Glyphosate Resistant Weed Update

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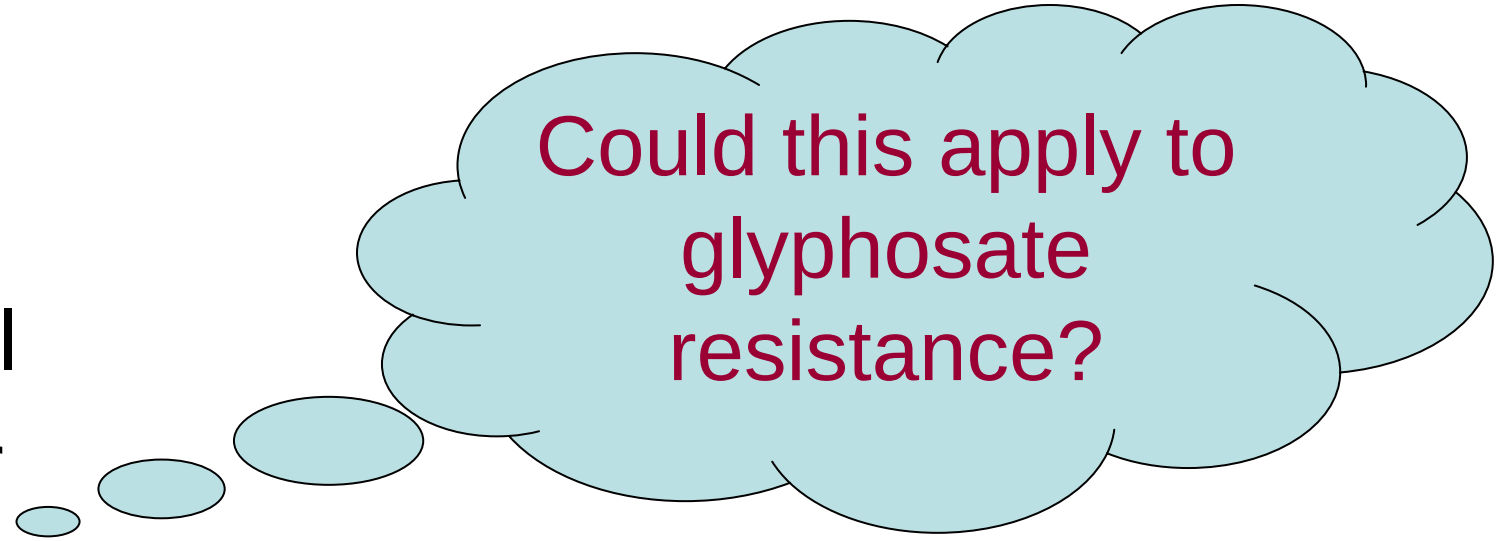
Kubler-Ross Model

- Denial
- Anger
- Bargaining
- Depression
- Acceptance



Glyphosate-Resistant Weeds

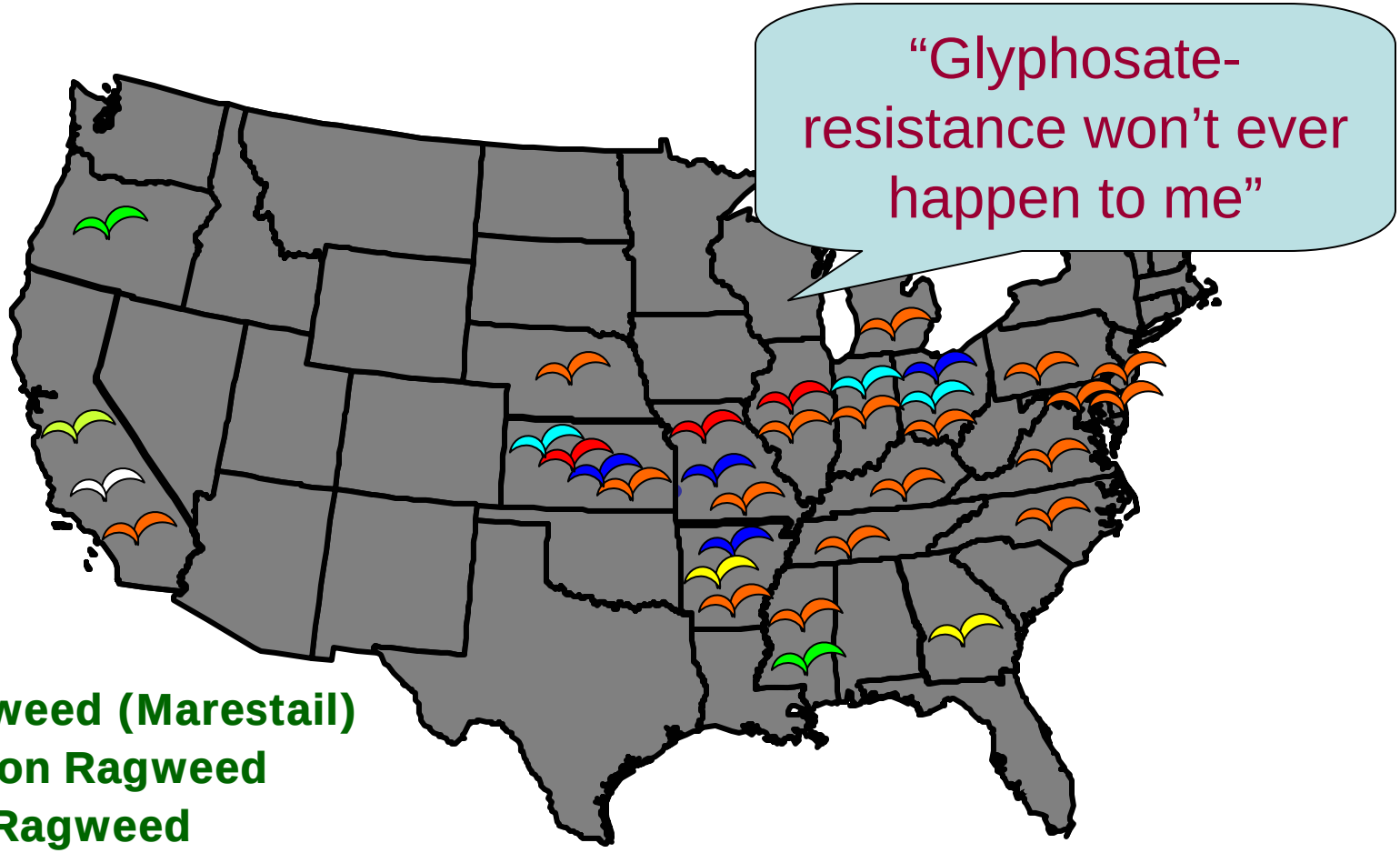
- Denial
  - "the complex manipulations that were required for the development of glyphosate-resistant crops are unlikely to be duplicated in nature to evolve glyphosate-resistant weeds"

    ~ Bradshaw et al. 1997.
  - "a hypothetical problem"

    ~ Grower at the National Glyp
    Forum Nov. 2004.

First Glyphosate Resistant Weed 1996

Confirmed Glyphosate Resistant Weeds in the U.S.



Glyphosate-Resistant Weeds

- Anger?
  - "This is great technology, why are you attacking it?"
  - "Don't restrict our access to RR crops."

We want to extend the value and use of glyphosate and glyphosate resistant crops

Glyphosate-Resistant Weeds

- Bargaining
  - "If I tank mix herbicide "XYZ" with glyphosate, that's good enough, right?"
  - "The companies will deve
    or herbicide-resistant trait

Not good enough unless overlapping weed spectrum

Glyphosate-Resistant Weeds

- Depression
  - "Just keep using glyphosate. Resistance is going to happen anyway."
  - "Industry isn't going to change."

~ C. Boerboom

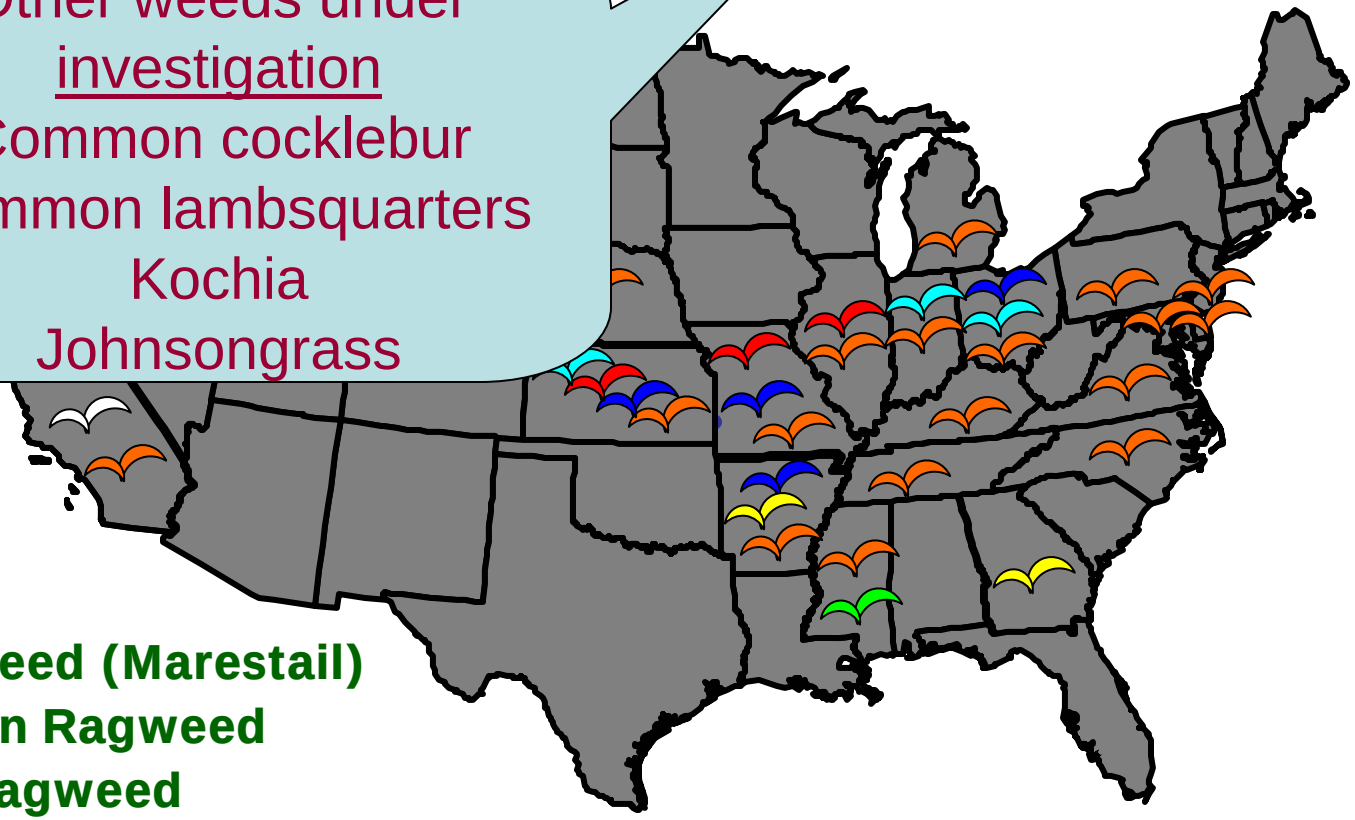
Glyphosate-Resistant Weeds

- Acceptance?
  - Are we acknowledging the glyphosate-resistance issue?
  - Yes at the National Glyphosate Stewardship Forum 2007

Still trying to turn this support into action

Confirmed Glyphosate Resistant Weeds in the U.S.

Other weeds under investigation
Common cocklebur
Common lambsquarters
Kochia
Johnsongrass



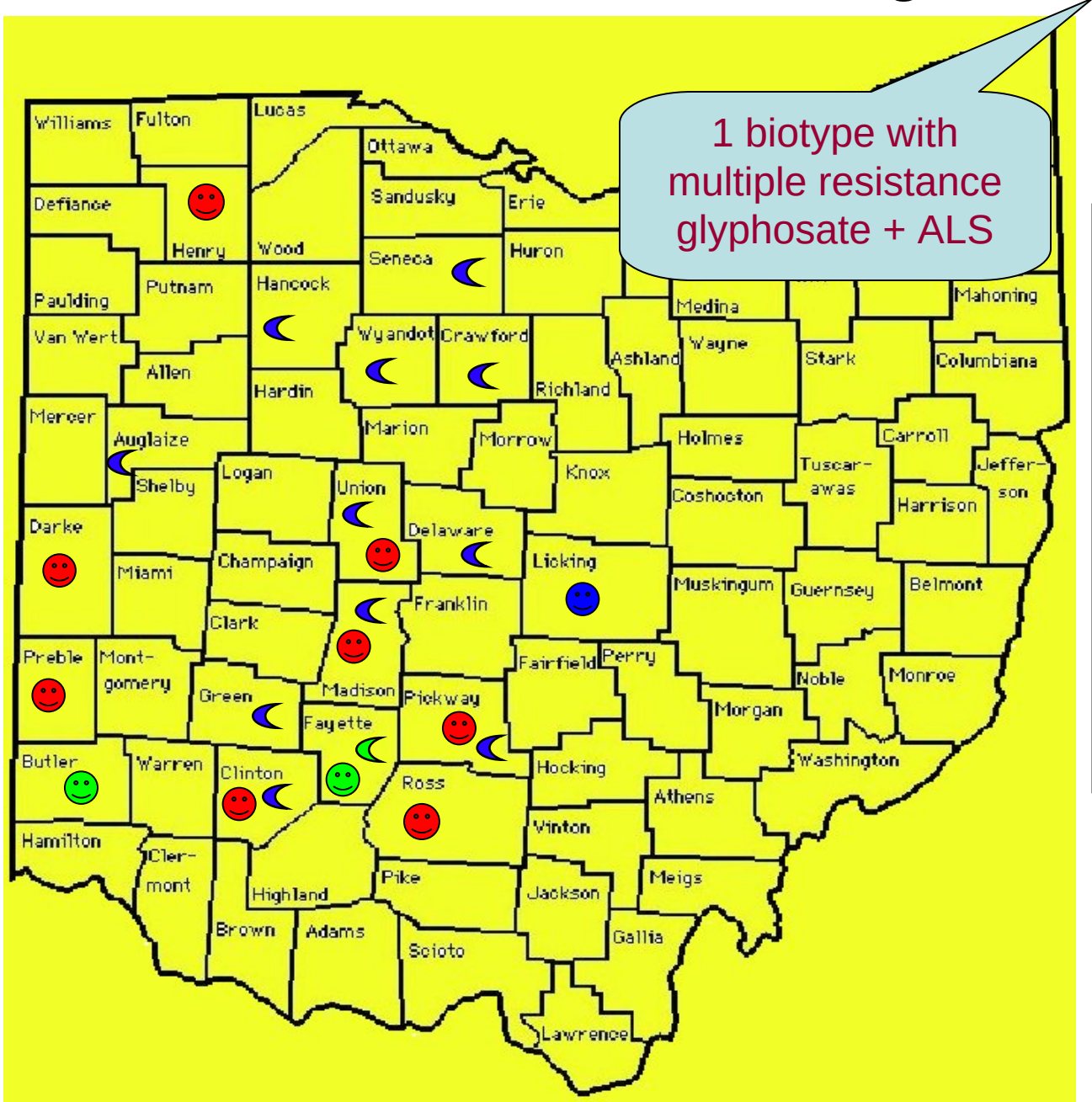
- Horseweed (Marestail)
- Common Ragweed
- Giant Ragweed
- Palmer Amaranth
- Common Waterhemp
- Hairy Fleabane
- Italian Ryegrass
- Rigid Ryegrass

NC Herbicide Resistant Weeds

	ND	SD	NE	KS	MN	IA	MO	WI	IL	MI	IN	OH
Pigweed spp.	1			1	1			1	1	2	1	1
Kochia	3	1		2	1	1		2	2		2	
Waterhemp				4		2	4	1	4	1		1
Common ragweed				1	1		1	1	1	2	1	2
Lambsquarters					1	1		1	1	2	1	2
Horseweed			1	1			1		1	4	1	2
Giant ragweed				1		1		1	1		2	2
Foxtail spp.	1				2	2		1		1		
Shattercane			1	1		1		1			1	1
Cocklebur				1	1	1	1					1
Sunflower		1		1		1	1					
E. b. nightshade	1							1	1			
Wild oat	2				1							
Velvetleaf					1			1				
Wild carrot										1		1
Smartweed spp.						1					1	

No. of modes of action

Herbicide-Resistant Giant Ragweed Biotypes in Ohio



ALS-Resistant

= 1998 to 2004 (11)

= 2005 (1)

** Suspect most Non-GMO soybean fields in OH have ALS-Resistance

Glyphosate-Resistant

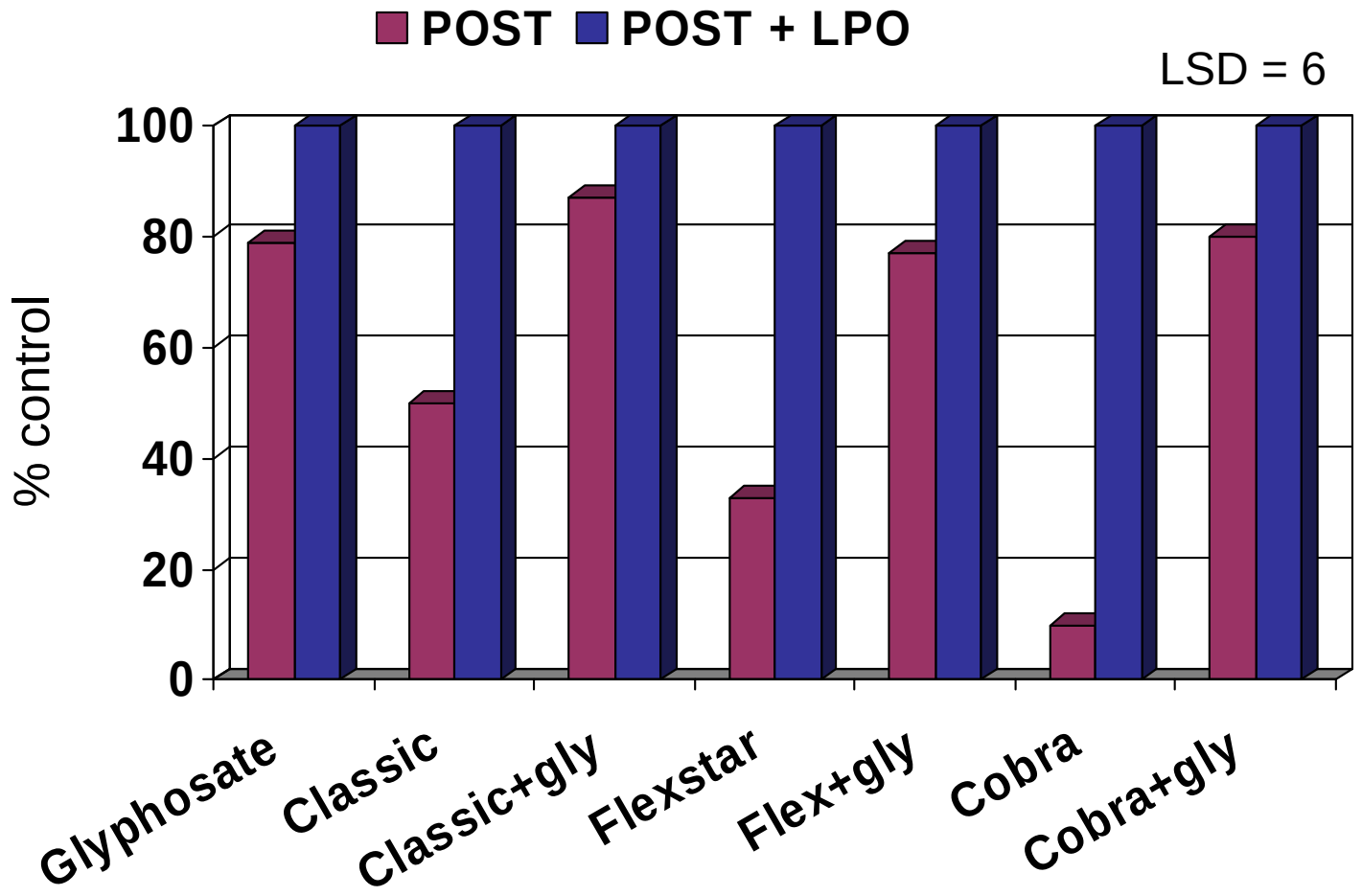
= 2004 (1)

= 2005 (2)

= 2006 (8)

Courtesy of M. Loux, OSU

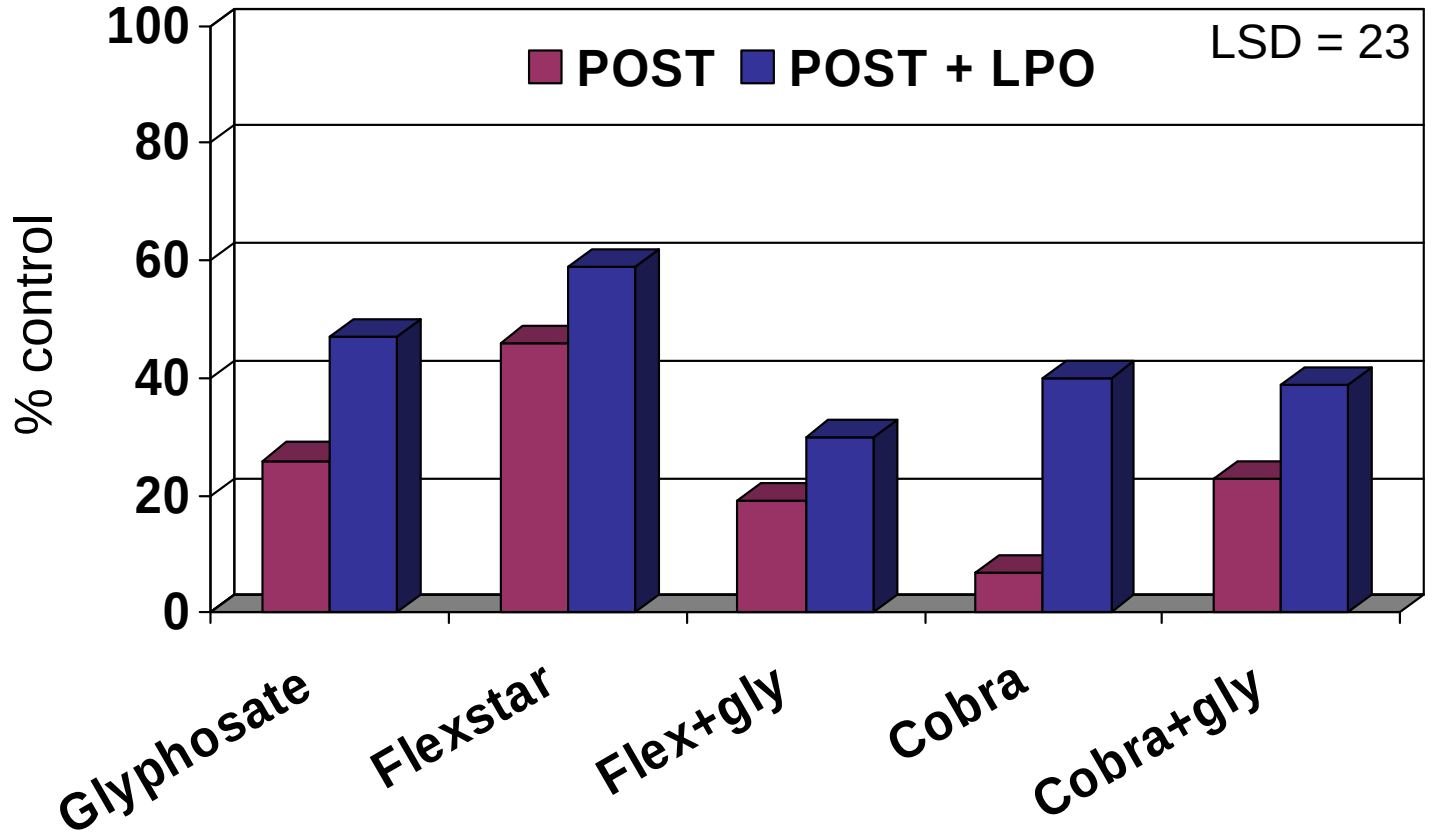
OSU Research Station - POST Management
% control in October



POST rates: glyphosate - 0.75 lb/a; Flexstar - 20 oz/a; Cobra - 12.5 oz/a; Classic - 1 oz/a
LPO rate: glyphosate – 0.75 lb/a

Courtesy of M. Loux, OSU

Pickaway County - POST Management
% control in October



POST rates: glyphosate – 1.5 lb/a; Flexstar – 20 oz/a; Cobra – 12.5 oz/a
LPO rate: glyphosate – 0.75 lb/a

Courtesy of M. Loux, OSU

A few random thoughts

- Multiple-resistant giant ragweed brings us closer to the point where it is impossible to obtain control in soybeans, and control requires $$$$.

- Suggested control program for multiple resistance?
  - Preplant - glyphosate + 2,4-D + residual herbicide
  - Early POST - Flexstar + glyphosate + MSO + AMS
  - Late POST - Cobra + glyphosate + COC/MSO + AMS

- > $50/A for weed control, exclusive of hidden cost of weed control in seed price
  - “it’s déjà vu all over again”

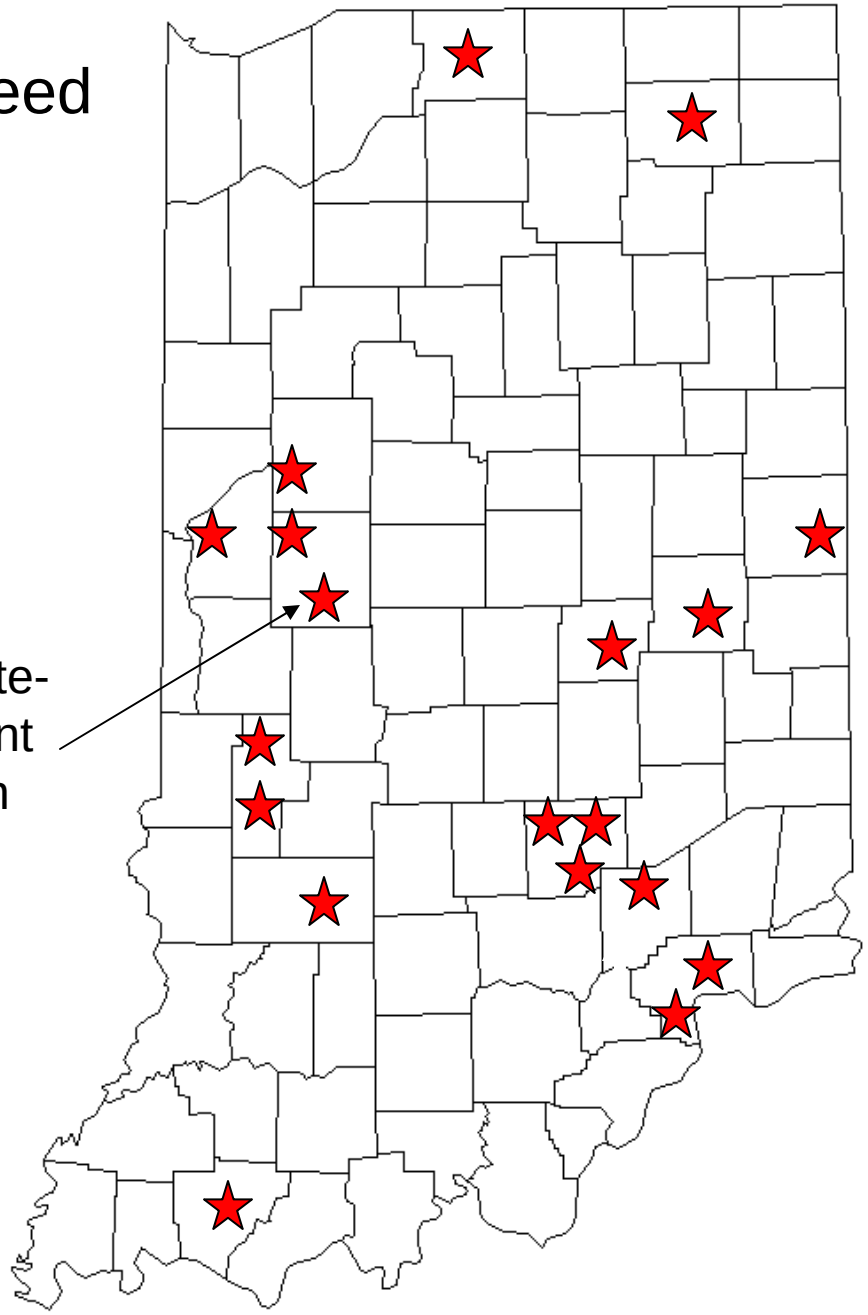
Courtesy of M. Loux, OSU

Indiana Counties with Glyphosate Resistant or Tolerant Giant Ragweed Populations (August 2007)

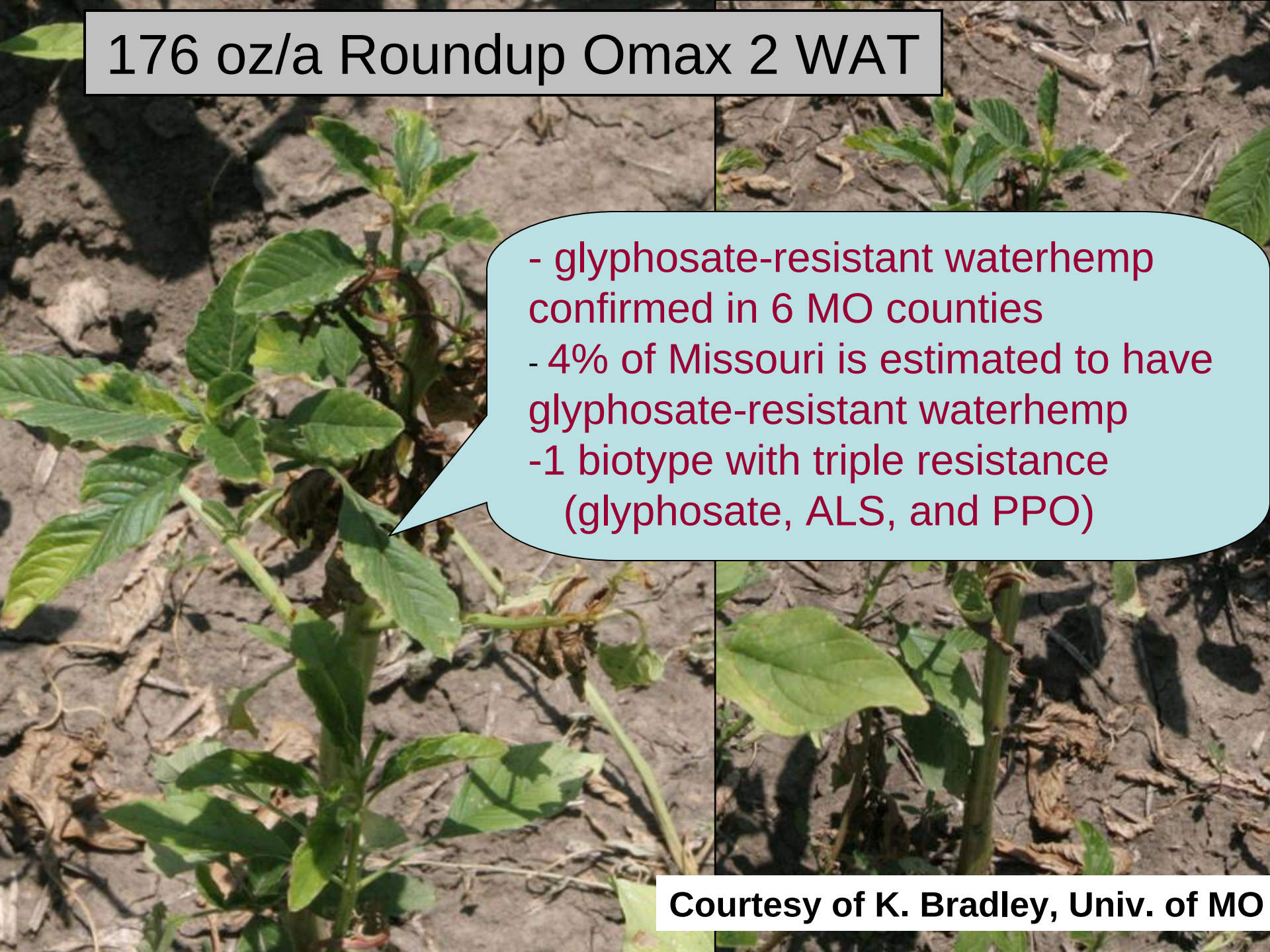
Proposed herbicide program

$18/a → $37/a
(application $ not included)

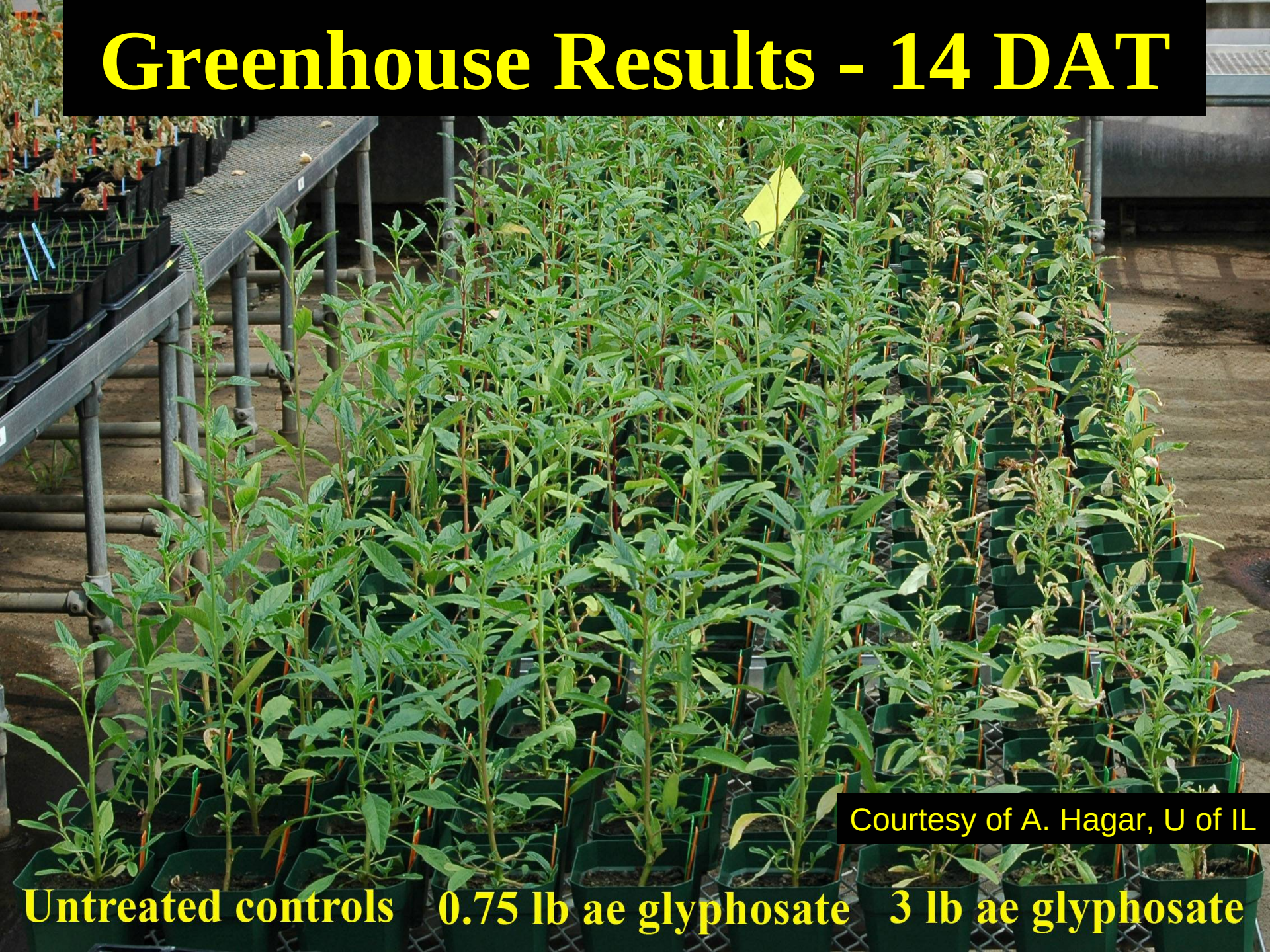
This Montgomery county field has glyphosate-resistant marestail, glyphosate-resistant giant ragweed, and glyphosate “tolerant” common lambsquarter!



Courtesy of B. Johnson, Purdue


176 oz/a Roundup Omax 2 WAT
- glyphosate-resistant waterhemp confirmed in 6 MO counties
- 4% of Missouri is estimated to have glyphosate-resistant waterhemp
-1 biotype with triple resistance (glyphosate, ALS, and PPO)
Courtesy of K. Bradley, Univ. of MO

Greenhouse Results - 14 DAT



Courtesy of A. Hagar, U of IL

Untreated controls

0.75 lb ae glyphosate

3 lb ae glyphosate

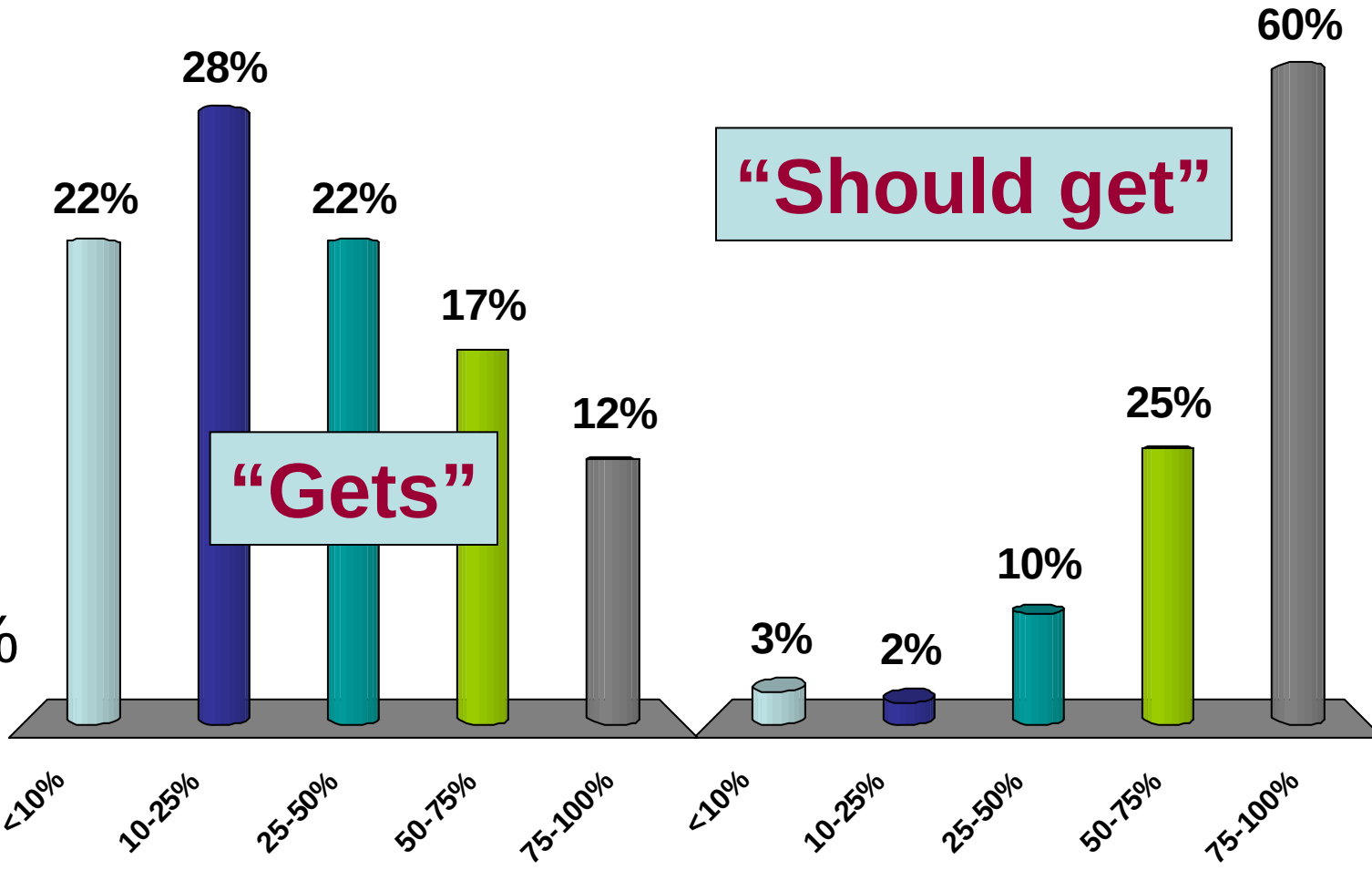
Glyphosate Management Recommendations

1. Start with a **clean field** and control weeds early by using a burndown treatment or tillage in combination with a **preemergence residual** herbicide as appropriate.
2. Apply **integrated** weed management practices.
   a) Use multiple herbicide modes-of-action with **overlapping weed spectrums** in **rotation, sequences, or mixtures**.
   b) Use cultural practices such as cultivation and crop rotation, where appropriate.
3. Use the **full recommended herbicide rate** and **proper application timing** for the hardest to control weed species present in the field.
4. **Scout fields** after herbicide application to ensure control has been achieved. Avoid allowing weeds to reproduce by seed or to proliferate vegetatively.
5. Use **good agronomic principles** that enhance crop competitiveness as well as scouting, monitoring and cleaning equipment between fields.

UW Extension

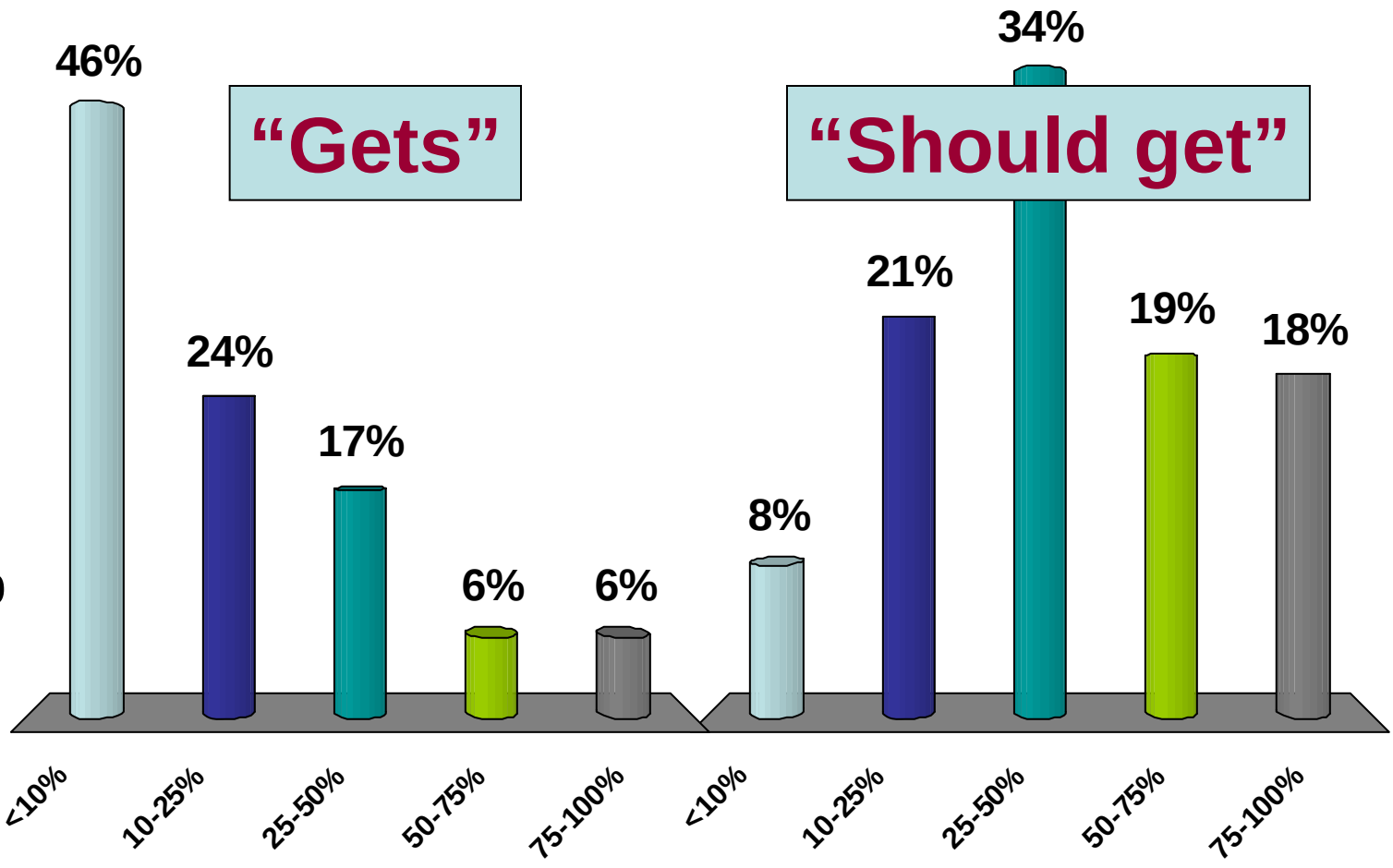
What percent of glyphosate-resistant corn gets a pre herbicide treatment?

1. <10%
2. 10-25%
3. 25-50%
4. 50-75%
5. 75-100%



What percent of glyphosate-resistant soybean gets a pre herbicide treatment?

1. <10%
2. 10-25%
3. 25-50%
4. 50-75%
5. 75-100%



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Are we here yet?