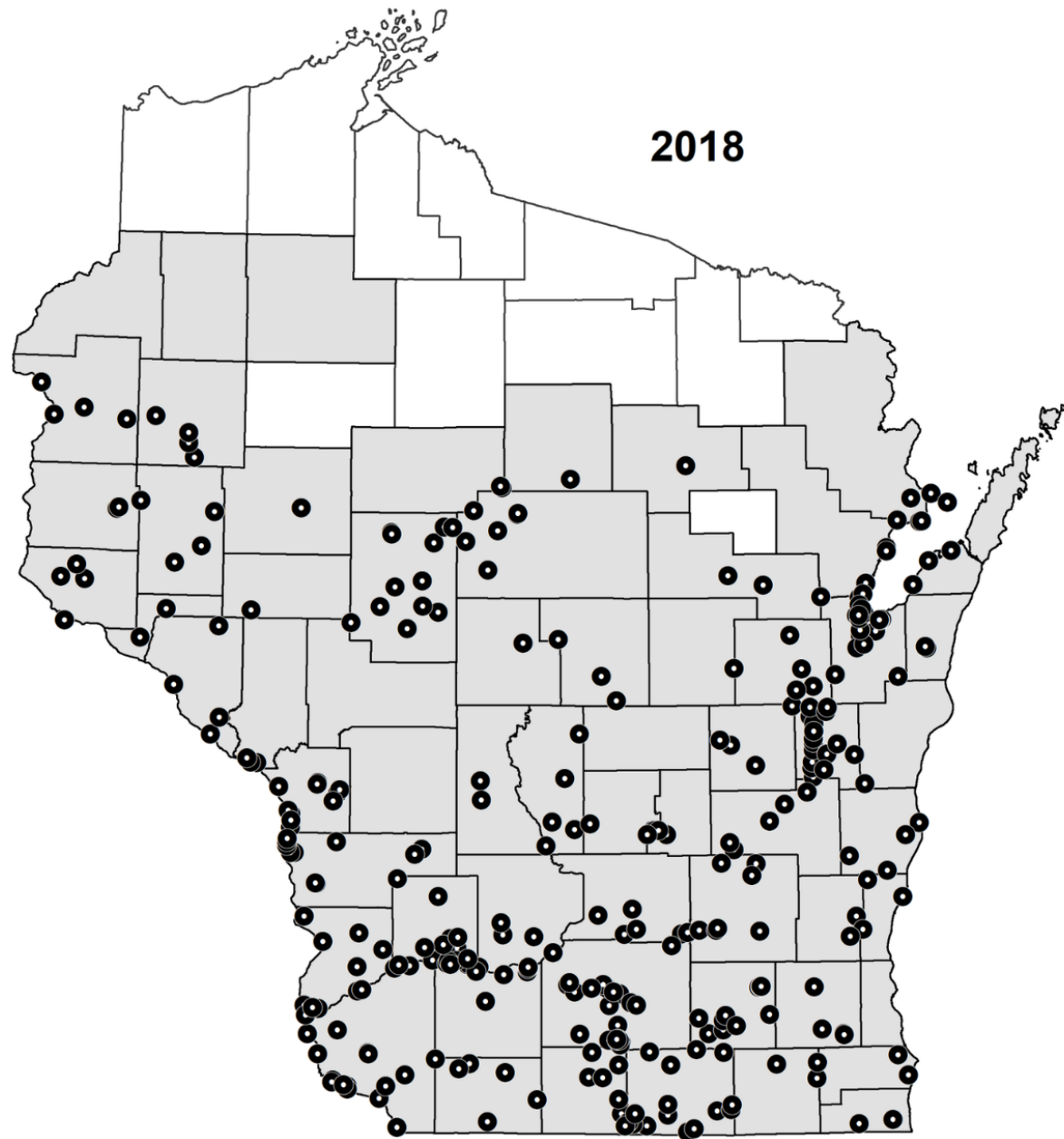
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  - Eastern



2010



2018



# How are populations spreading?

1. Custom harvesting
2. Inputs from other states
  - Feed
  - Manure
  - Birdseed
  - equipment
3. Non-human spread
  - Waterfowl
  - Water
  - Erosion

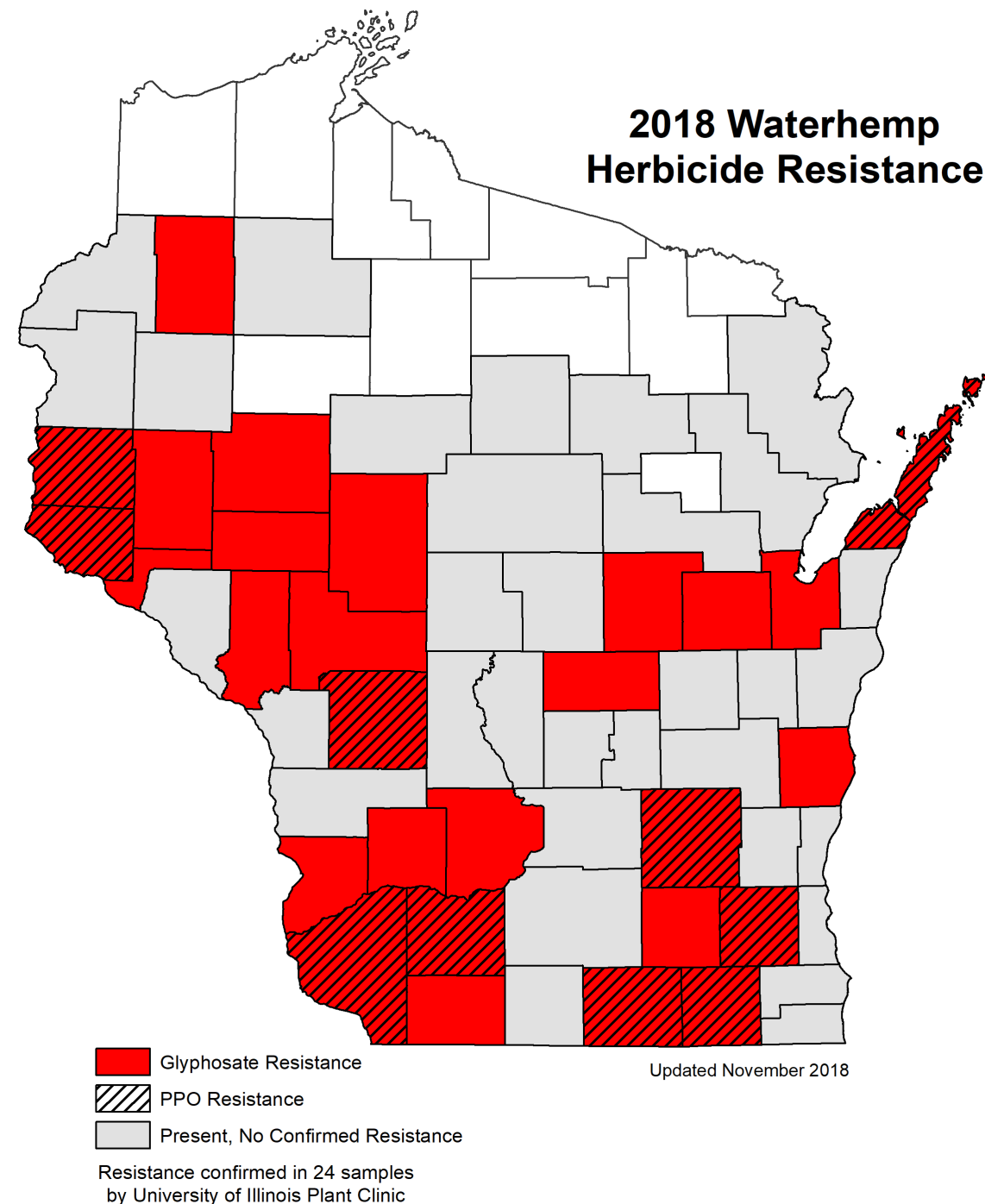




# Waterhemp resistance to herbicides in Wisconsin

28 counties with glyphosate resistant populations

10 counties with glyphosate + PPO resistant populations









# Resistances documented in US (1/7/18)

Mode of action	Waterhemp	States reported in midwest
5 (Atrazine)	Y	MO, KS, IL, IA, NE
2 (ALS inhibitors)	Y	MN, IA, IL, MO, OH, WI, KS, OK, IN, MN, NE, MI
9 (glyphosate)	Y	MO, IL, KS, MN, OH, IN, IA, SD, ND, WI, NE
27 (HPPD)	Y	IL, IA, NE
14 (PPO)	Y	KS, IL, MO, IA, MN, IN, NE, WI
4 (Auxins)	Y	NE, IL

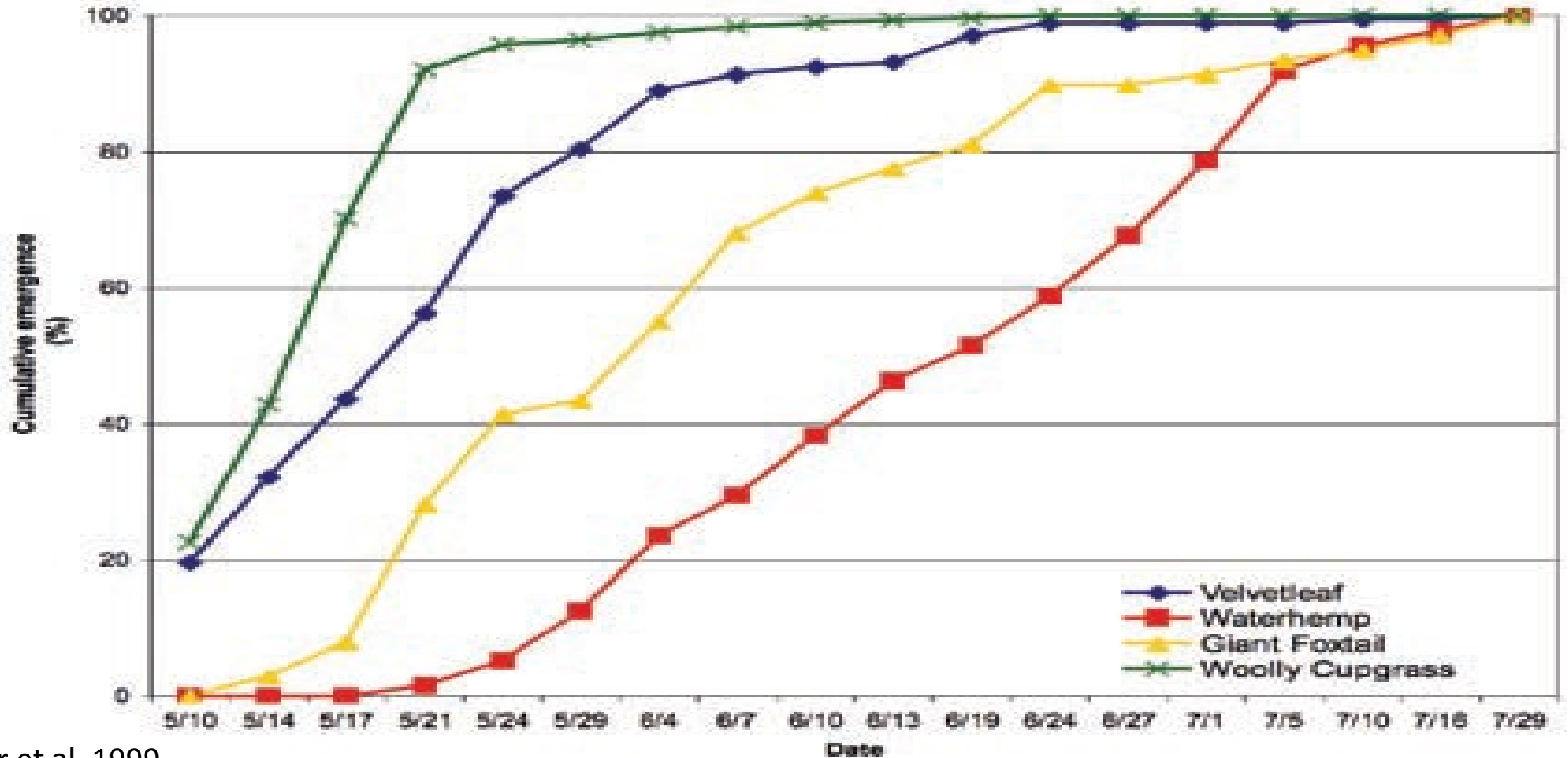
# Waterhemp is more competitive than common weeds in WI

- High growth rates (>1 inch per day)
  - More than most weeds and crops
- Produces more seed
  - 1.5 X more seeds than other pigweeds
- Emerges later into the season
  - Allows some plants to escape PRE applications
  - Flourish after POST applications of non-residual herbicides





# Emergence pattern of 4 annual weeds



# Tips on managing waterhemp in alfalfa

- Management in alfalfa will be different than corn/soybeans
- Optimize alfalfa plant health to minimize impact
  - Proper fertilization, cutting schedule, rotation, etc.....
- Use herbicides efficiently to get desired results
  - Residual herbicides used will be similar to soybeans
  - Do not rely on POST herbicides to control waterhemp

# Alfalfa is a competitive crop

- If well managed established alfalfa will provide effective early season competition = reduced emergence
- Harvesting waterhemp plants will limit impact
  - Pigweed forage quality is decent if harvested when vegetative
- Regrowing alfalfa **that is not stressed** should compete with waterhemp
  - Moisture, insect damage, disease damage



# Why is Waterhemp in our established alfalfa fields?

- Emergence of waterhemp is likely after the first two harvests
- Delays in harvesting will benefit waterhemp
- Waterhemp plants that are mowed will likely resprout
- Stands that are injured (disease, insect) or below threshold may not be able to compete with plants

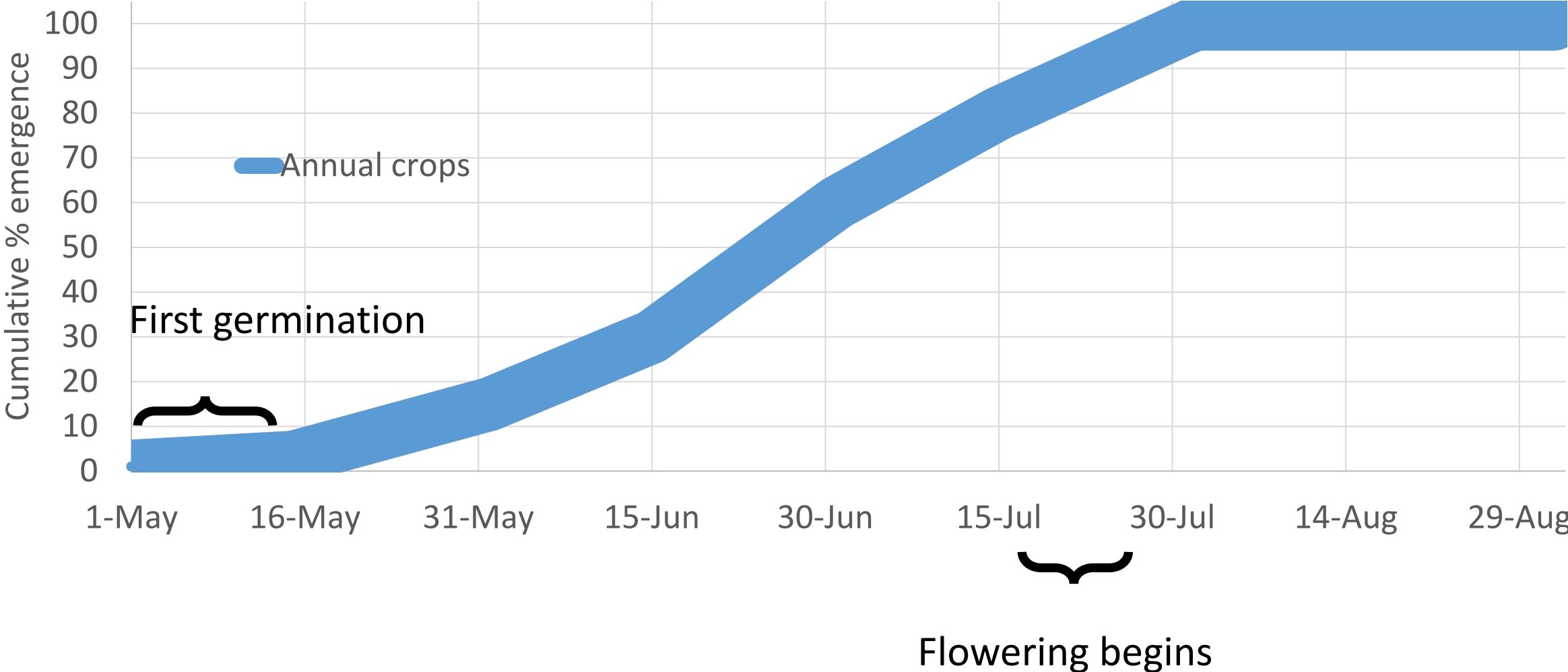


Photo: Richard Halopka



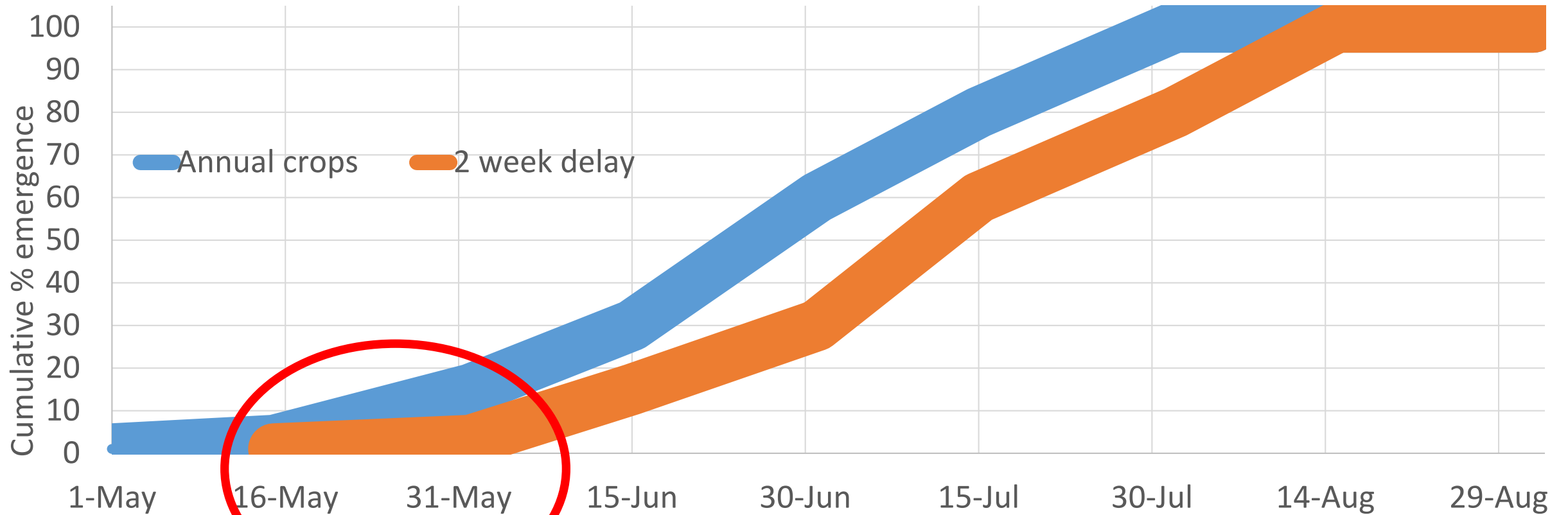
# Estimated waterhemp emergence pattern in WI

from data from annual row crops in 1990s



# Estimated waterhemp emergence pattern in WI

from annual row crops in 1990s



First waterhemp emergence likely delayed 2-4 weeks under alfalfa

# POST Herbicides we use in established alfalfa

Herbicide	Active ingredient	Rate used	Effectiveness
Butyrac	2,4-DB	1-3 qt/A	Fair-good
Extreme	glyphosate + imazethapyr	2.2-4.4 pt/A	Excellent*
Pursuit	imazethapyr	3-6 fl oz/A	Excellent*
Raptor	imazamox	4-6 fl oz/A	Excellent*
Roundup	Glyphosate	22-44 fl oz/A	Excellent*

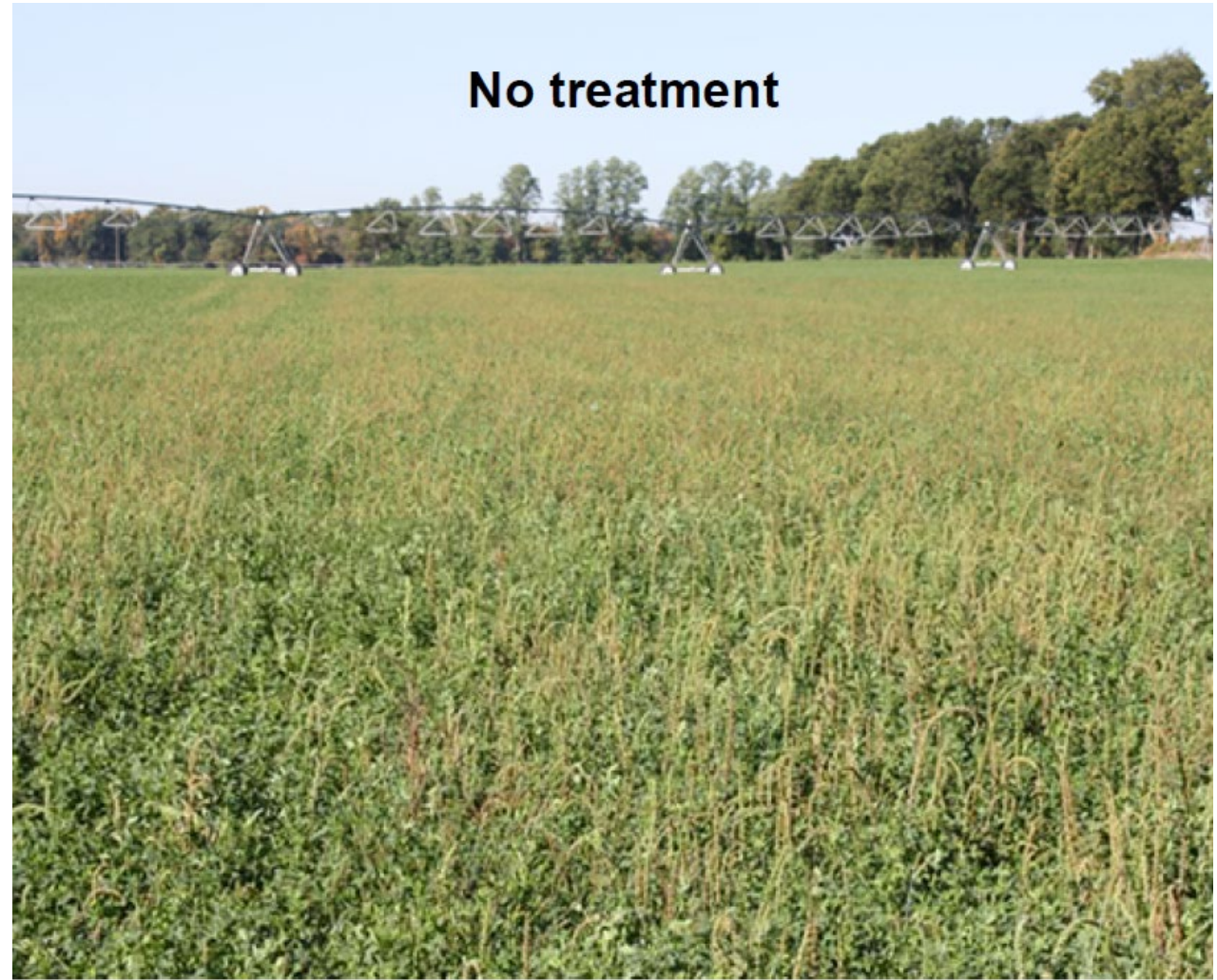
\* Denotes resistance to these products is common in some areas of Wisconsin

# In Michigan, promoting Paraquat between 3-4 cuttings.....

Between cutting Gramoxone



No treatment







# PRE Herbicides we use in established alfalfa

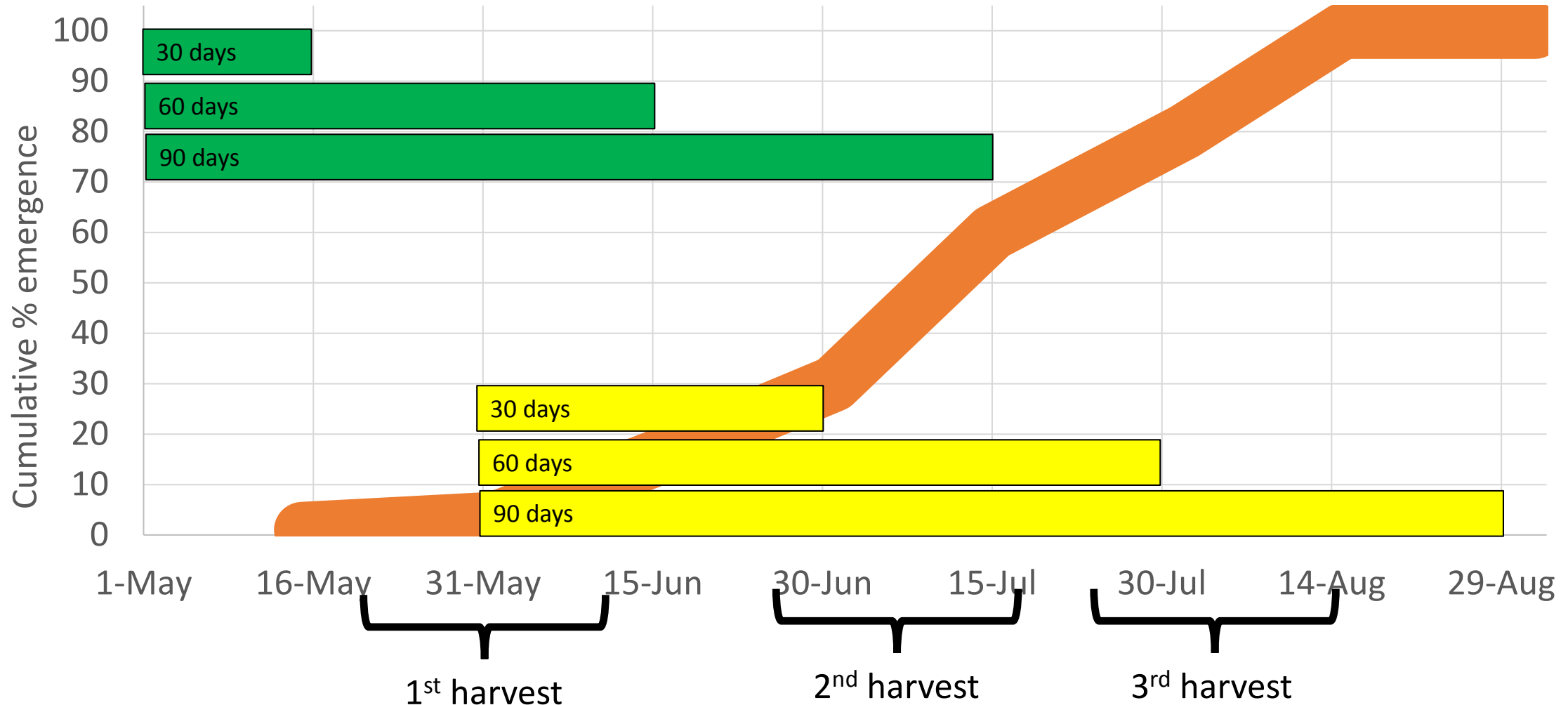
*applied either pre-greenup or in between cuttings*

Herbicide	Active ingredient	Rate	Plantback restriction corn	Plantback restriction soy	Plantback restriction small grain
Chateau	flumioxazin	4 oz/A	4 months	4 months	12 months
Metribuzin	metribuzin	0.33-1.33 lbs/A	4 months	0 months	4-12 months
Prowl H2O	pendimethalin	1.1-4.2 qt/A	Following year	0 months	4 mo – following year
Velpar	hexazinone	1-6 pt/A	12 months	2 years	2 years
Warrant	acetochlor	1.25-2 qt/A	0 months	0 months	0- 4 months

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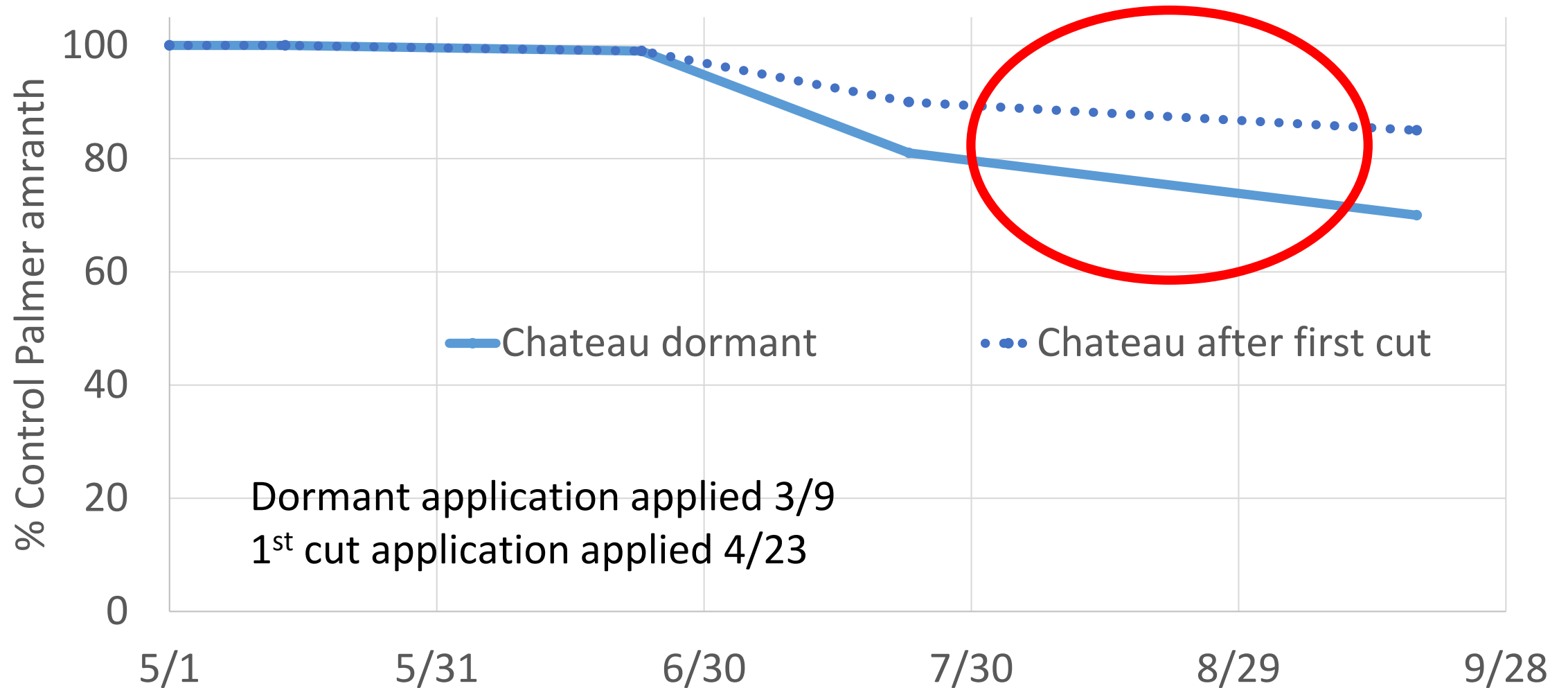
Herbicide	Active ingredient	Rate	% Control 25 DAT	% Control 50 DAT	Data source																																																																																		
Chateau	flumioxazin	4 oz/A	<div><div><p><b>UW Waterhemp Challenge:</b> Preliminary Report</p><p>Comparison of Soil Residual Herbicides</p><p>Trial Number: UW-2018-WC-2 Lancaster/Preliminary data (August 2018), not for publication</p><p><b>Daniel H. Smith</b>, Southwest Regional Specialist and <b>Richard Proost</b>, Southeast Agronomist, Nutrient and Pest Management Program; <b>Rodrigo Werle</b>, Weed Science Extension Specialist, Department of Agronomy, University of Wisconsin-Madison and UW-Extension</p><p>The authors would like to acknowledge Lancaster ARS staff and Wisconsin Cropping Systems Weed Science (WiscWeeds) Team: Maxwel Oliveira, Victor Ribeiro, Sarah Striegel, Nikola Arsenijevic and Ryan DeWerff.</p><p><b>Site description</b> Soil type: Fayette Crop: Soybean % OM: 2.4 Variety: Asgrow AG21X8 pH: 7.3 Date planted: 5/24/2018 Fertilization: None Planting depth: 1.5 in Row spacing: 30 in Plot size: 10 x 25 ft Planting population: 145,000</p></div><div><p>Always Read, Follow and Understand the Pesticide Label. <b>The Label is the Law.</b> Information presented does not constitute a recommendation or endorsement.</p></div></div>	<div></div> <table><tr><th colspan="2">Preliminary Weed Control Ratings from the Lancaster ARS Trial Site</th><th colspan="2">WATERHEMP</th><th colspan="2">COMMON LAMBSQUARTERS</th><th rowspan="2">Pri. Estim.</th></tr><tr><th>Trt #</th><th>Plot</th><th>Herbicide and application rate (ac<sup>-1</sup>)</th><th>Soybean growth stage (days after treatment)</th><th>V3 (25 DAT)</th><th>R2 (50 DAT)</th></tr><tr><td></td><td></td><td></td><td></td><td colspan="2">Greater than 91% is considered acceptable. Average % control (standard error)</td><td></td></tr><tr><td>2</td><td>102</td><td>Pursuit (4 fl oz)</td><td>24 (13)</td><td>18 (7)</td><td>100 (0)</td><td>100 (0)</td></tr><tr><td>3</td><td>103</td><td>Classic (3 oz)</td><td>43 (19)</td><td>33 (13)</td><td>100 (0)</td><td>100 (0)</td></tr><tr><td>4</td><td>104</td><td>FirstRate (0.6 oz)</td><td>13 (8)</td><td>6 (4)</td><td>100 (0)</td><td>100 (0)</td></tr><tr><td>5</td><td>105</td><td>Tricor DF (10.7 oz)</td><td>98 (1)</td><td>92 (3)</td><td>96 (4)</td><td>87 (9)</td></tr><tr><td>6</td><td>106</td><td>Spartan (8 fl oz)</td><td>90 (4)</td><td>85 (5)</td><td>100 (0)</td><td>100 (0)</td></tr><tr><td>7</td><td>107</td><td>Valor SX (3 oz)</td><td>100 (0)</td><td>96 (3)</td><td>94 (3)</td><td>87 (5)</td></tr><tr><td>8</td><td>108</td><td>Sharpen (1 fl oz)</td><td>83 (8)</td><td>65 (20)</td><td>88 (5)</td><td>68 (10)</td></tr><tr><td>9</td><td>109</td><td>Warrant (24 fl oz)</td><td>68 (16)</td><td>66 (13)</td><td>57 (11)</td><td>41 (18)</td></tr><tr><td>10</td><td>110</td><td>Warrant (48 fl oz)</td><td>91 (4)</td><td>82 (7)</td><td>72 (11)</td><td>60 (19)</td></tr></table>	Preliminary Weed Control Ratings from the Lancaster ARS Trial Site		WATERHEMP		COMMON LAMBSQUARTERS		Pri. Estim.	Trt #	Plot	Herbicide and application rate (ac <sup>-1</sup> )	Soybean growth stage (days after treatment)	V3 (25 DAT)	R2 (50 DAT)					Greater than 91% is considered acceptable. Average % control (standard error)			2	102	Pursuit (4 fl oz)	24 (13)	18 (7)	100 (0)	100 (0)	3	103	Classic (3 oz)	43 (19)	33 (13)	100 (0)	100 (0)	4	104	FirstRate (0.6 oz)	13 (8)	6 (4)	100 (0)	100 (0)	5	105	Tricor DF (10.7 oz)	98 (1)	92 (3)	96 (4)	87 (9)	6	106	Spartan (8 fl oz)	90 (4)	85 (5)	100 (0)	100 (0)	7	107	Valor SX (3 oz)	100 (0)	96 (3)	94 (3)	87 (5)	8	108	Sharpen (1 fl oz)	83 (8)	65 (20)	88 (5)	68 (10)	9	109	Warrant (24 fl oz)	68 (16)	66 (13)	57 (11)	41 (18)	10	110	Warrant (48 fl oz)	91 (4)	82 (7)	72 (11)	60 (19)
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# If use residual herbicides, do we treat at green-up or wait until the first cutting?



# Applications after first cut may improve season long control

*Data from Kansas on palmer amaranth*





# Data from other states on palmer may demonstrate how waterhemp in WI will behave

- Weed competition with alfalfa was minimal for the first two alfalfa cuttings
  - Impact likely in 3rd and 4<sup>th</sup> cutting
- Residual herbicides provide control, but not year-long
  - Sequential applications best
- No differences in forage quality among treatments
  - In 1<sup>st</sup> and 2<sup>nd</sup> cutting



# When you start developing a plan for waterhemp, think about your goals....

## Maximize high quality forage

- Manage alfalfa to optimize competition
  - Proper fertility, cutting schedule, rotation
- Use herbicides to keep Waterhemp < 25% of forage biomass
  - Likely only in 3<sup>rd</sup> and 4<sup>th</sup> cut
    - POST after 3<sup>rd</sup> cut (Paraquat)
    - Residual after 1st or 2<sup>nd</sup> cut
- Mow/harvest when waterhemp is vegetative

## Eliminate waterhemp seed

- Manage alfalfa to optimize competition
  - Proper fertility, cutting schedule, rotation
- Use herbicides to prevent emergence of waterhemp
  - Residual herbicides (sequential apps)
  - Incorporate POST applications
    - Make sure populations are not resistant to herbicides you use

# Management options

- Timely mowing
  - Will impact waterhemp but it will resprout
- POST herbicides
  - Pursuit\*, Raptor\* and Roundup\* are effective but resistance is common
  - Paraquat and 2,4-Db are options with no known resistance in WI
- PRE herbicides
  - Chateau\* & Metribuzin\* will give good to excellent control through summer
  - Warrant will give good to excellent control for 1-2 months
  - Others can control Waterhemp, but long plant-back or short residual make less valuable

\* Resistance to this mode of action has been documented in WI

# Summary

- We have a lot to learn about Waterhemp management in established alfalfa
  - Emergence timings and how harvest schedule alters it
  - Length of residual herbicides on Waterhemp in WI
  - Impact of Waterhemp on forage production, quality and stand in WI
- Develop a plan based on
  - Goals in waterhemp management
  - Evaluate costs
  - how widespread waterhemp is in your area and farm



# Data from Kansas on palmer suggests....

