

Waterhemp Management in Soybean

**Mizzou Weed Science
2019**



Waterhemp

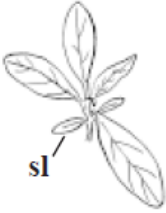


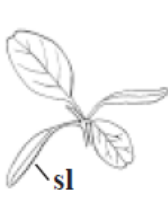
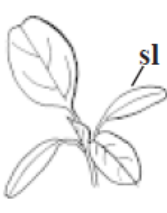










(weedid.Missouri.edu for more descriptive info)



- Season long competition with soybean (>20 plants ft²) can reduce yield ~44%
- Can grow 1 to 1.25” per day during the growing season
- Multiple flushes will emerge throughout the growing season
- Typically produces ~250,000 seeds per plant
- Seed are very small (~3 mm) and easily transported
- Seed can remain viable in the soil for ~4 years

What distinguishes waterhemp from other pigweeds?



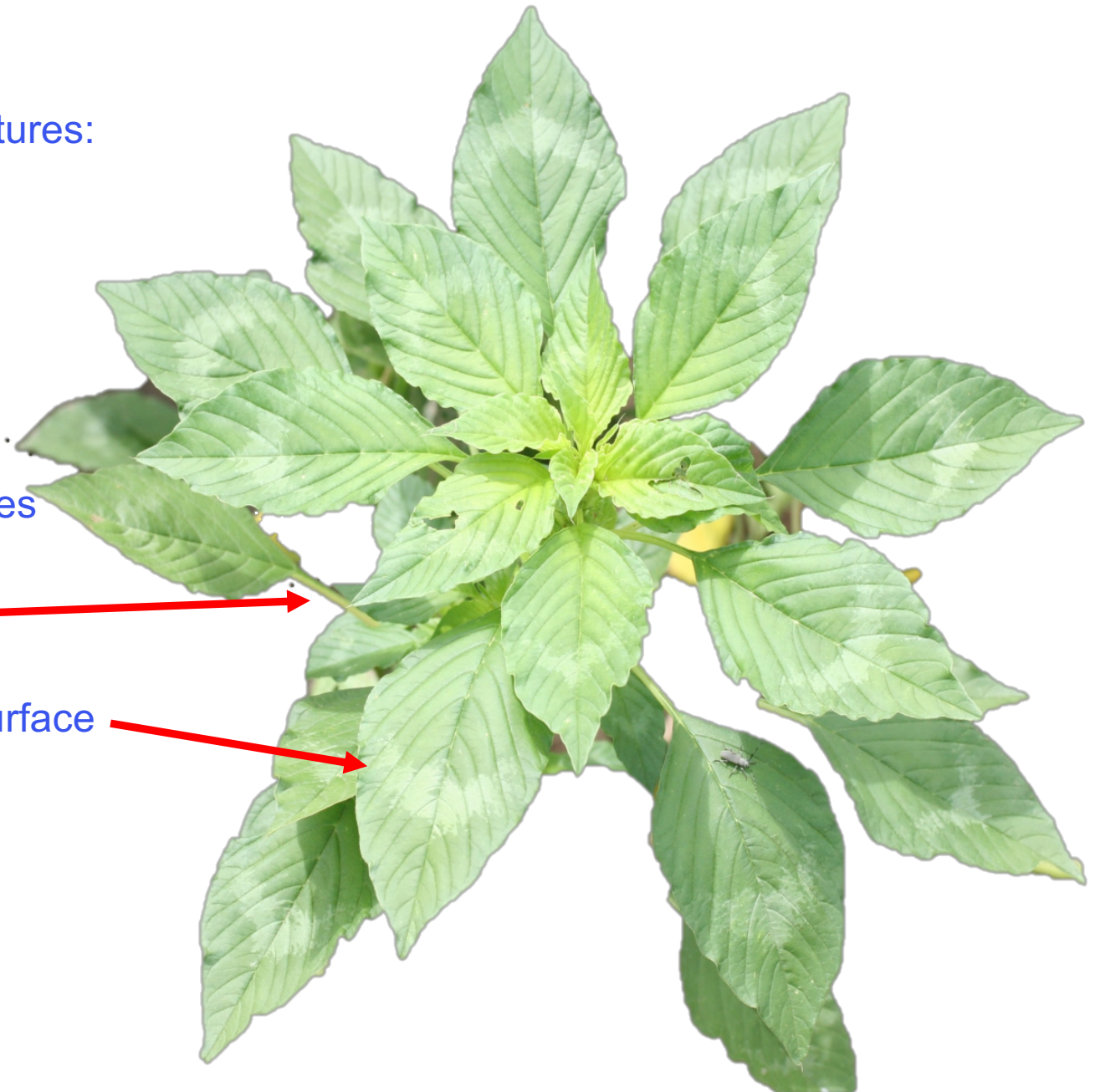
	Common Waterhemp	Redroot Pigweed	Smooth Pigweed	Powell Amaranth	Palmer Amaranth
Seedling shape					
Stem hairs					
Leaf shapes					
Separate male and female plants	Yes	No	No	No	Yes
Seedhead shape	smooth, long, slender	prickly, short, stout	slightly prickly, long, slender	prickly, very long, thick	very prickly, very long, thick

Source: Identification of the weedy pigweeds and waterhemp of Iowa, Iowa State University.

Is it Palmer Amaranth or Waterhemp?

Palmer amaranth key features:

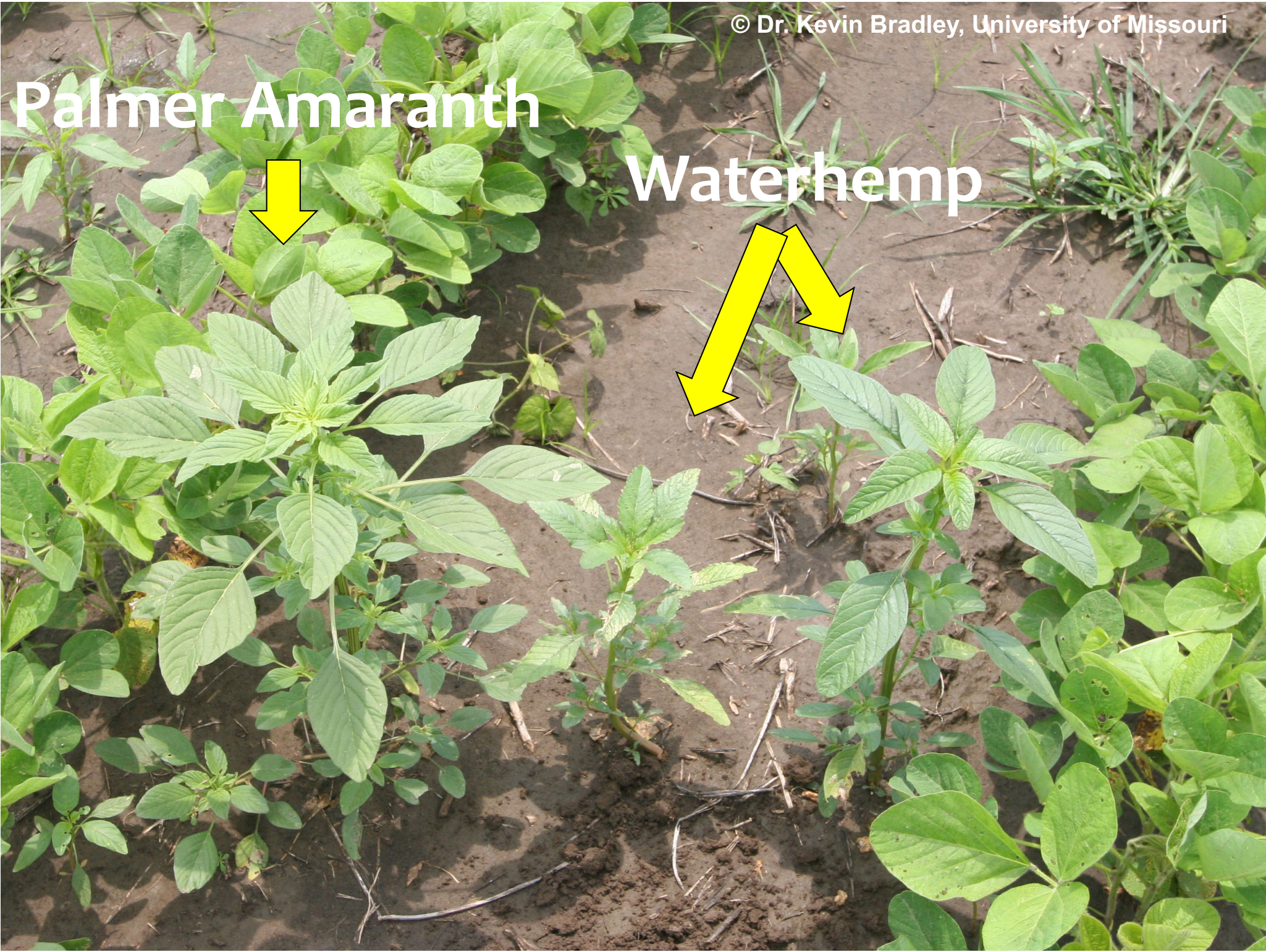
- Stems lack hairs
- Poinsettia type leaf arrangement
- Diamond-shaped leaves
- Very long petioles
- Watermarks on leaf surface (sometimes)
- Prickly seedhead



Palmer Amaranth

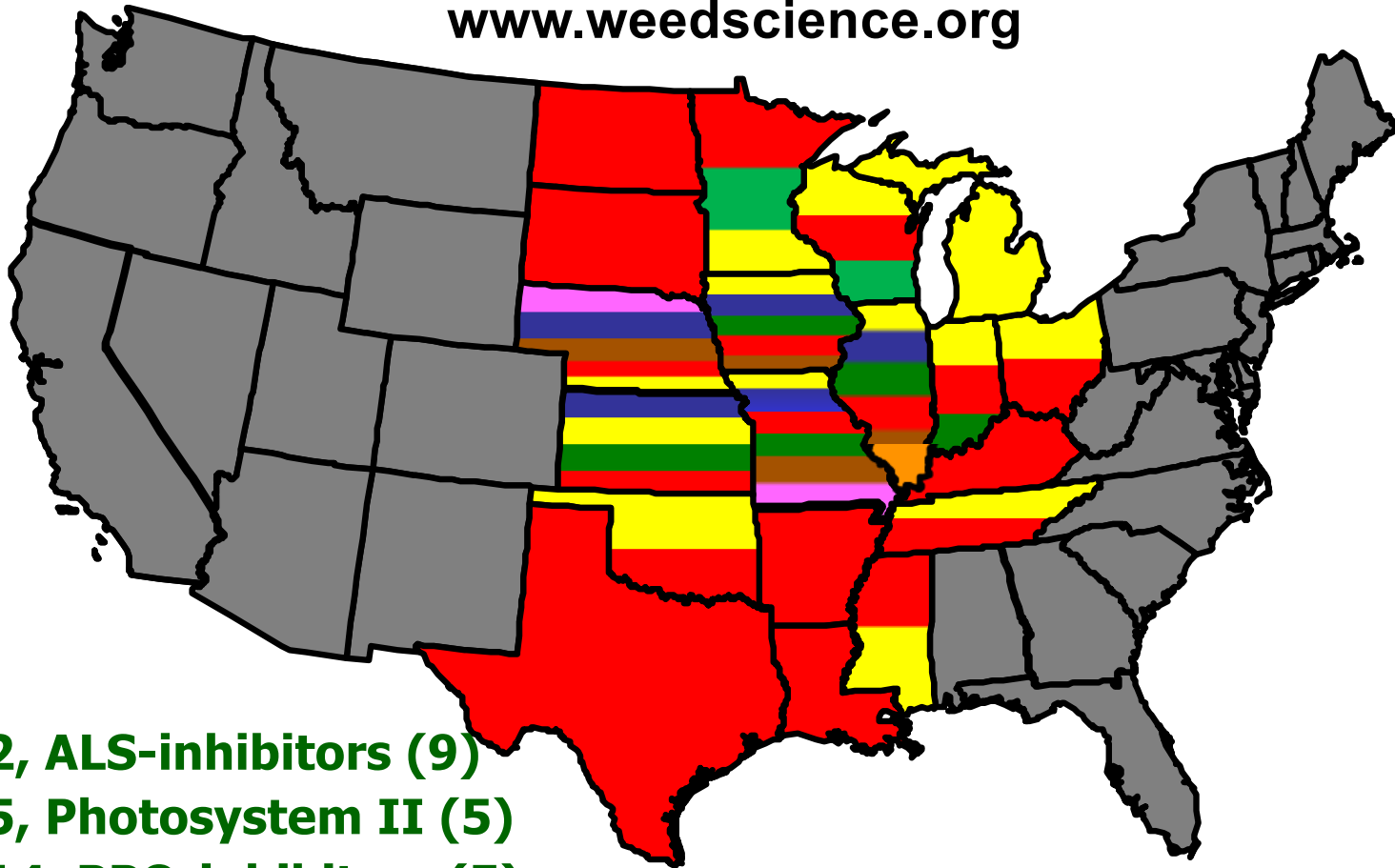


Waterhemp



Herbicide Resistance in Waterhemp - 2019

www.weedscience.org



● **Group 2, ALS-inhibitors (9)**

● **Group 5, Photosystem II (5)**

● **Group 14, PPO-inhibitors (5)**

● **Group 9, Glyphosate (14)**

● **Group 27, HPPD-inhibitors (4)**

● **Group 4, Auxins (1)**

● **Group 15, Long chain fatty acid inhibitors (15)**

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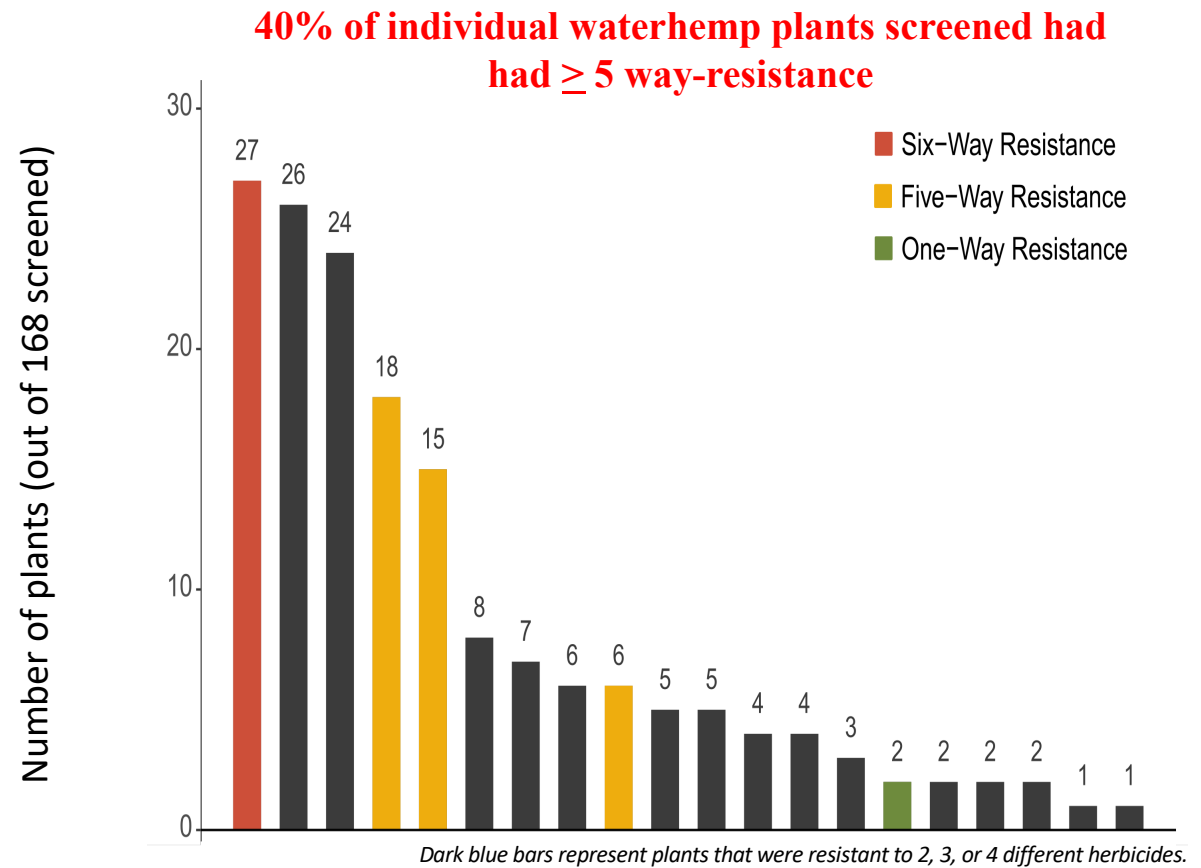
Individual Plants Can Have Multiple Resistances.

6-Way resistance Confirmed in Missouri.

Population confirmed resistant to:
 Chlorimuron (Group 2)
 Glyphosate (Group 9)

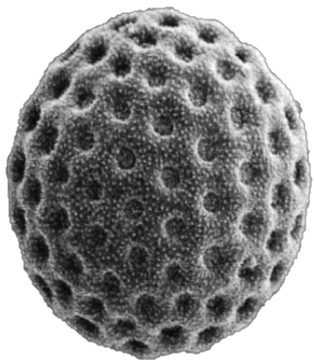
2,4-D (Group 4)
 Fomesafen (Group 14)

Atrazine (Group 5)
 Mesotrione (Group 27)

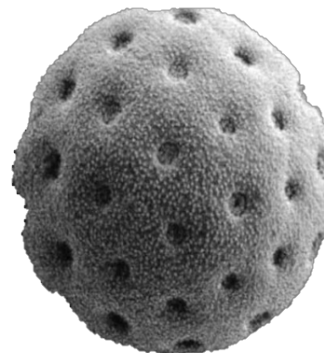


Why is Waterhemp Quick to Develop Resistance?

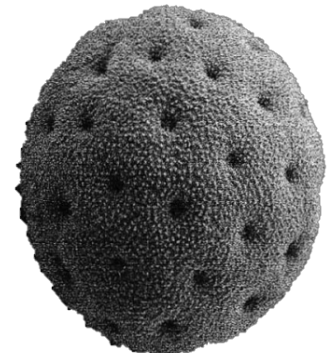
1. Dioecious: male and female flowers on separate plants. Outcrossing leads to increased genetic diversity, which in turn increases the potential for developing resistance.
2. Waterhemp pollen can remain viable up to 120 hours after pollen shed.
3. Long distance pollen dispersal can occur to plants up to ½ mile away.
4. Pollen can transfer resistance traits!



Waterhemp



Palmer amaranth



Spiny pigweed

Waterfowl can Transport Pigweed Seed!

- ~49 million ducks (U.S. Fish and Wildlife Service)
- An average of 18 pigweed seeds emerged per duck



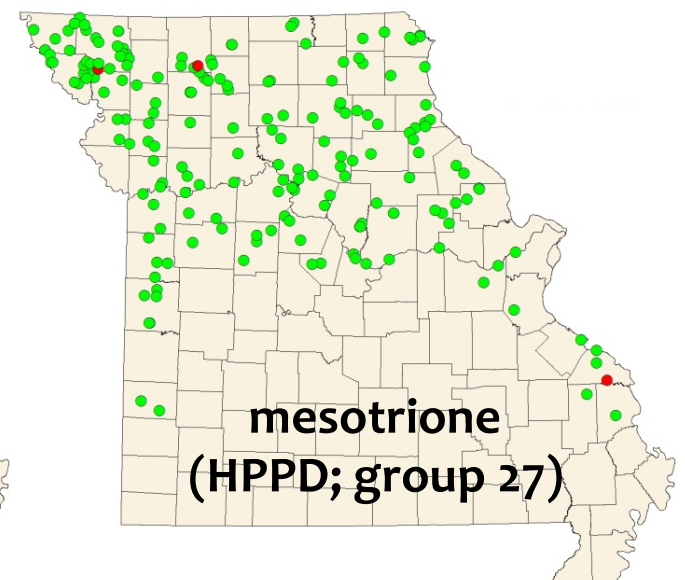
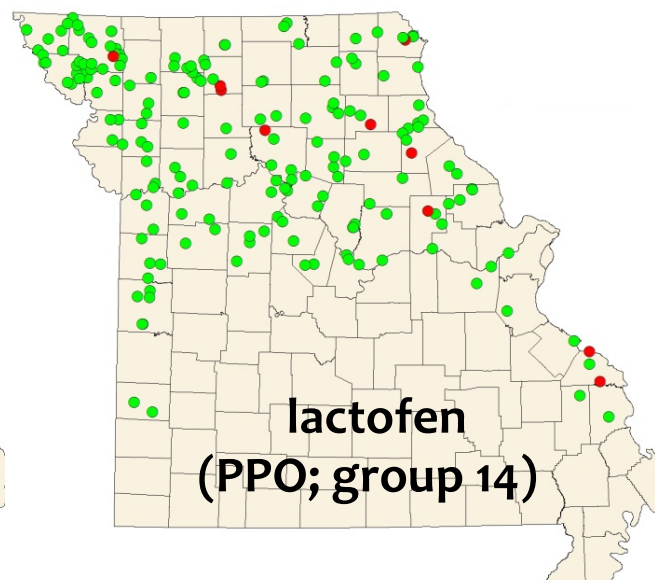
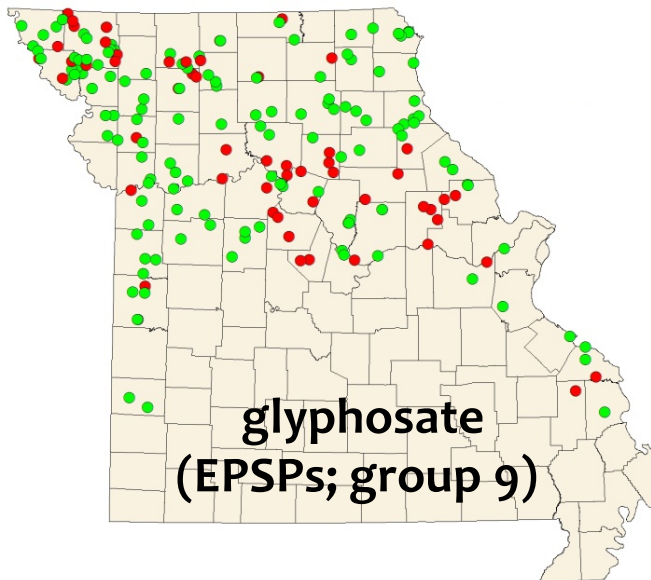
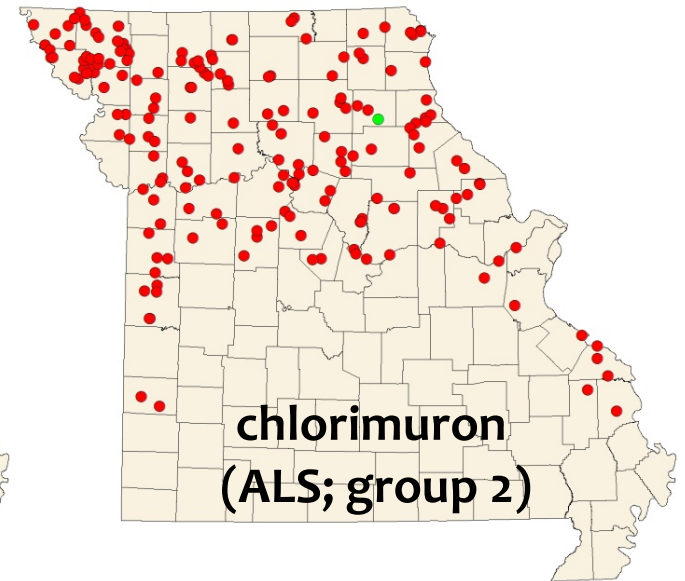
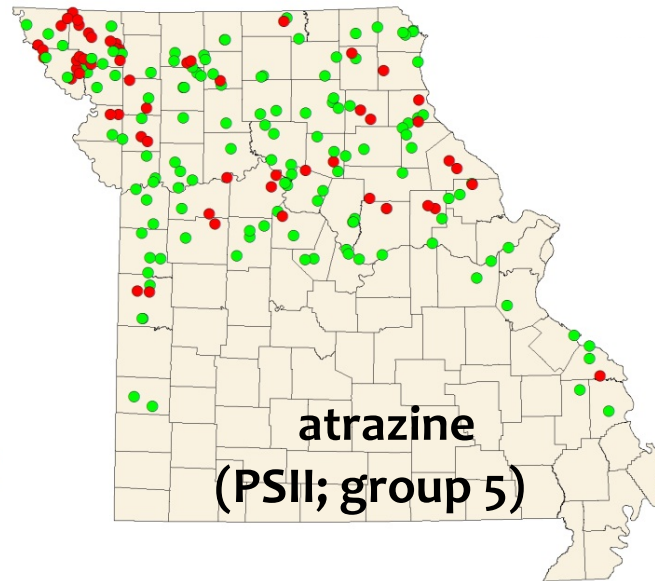
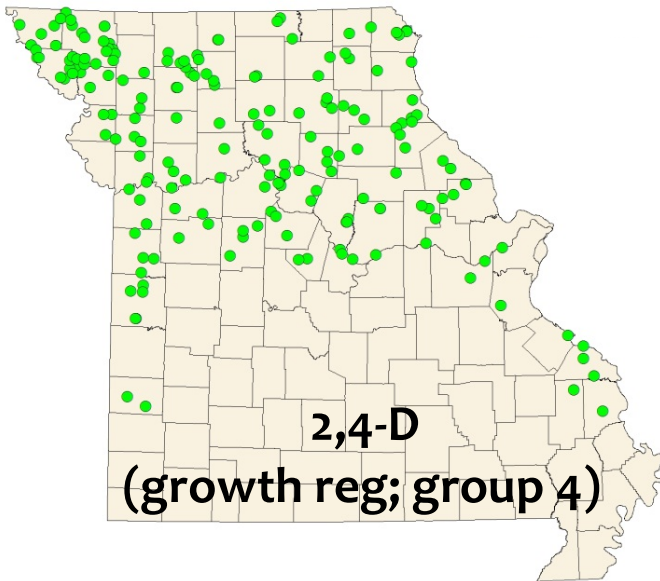
- Potential of ~ 882 million pigweed seed transported annually



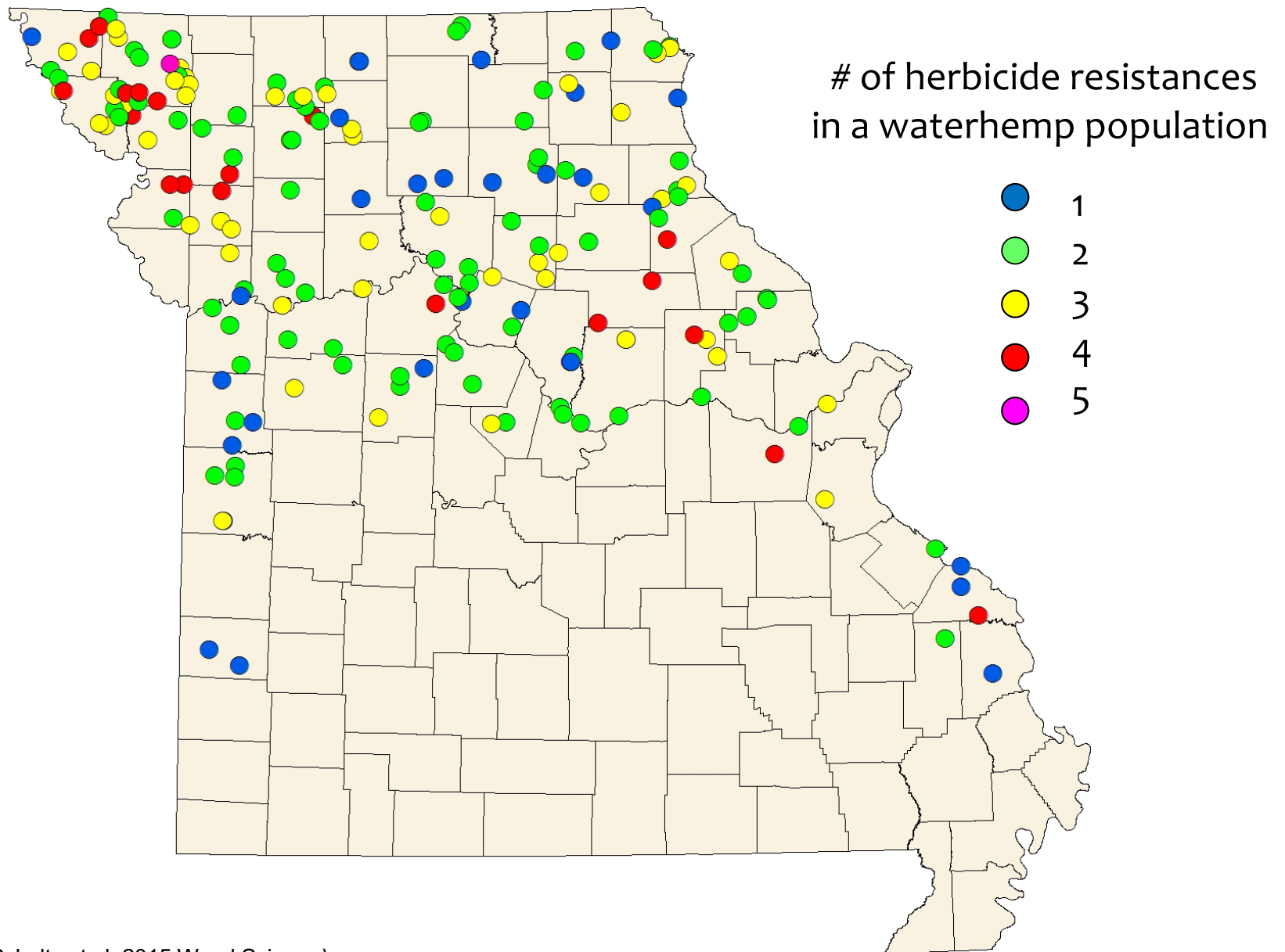
- Mallards can maintain flight speeds of 48 mph for 38 hours
- Potential to move pigweed >1,000 miles

Distribution of Resistance to 3X Use Rates of Selected Herbicides in Missouri Waterhemp (2013)

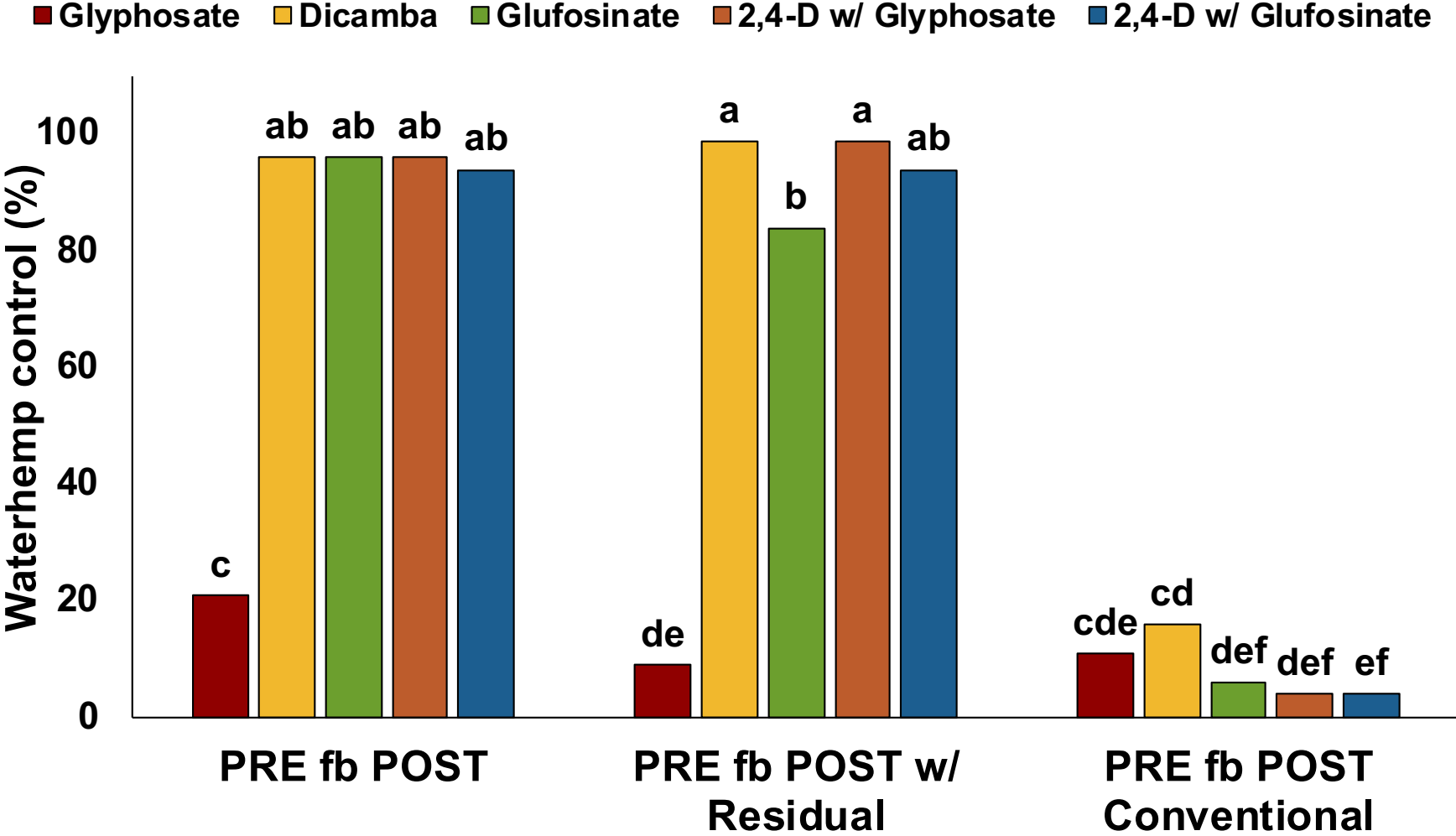
● susceptible ● resistant



Distribution of Waterhemp with Multiple Herbicide Resistances in Missouri (2013)

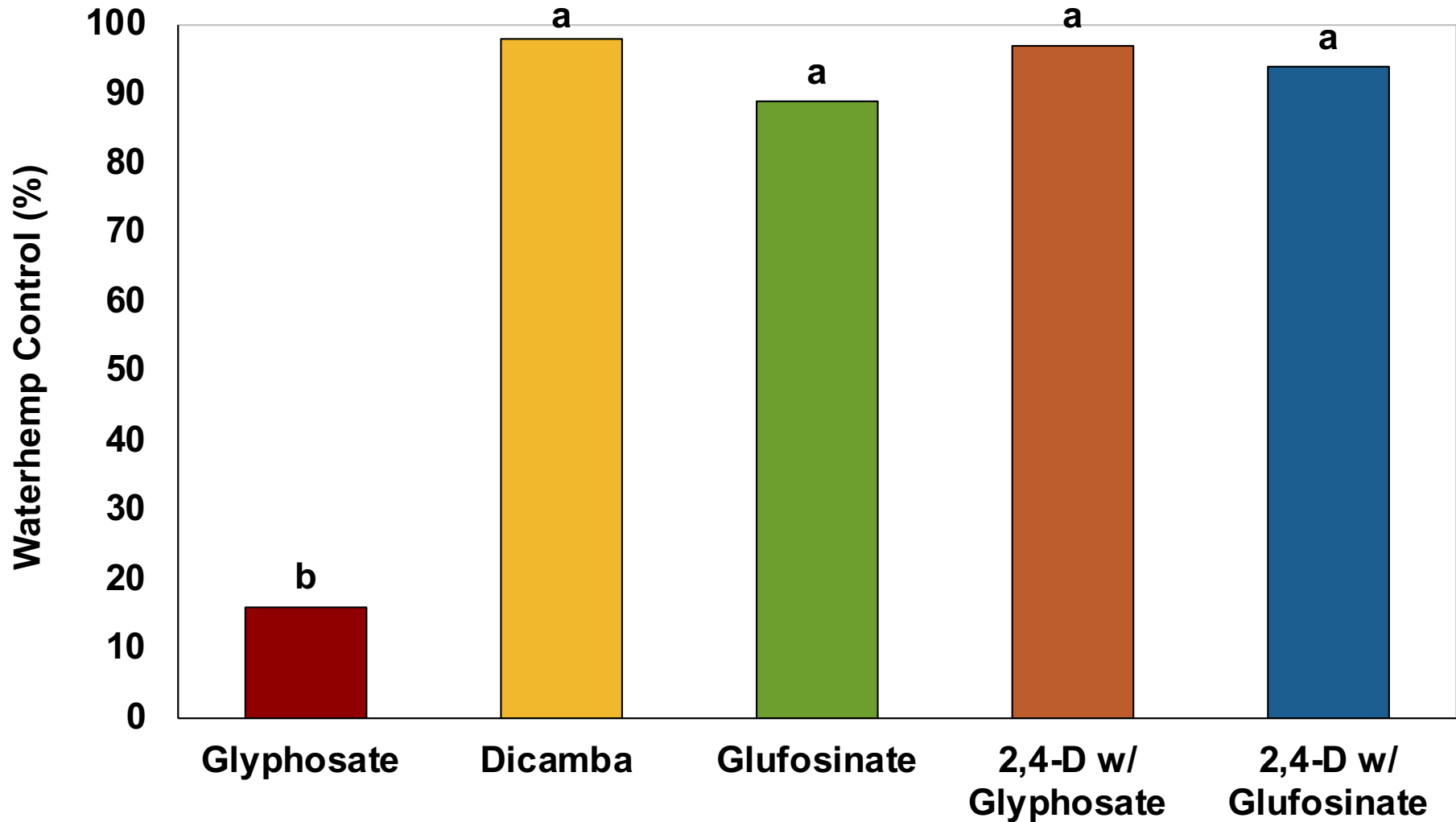


How effective are currently-available soybean systems and herbicide programs on multi-resistant waterhemp control? (2017-2018)



*Bars followed by the same letter are not significantly different, P> 0.05

How effective are currently-available soybean systems and herbicide programs on multi-resistant waterhemp control? (2017-2018)



*Bars followed by the same letter are not significantly different, $P > 0.05$

**Non-treated and conventional treatments removed in comparison

Rotate or Mix Herbicides?

- Analysis of 500 site years of data from 105 Illinois fields (2004 to 2010).
- Glyphosate-resistant waterhemp was greatest in fields where glyphosate had been used in over 75% of the seasons, including sites where herbicide rotation occurred annually.
- Growers that mixed 2.5 herbicide sites of action (SOA's) on average per application were 83 times less likely to have glyphosate resistance than growers that had mixed 1.5 SOA's on average.
- **MIXING EFFECTIVE HERBICIDE SOA'S IS THE BEST OPTION!**



Additional Thoughts on Current Waterhemp Management:

1. **Use full use rates** and/or combinations of pre-emergence residual herbicides as close to planting as possible.
2. **Overlapping residual** herbicide programs aren't for all weed species, but they match waterhemp.
3. The LibertyLink soybean system is still a mechanism of action that still works in most regions.
4. New technologies **will not "solve"** the problem of resistant waterhemp, or change #'s 1-3.

#1. Use full use rates and/or combinations of pre-emergence residual herbicides as close to planting as possible.

But there are still some product labels that talk about reduced rates!!!

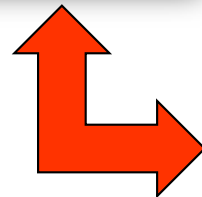
FULL USE RATE (25)

Rate Table 1:

Fall Application, Early Pre-plant, Preplant Burndown, Pre-plant Incorporated, and Preemergence:

No-Till, Minimum-till, Conventional tillage

Soil Texture	Organic Matter	
	0.5 – 2%	2 – 4%
Ounces Product Per Acre		
Coarse: Loamy Sand, Sandy loam	5.0 – 6.0	6.0 – 7.0
Medium: Loam, Silt Loam, Silt, Sandy clay loam	6.5 – 7.5	7.0 – 8.0
Fine: Silty Clay Loam, Clay Loam, Clay	7.0 – 8.0	8.0 – 9.6



REDUCED RATE FOR GMO SOYBEAN (ROUNDUP READY, LIBERTY LINK etc.) (26)

Rate Table 2:

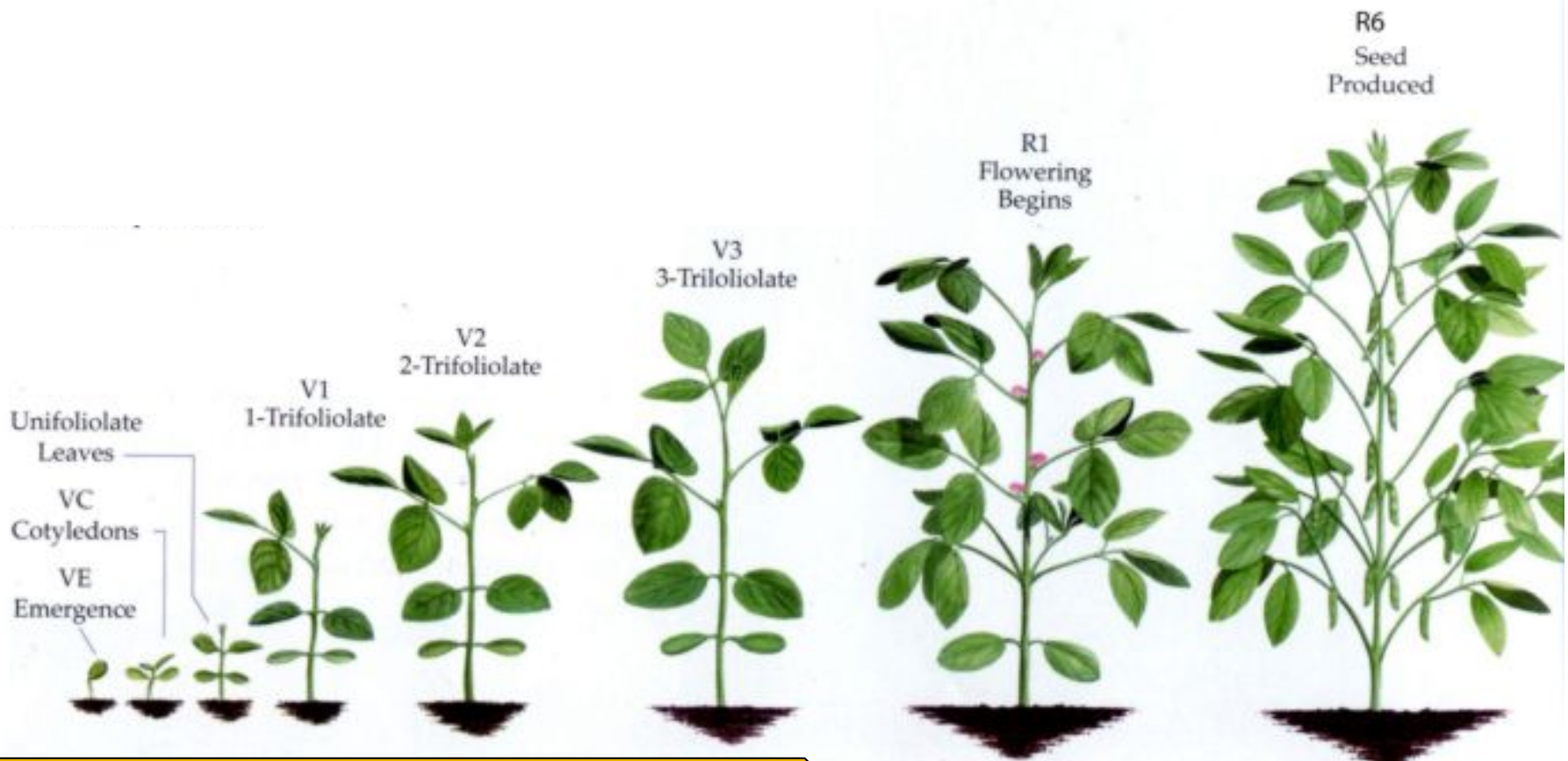
Use rates in Table 2 are to be used in conjunction with a planned POST herbicide program; ~~XXXXXXX~~ at these reduced rates will provide early season control or suppression to reduce early season weed competition.

Fall application, Early Pre-plant, Early Pre-plant Burndown, Pre-plant Incorporated, Preemergence:

No-Till, Minimum-till, Conventional Tillage

Soil Texture	Organic Matter	
	0.5 – 2%	2 – 4%
Ounces Product Per Acre		
Coarse: Loamy Sand, Sandy loam	3.0 – 4.0	3.2 – 4.0
Medium: Loam, Silt Loam, Silt, Sandy clay loam	3.2 – 4.0	3.2 – 4.8
Fine: Silty Clay Loam, Clay Loam, Clay	4.0 – 5.0	4.0 – 5.0

#2. Overlapping residuals is a program that fits the pattern of waterhemp emergence.



Residual, Pre-emergence Herbicide

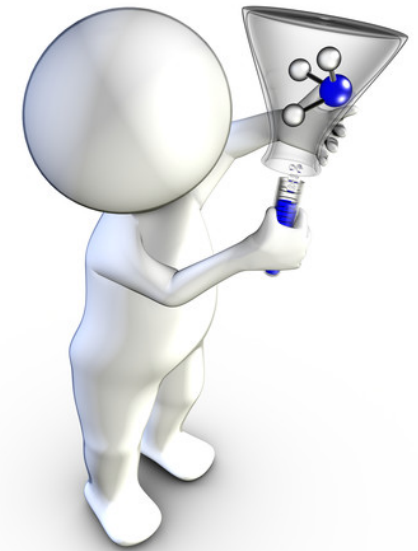
Contact + Residual Herbicide

#3. Liberty provides a mechanism of action that still works, but if we abuse it we will break it.

Only with a pre-emergence herbicide
Only with timely POST applications of Liberty



#4. New technologies cannot “solve” the problem of resistant waterhemp, or change the emphasis that we should place on good weed management practices.



SOYBEAN PERFORMANCE SYSTEM

BalanceTM





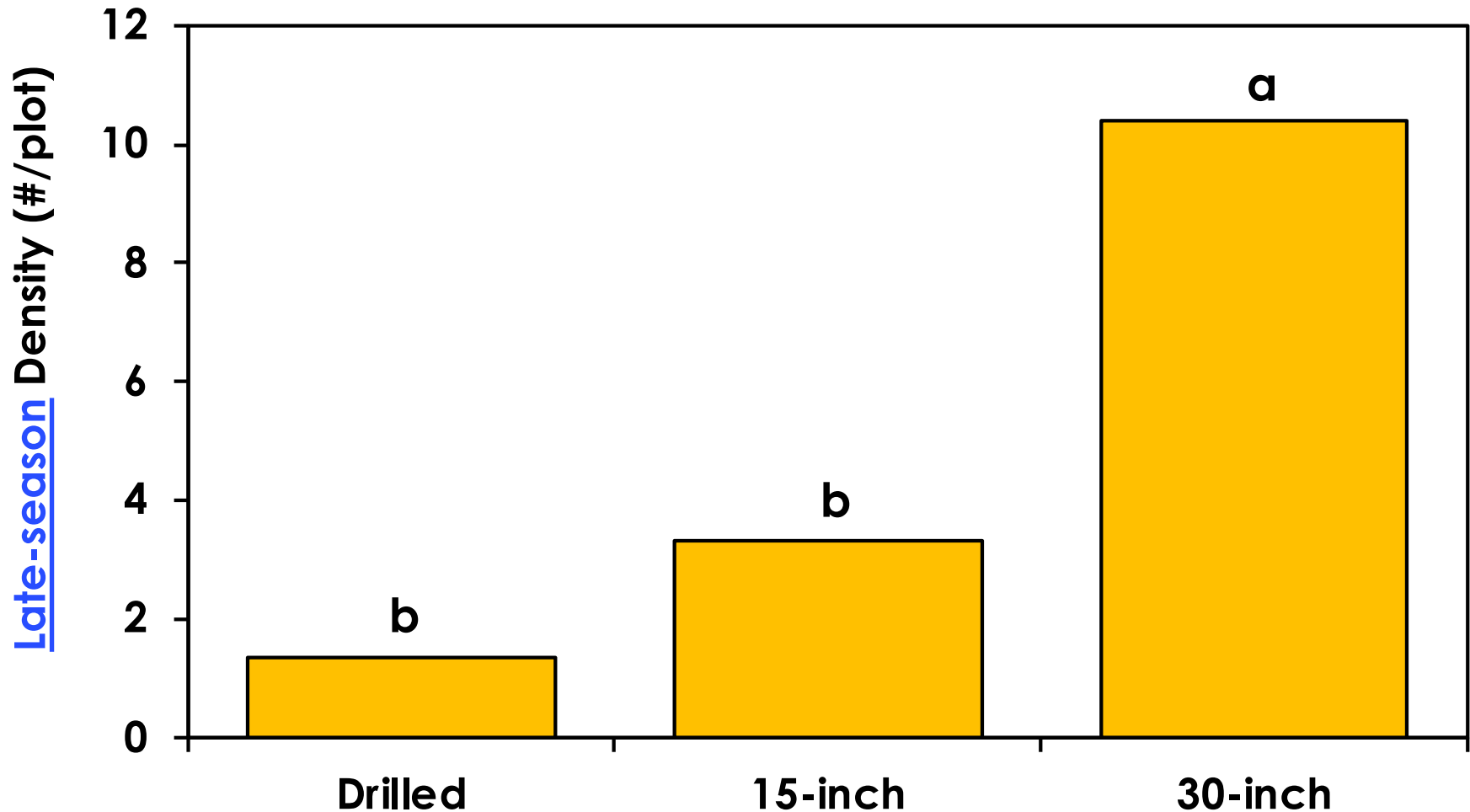
**What's the
future of
waterhemp
management
look like?**



We Must Integrate Cultural Management Techniques With Herbicides



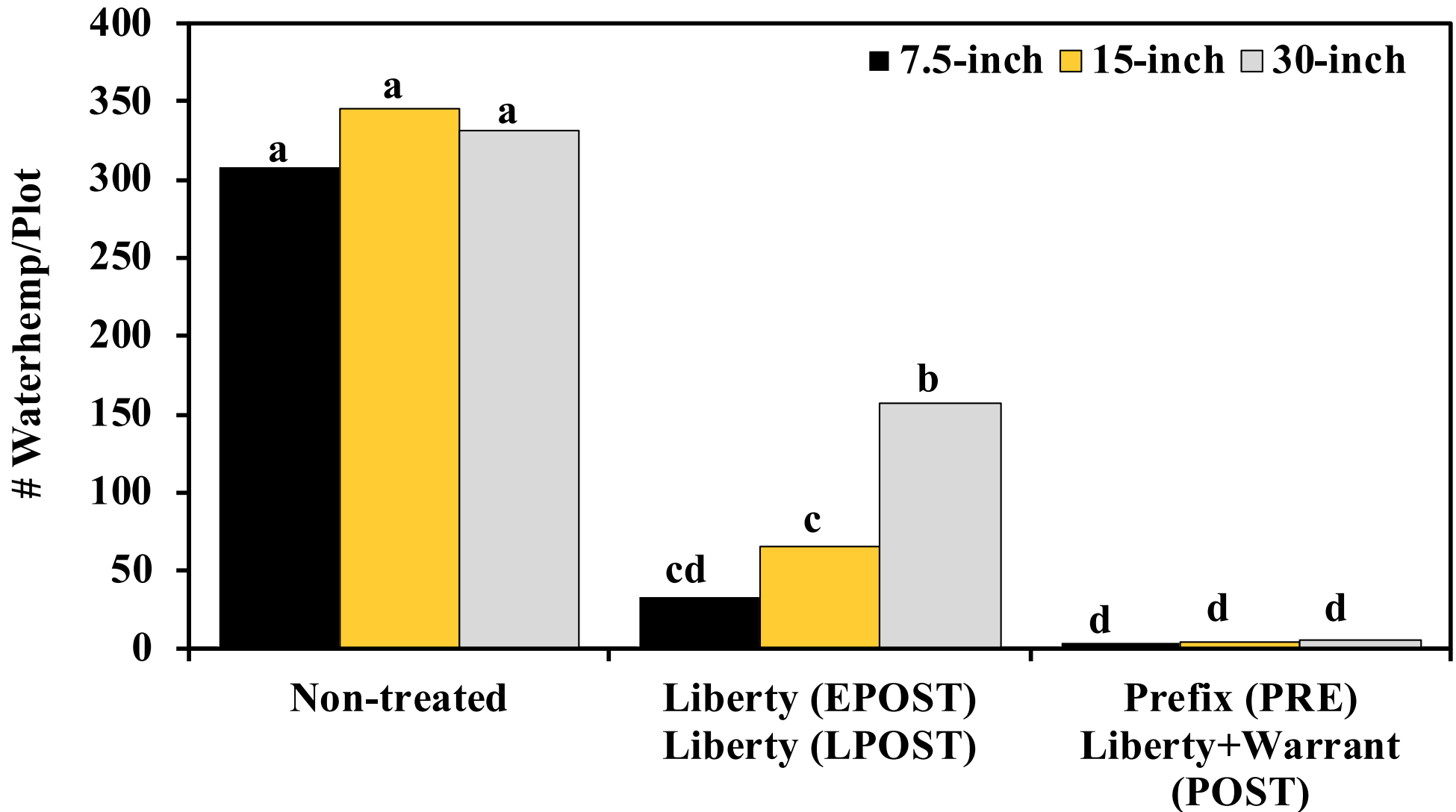
Effects of soybean row spacing on waterhemp density



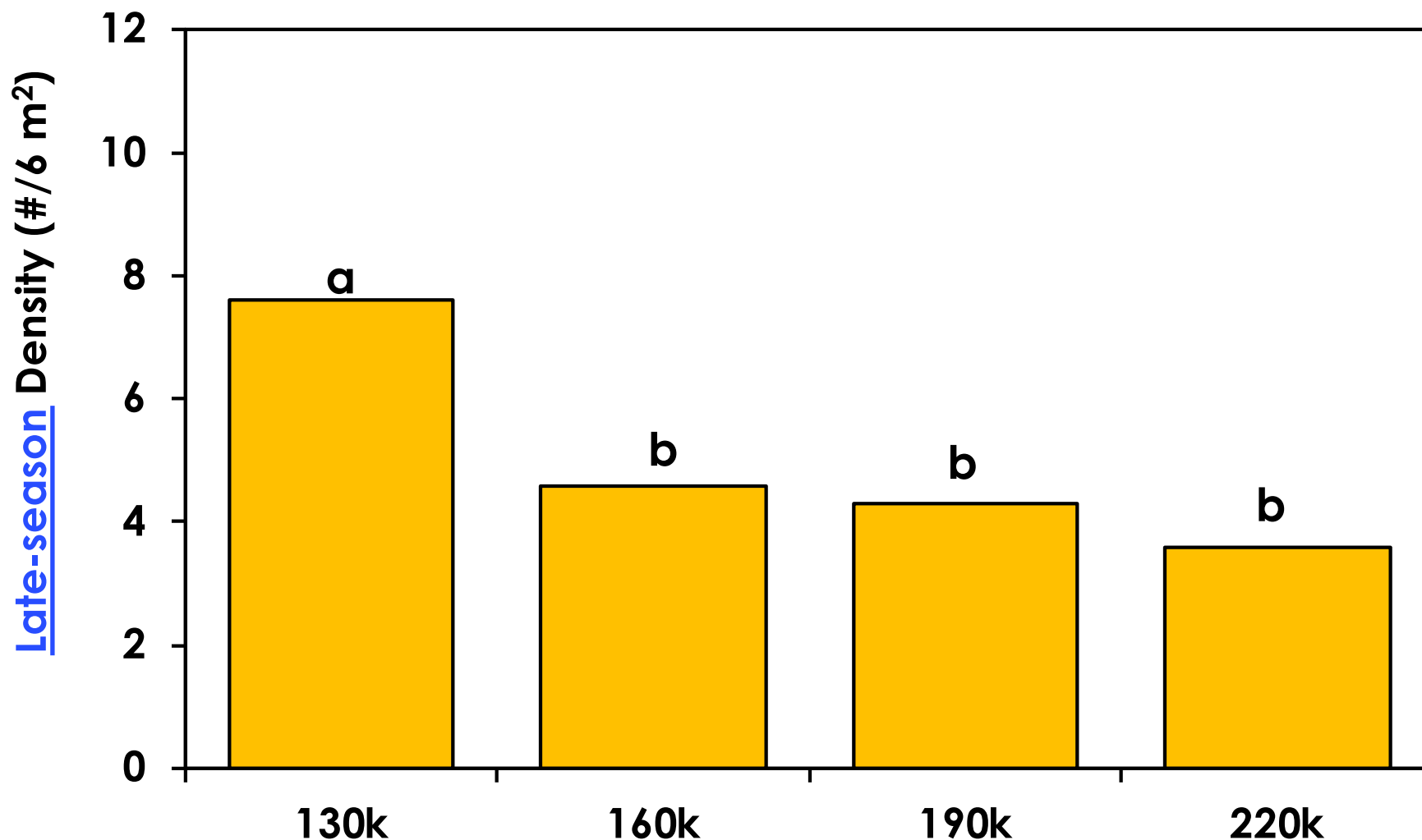
*Results summarized across herbicide programs, tillage types, and planting populations.

**Means followed by the same letter are not different, $P \leq 0.05$

Effects of soybean row spacing and herbicide programs on waterhemp density in LL Soybean



Effects of soybean planting population on waterhemp density



*Results summarized across herbicide programs, tillage types, and row spacings.

**Means followed by the same letter are not different, $P \leq 0.05$

Impact of Crop Rotation

In one Missouri survey, the likelihood of finding resistant waterhemp was 44% higher in fields with soybeans grown continuously for 5 years compared to fields that had at least one other crop added to the rotation during the 5-year time period.

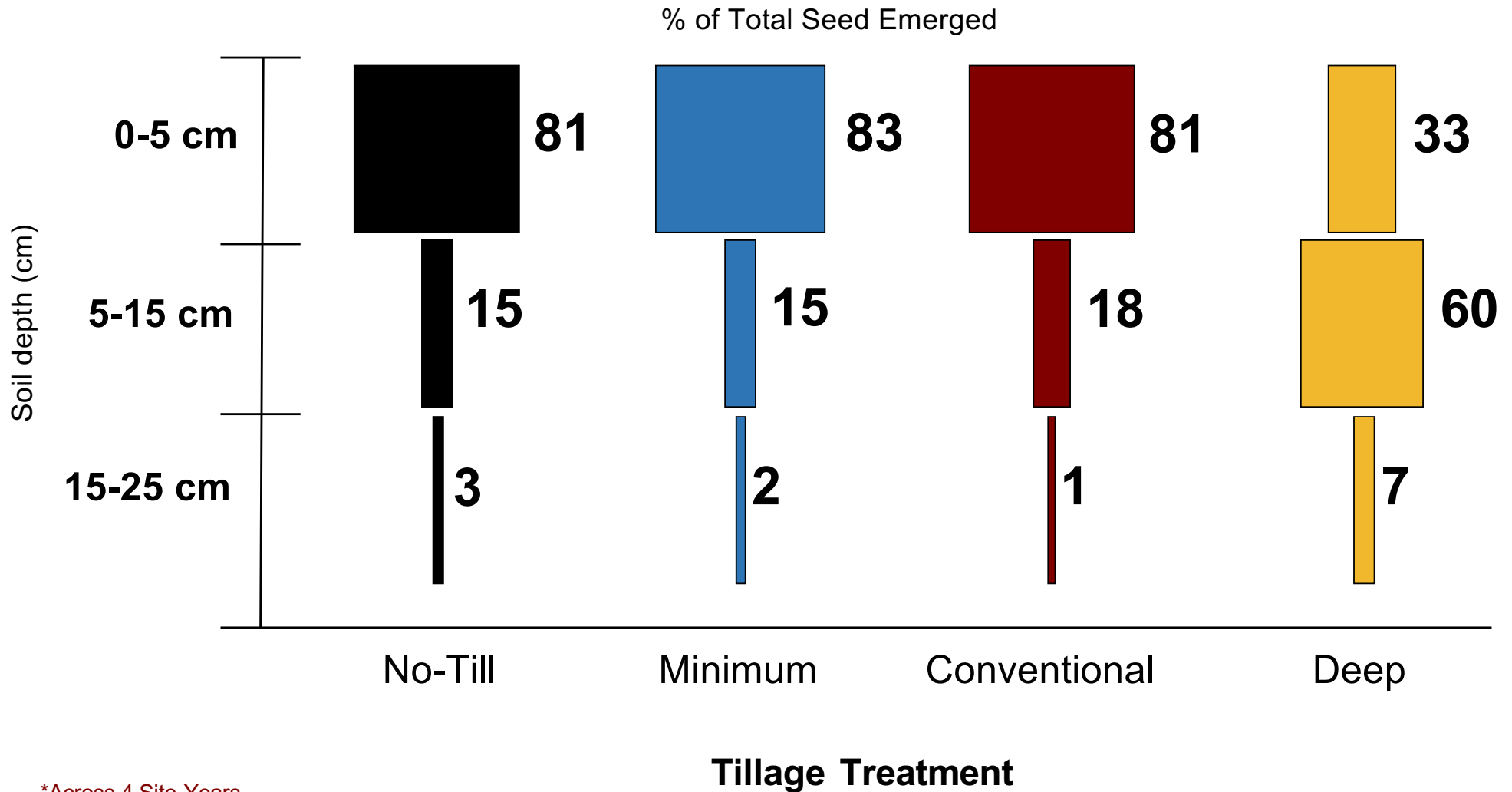
Waterhemp seed do not emerge from low soil depths



What effect does tillage have?

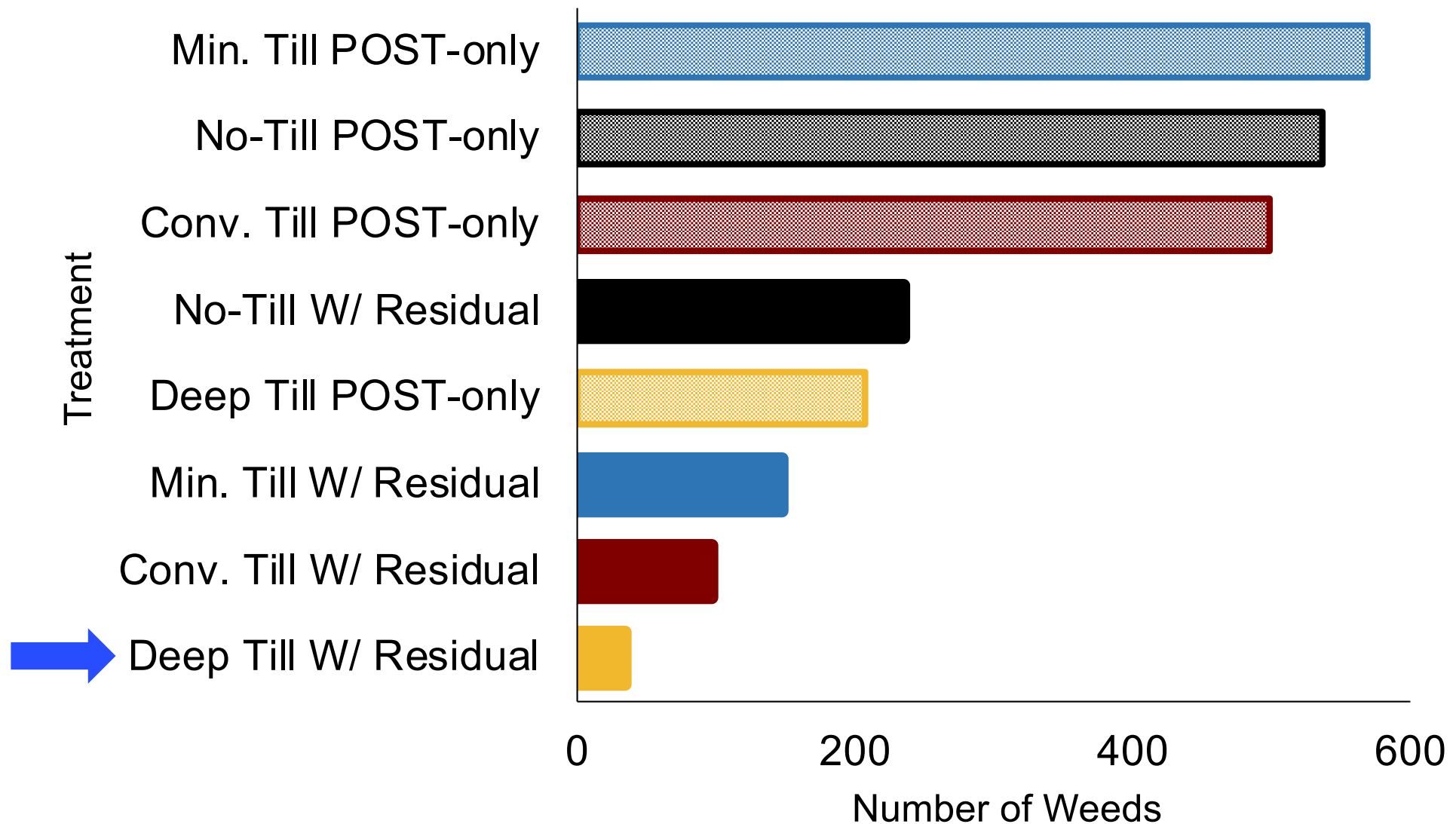


Conventional and minimum tillage were not effective in burying *Amaranthus* seed



*Across 4 Site-Years
(Farmer et al. 2017)

Deep tillage with a residual herbicide program was most effective in reducing weeds



*Across 10 of 14 Site-Years

*Bars followed by the same letter are not different, LSD=0.05

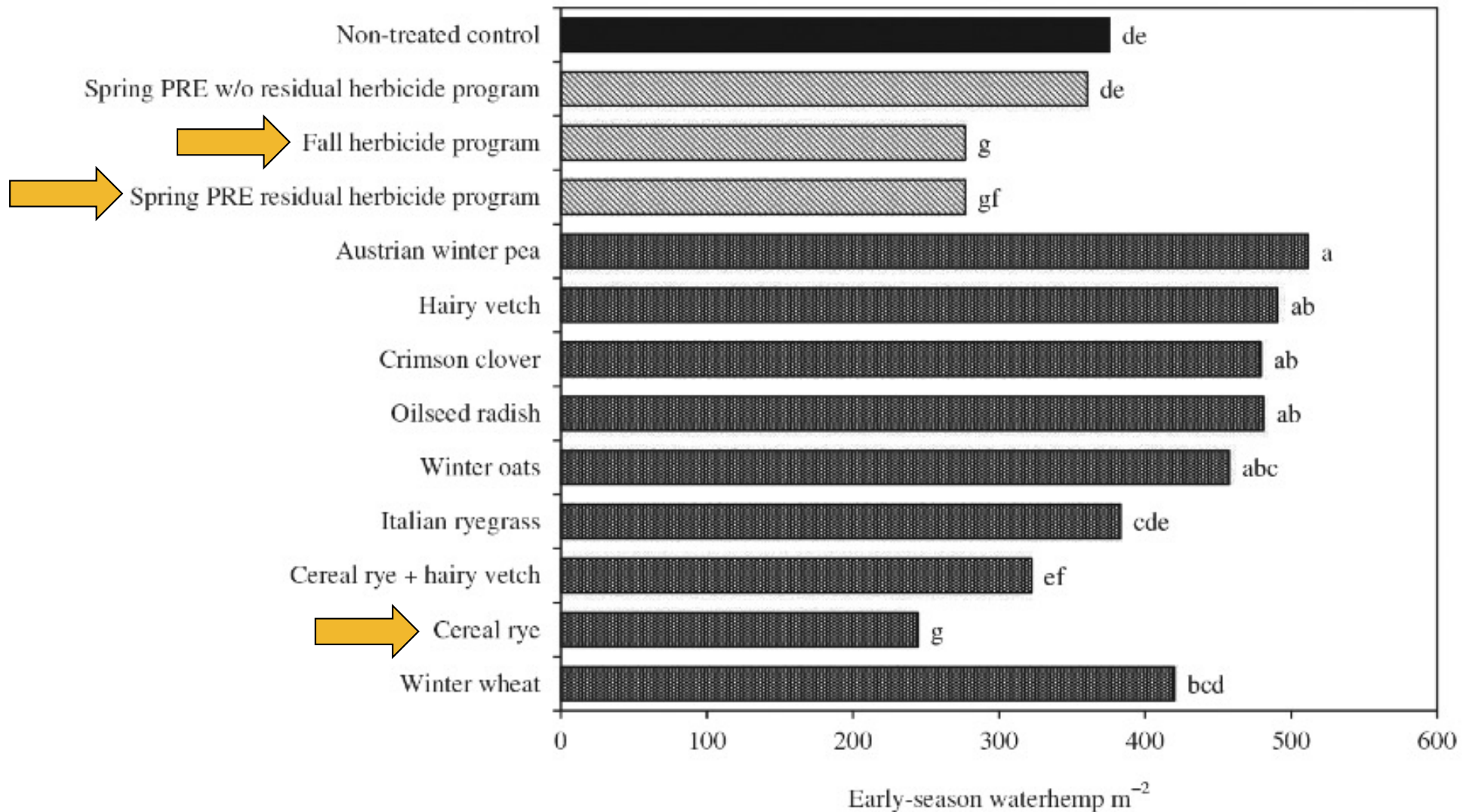
(Farmer et al. 2017)

The image is a side-by-side comparison of two cover crop stages. The left half shows a lush, green cover crop with dense, upright blades. The right half shows the same cover crop after it has dried and turned a golden-brown color, with the blades appearing more tangled and less structured. The text is centered across the middle of the image, overlapping both halves.

What kind of weed control can we expect from cover crops?

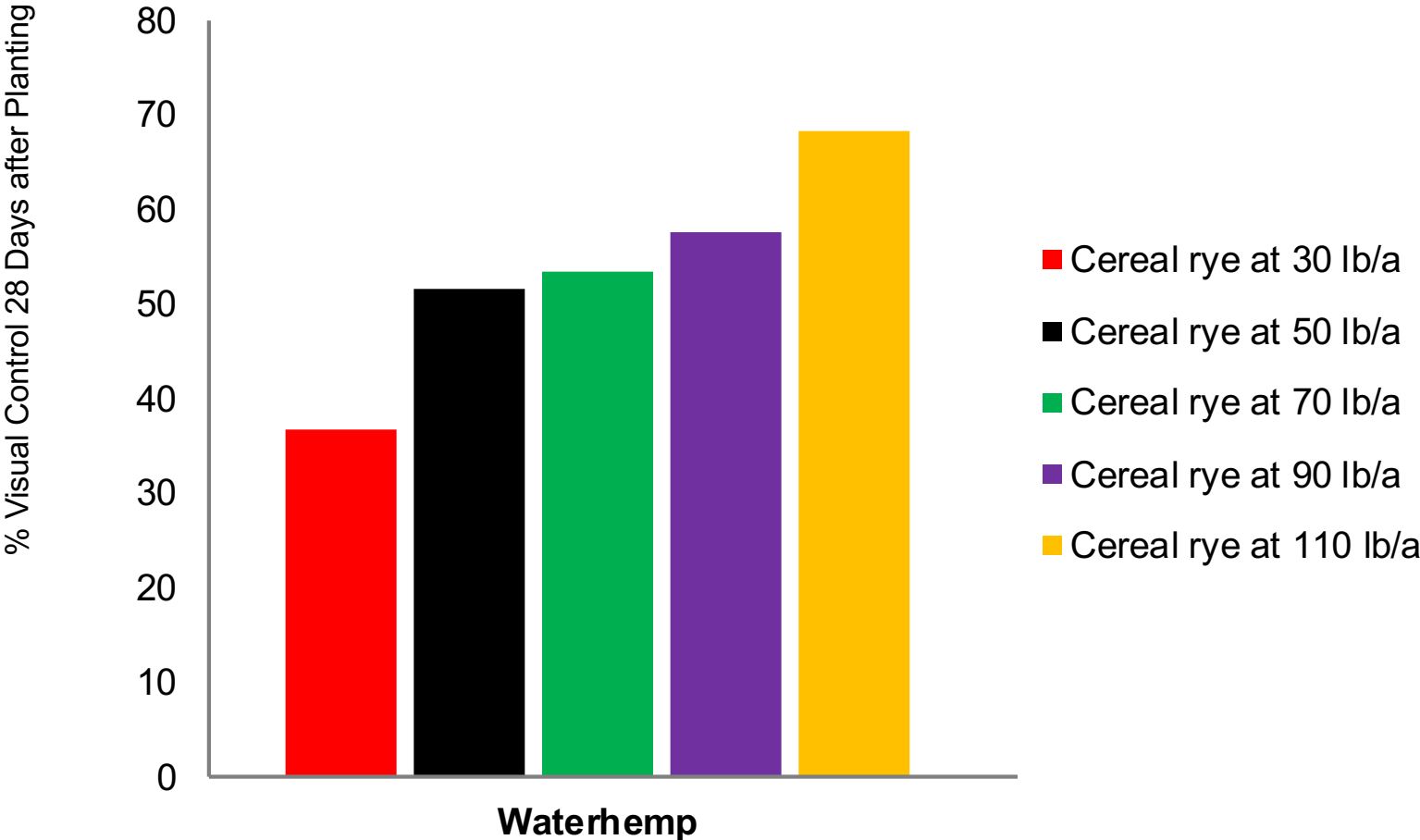
Cereal Rye and residual herbicide programs had similar effects on early-season waterhemp emergence

(results summarized across 5 sites in 2 years in Missouri)



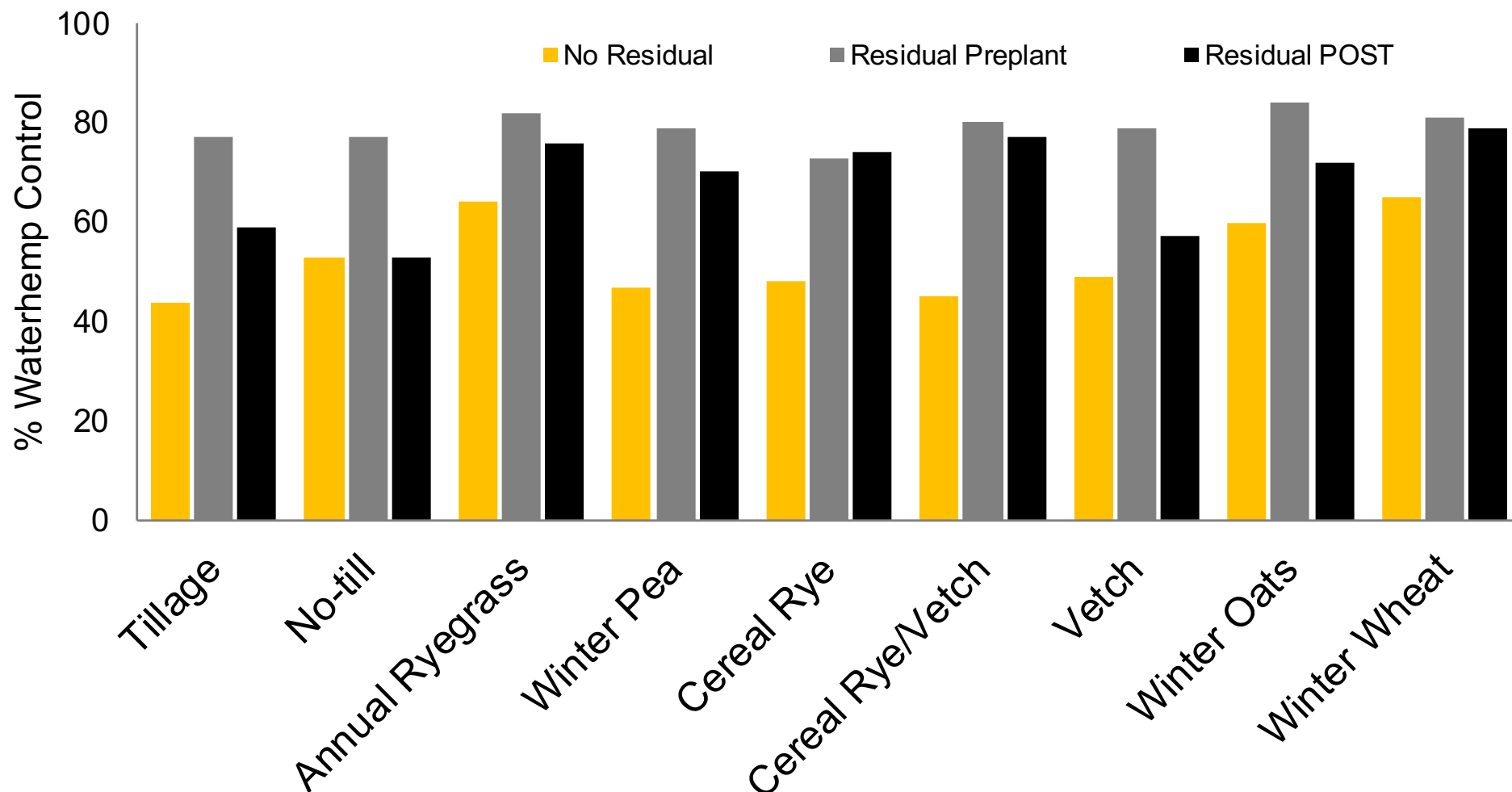
(Cornelius and Bradley, Weed Technology, 2017)

Cereal Rye Seeding Rate Influences the Effect on Waterhemp Control (2018)



*Cereal rye terminated immediately after planting.

Influence of Cover Crop Species and Herbicide Programs on Waterhemp Control in Soybean



(Columbia, MO 2016 and 2017)

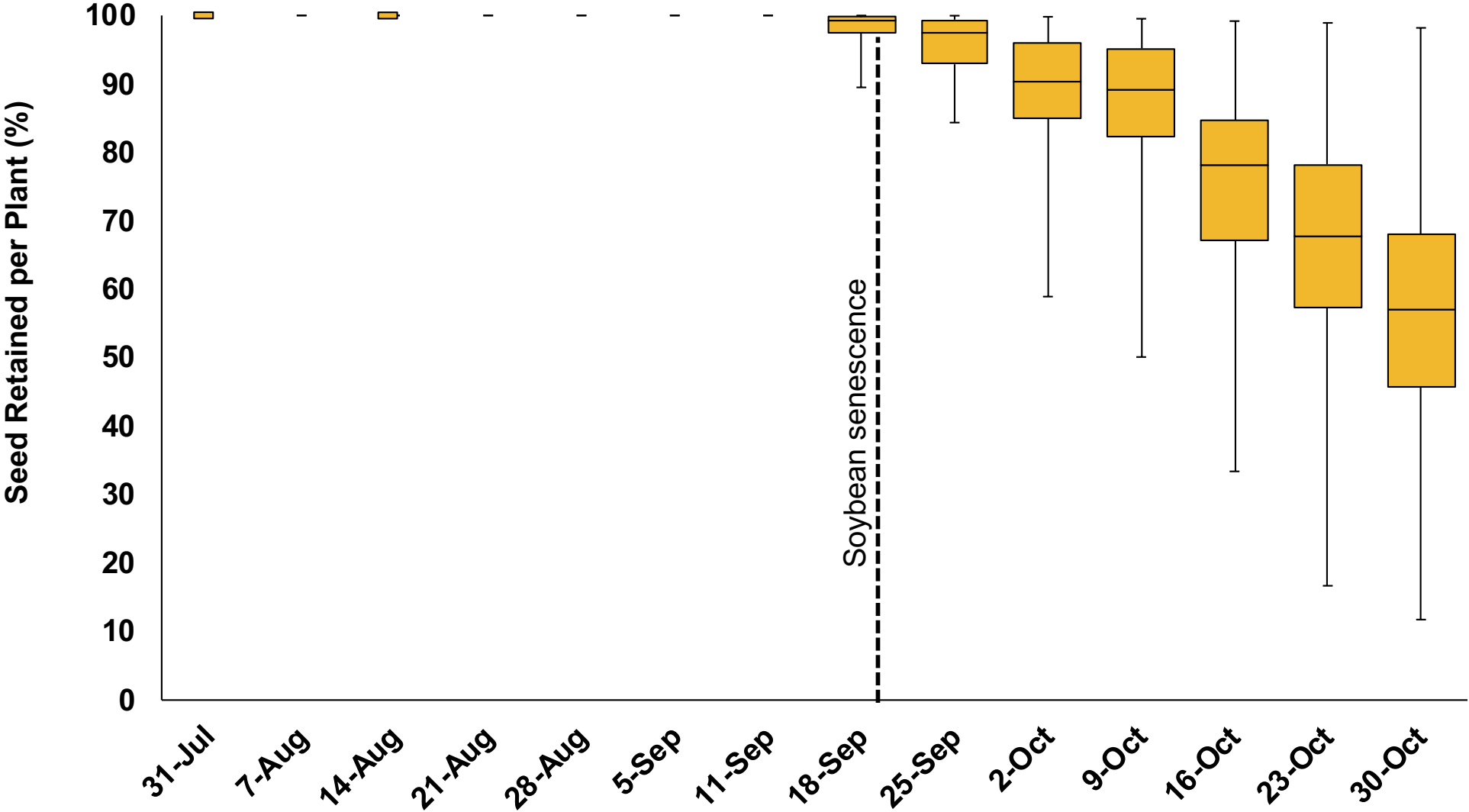
© Dr. Kevin Bradley, University of Missouri

Whatever management approach you take, the ultimate objective must be to reduce the soil seedbank.



Escaped Waterhemp Plants Retain Much of the Seed at Harvest

Waterhemp seed retention (24 plants)



Can Harvest Weed Seed Management reduce the number of waterhemp seed that make it to the soil?

Researching Windrow Burning for Missouri



What's the best way to manage waterhemp?



A photograph of a soybean field. Two rows of healthy, green soybean plants are visible on either side of a central gap. The gap contains bare, light-brown soil with some small clumps and debris. The plants have characteristic trifoliate leaves. The text "... to never see them emerge" is overlaid in white on a semi-transparent dark grey rectangular background at the bottom of the image.

... to never see them emerge

Questions?

E-mail Dr. Bradley @ bradleyke@missouri.edu



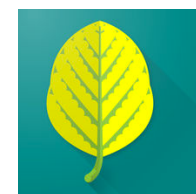
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ID Weeds App



Herbicide Injury App