

Glyphosate Resistance: An Emerging National Issue

Bill Johnson

Associate Professor of Weed Science

**CUSTOM
SPRAYED
BY
AG—ONE**

Common Ragweed
Ambrosia Artemisiifolia

Horseweed
Conyza canadensis

Rigid Ryegrass
Lolium rigidum

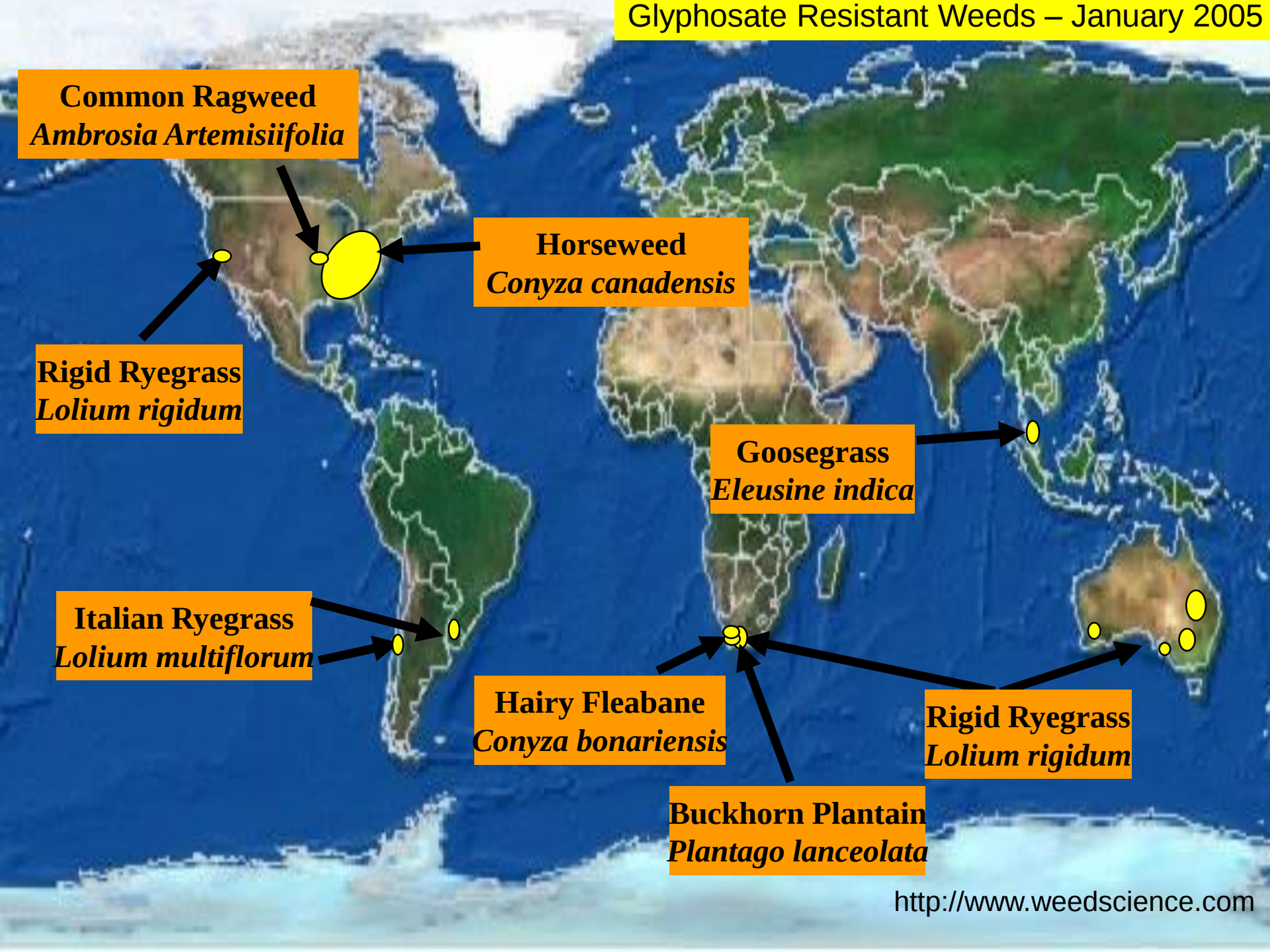
Goosegrass
Eleusine indica

Italian Ryegrass
Lolium multiflorum

Hairy Fleabane
Conyza bonariensis

Buckhorn Plantain
Plantago lanceolata

Rigid Ryegrass
Lolium rigidum





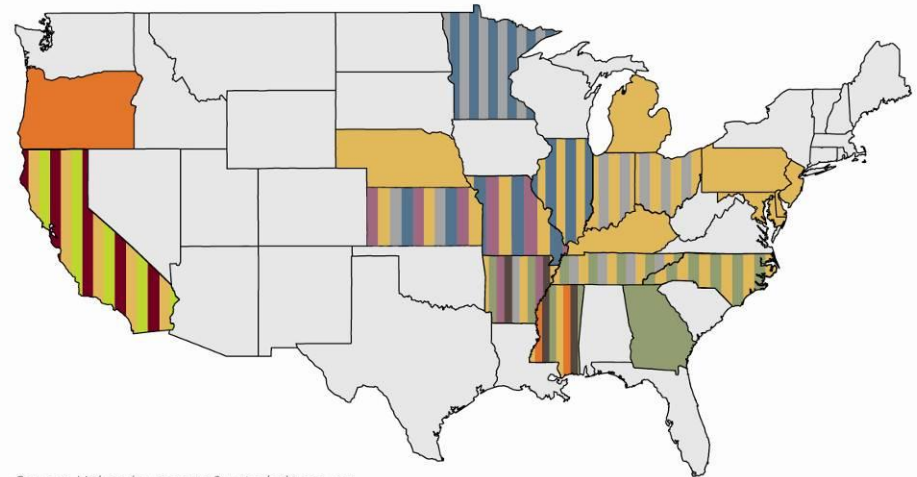
Glyphosate Resistance Evolution

Glyphosate-resistant Weeds Globally

<u>Weed</u>	<u>Countries</u>
Palmer amaranth	USA
Common waterhemp	USA
Common ragweed	USA
Giant ragweed	USA
Hairy fleabane	South Africa, Spain, Brazil, Colombia, USA
Horseweed	USA, Brazil, China
Sourgrass	Paraguay, Brazil
Junglerice	Australia
Goosegrass	Malaysia, Taiwan, The Philippines
Wild poinsettia	Brazil
Italian ryegrass	Chile, Brazil, USA
Rigid ryegrass	Australia, USA, South Africa, France
Buckhorn plantain	South Africa
Johnsongrass	Argentina, USA
Liverseedgrass	Australia

8 broadleaf species, 7 grass species

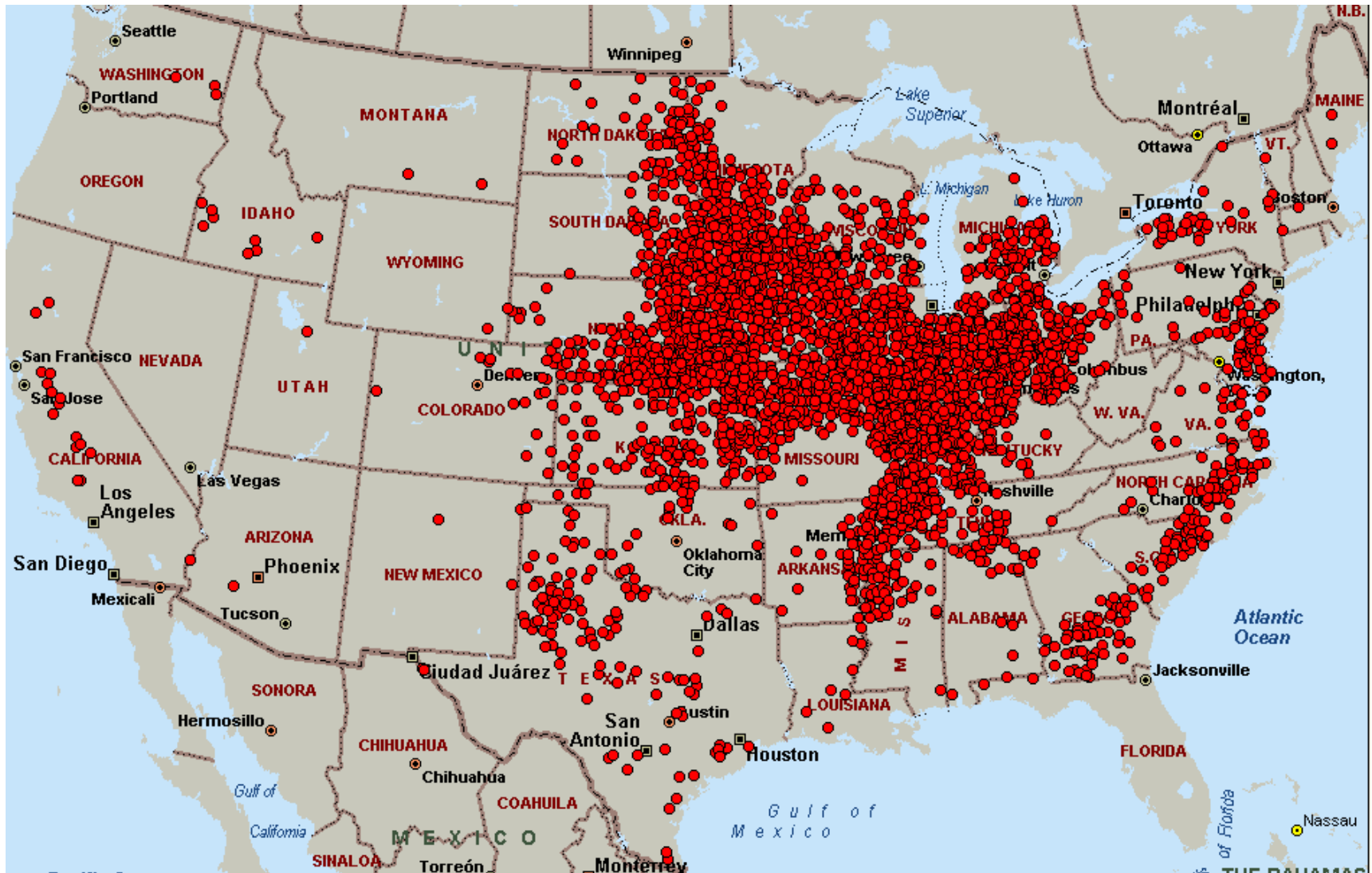
Glyphosate-resistant Weeds in the U.S.



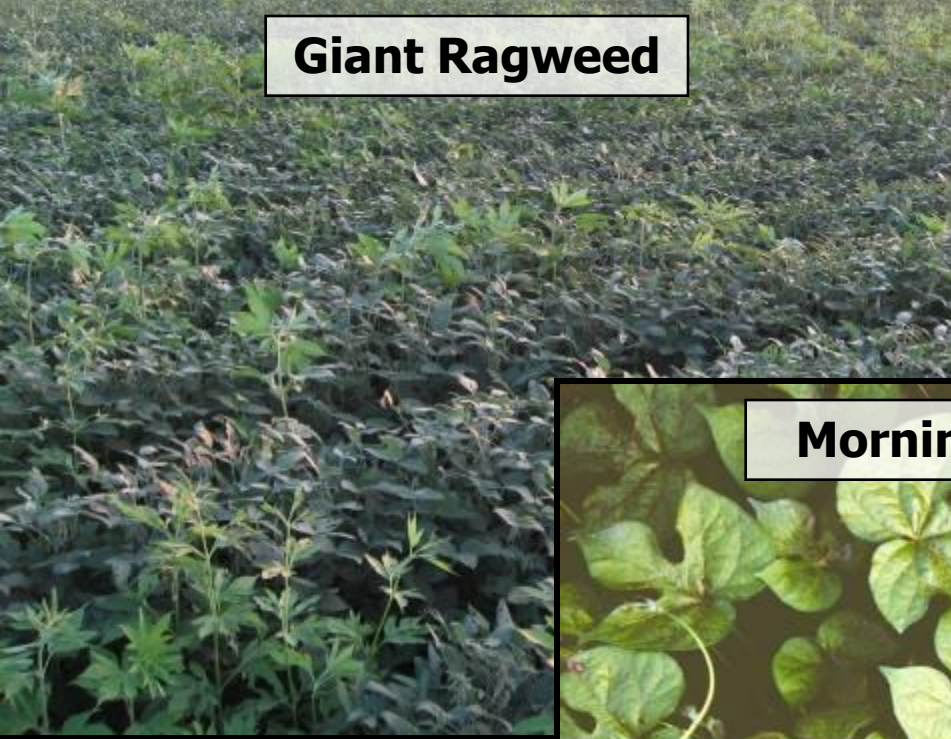
6 broadleaf species, 3 grass species

Source: International Survey of Herbicide Resistant Weeds
www.weedsience.org

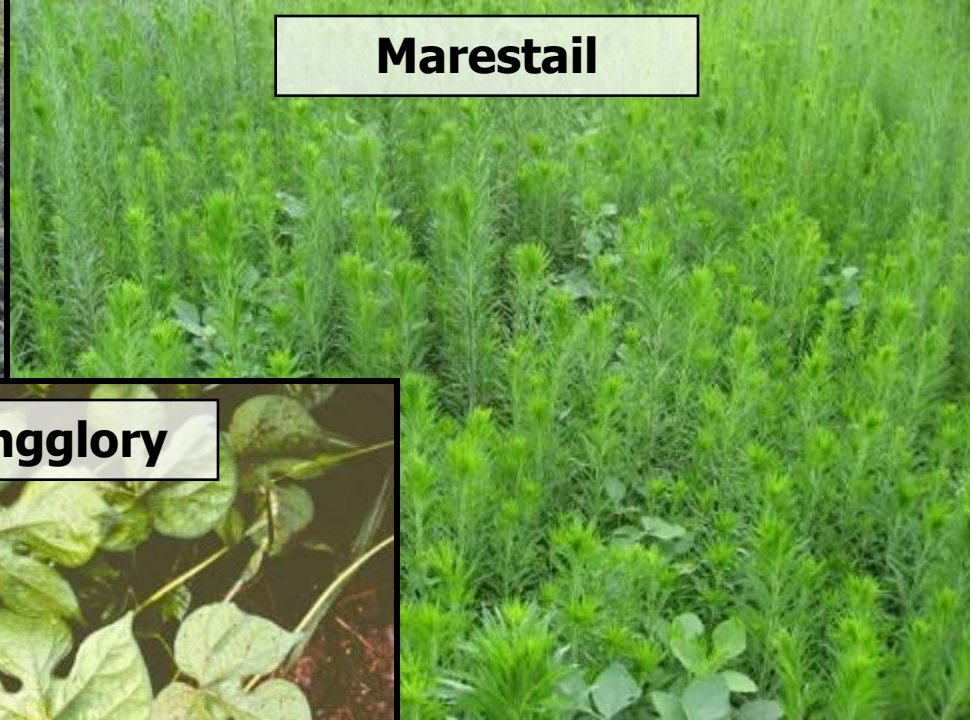
Growers and Retailers with Perceived Glyphosate Weed Resistance



Giant Ragweed



Marestail



Morningglory



Waterhemp



Lambsquarters



Glyphosate-Resistant Marestail

Management Costs

Soybean		Corn	
Year 1	Year 2 and beyond	Year 1	Year 2 and beyond
Yield loss = 15% (assume 50 bu/A beans so 7.5 bu/A * 9 = \$68/A)	Hopefully no yield loss.	Yield loss = 5% (assume 180 bu/A corn so 9 bu/A * \$5 = \$45/A)	Hopefully no yield loss.
Recommendation: 2,4-D in the burndown and higher and more timely glyphosate rates or an ALS tankmix (\$10-20/A)	Use 2,4-D in burndown + residual ALS+Sencor/Valor product (\$12-15/A)	Use 2,4-D or dicamba postemergence in corn (\$2-6/A)	Same as year 1

Cost of Glyphosate-Resistant Maretail/Horseweed in Soybean

- ◆ Low yield loss potential (0-20%)
- ◆ Low level of resistance can be managed with higher and more timely glyphosate treatments (\$8-16/A)
- ◆ Use of 2,4-D in the burndown = \$4/A
- ◆ Use of ALS inhibitors in burndown or postemergence = \$8-10/A
- ◆ Use of Gramoxone + Sencor + 2,4-D as an alternative burndown = \$15-17/A
- ◆ Cost of preplant tillage = depends on the number of passes (most likely more than 1)



Glyphosate-Resistant Giant Ragweed Management Costs

Soybean		Corn	
Year 1	Year 2 and beyond	Year 1	Year 2 and beyond
Yield loss = 30% (assume 50 bu/A soybeans so 15 bu/A * 9\$ = \$135/A)	Hopefully no yield loss.	Yield loss = 10% (assume 180 bu/A corn so 18 bu/A * \$5 = \$90/A)	Hopefully no yield loss.
Recommendation: Use 2,4-D in burndown followed by higher and more timely glyphosate post or an ALS tankmix (\$10-20/A)	Use 2,4-D in burndown + residual ALS + Sencor/Valor product or post PPO (\$12-15/A)	Use 2,4-D or dicamba postemergence in corn (\$2-4/A)	Same as year 1

Cost of Glyphosate-Resistant Giant Ragweed in Soybean

- ◆ High yield loss potential (30-80%)
- ◆ No-tillers will need 2,4-D in the burndown = \$2-4/A
- ◆ Low level of glyphosate resistance can be managed with higher rates and more timely glyphosate treatments = \$8-16/A
- ◆ Preplant residual herbicides in soybeans = \$10-15/A
 - ❖ ALS products (FirstRate, Classic, Scepter) = alone \$10-12/A
 - ❖ Authority First, Canopy DF, Gangster, Sonic, Valor XLT = \$10-15/A
- ◆ Use of PPO's postemergence = \$13-15/A
- ◆ Use of ALS products postemergence = \$8-10/A
- ◆ Liberty Link soybeans = ?





Influence of Herbicide Programs on Late Season Glyphosate-resistant Waterhemp Control in Soybean

Preemergence Treatments	Postemergence Treatments ^a					
	Phoenix (8 ozs)	Ultra Blazer (1.5 pt)	Roundup Omax (22 ozs)	Roundup Omax + Phoenix (22+8 ozs)	Roundup Omax + Ult Blazer (22 ozs+1.5 pt)	None
----- % Visual Waterhemp Control 3 Months After Planting ^b -----						
Valor (2.5 ozs)	68	81	66	86	85	58
Spartan (8 fl ozs)	89	94	91	95	95	80
IntRRo (2.5 qts)	76	85	73	86	88	45
Boundary (2.1 pt)	88	88	81	95	94	80
None	23	23	0	5	3	0
LSD (0.05):	12					

^aAMS added to all Roundup trtmts; NIS added to Phoenix & Blazer treatments when applied alone.

Source: Bradley



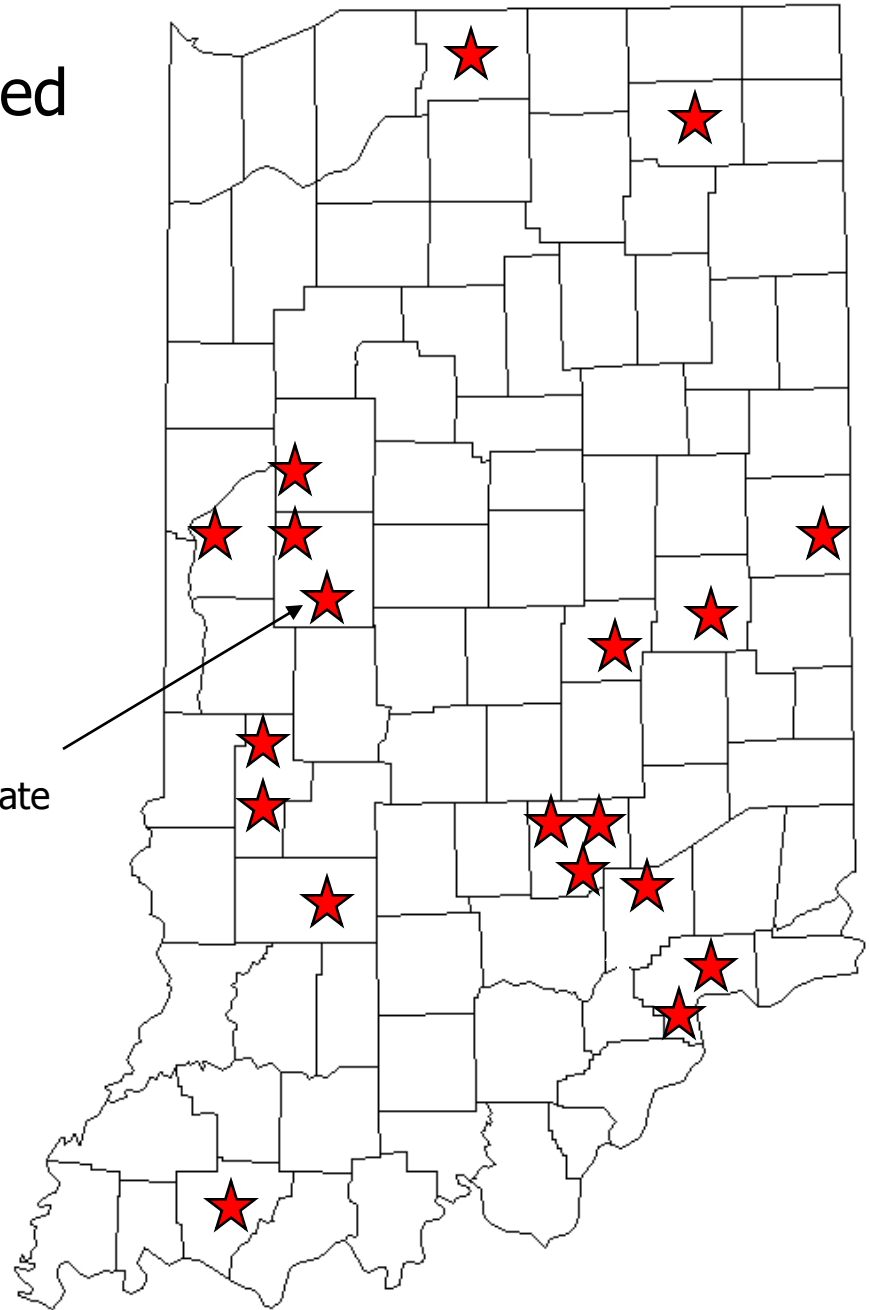
Approximate Cost of Herbicide Programs

	Postemergence Treatments ^a					
Preemergence Treatments	Phoenix (8 ozs)	Ultra Blazer (1.5 pt)	Roundup	Roundup	Roundup	None
			Omax (22 ozs)	Omax + Phoenix (22+8 ozs)	Omax + Ult Blazer (22 ozs+1.5 pt)	
	----- Herbicide Program Cost (\$/A) -----					
Valor (2.5 ozs)	29.51	31.66	25.77	34.65	36.80	15.31
Spartan (8 fl ozs)	44.20	46.35	40.46	49.34	51.49	30.00
IntRRo (2.5 qts)	31.20	33.35	27.46	36.34	38.49	17.00
Boundary (2.1 pt)	34.75	36.90	31.01	39.89	42.04	20.55
None	14.20	16.35	10.46	19.34	21.49	0.00

^aAMS added to all Roundup trtmts; NIS added to Phoenix & Blazer treatments when applied alone. Prices include costs associated with custom application, typically valued at \$5.00 per acre. PRE followed by POST programs have a custom application cost of \$10 per acre.

Source: Bradley

Indiana Counties with Glyphosate Resistant or Tolerant Giant Ragweed Populations (January 2008)



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



September 2006, Montgomery County

What Went Wrong?

- ◆ Crop rotation?
- ◆ Herbicide use pattern?
 - ☑ Single vs multiple modes of action
 - ☑ Full rates vs reduced rates
 - ☑ Application timing
- ◆ Field productivity/land value?
 - ☑ Big productive field on a main road vs small field tucked away in a river or creek bottom

What Went Wrong?

- ◆ Full time farmer vs part time farmer?
- ◆ College education?
 - ☒ None
 - ☒ Mississippi State
 - ☒ Tennessee
 - ☒ Auburn
 - ☒ LSU
 - ☒ University of Arkansas



September 2006, Montgomery County

Montgomery Field History

◆ Corn:Soybean rotation

☒ Corn

- ❖ Conventional till
- ❖ No Roundup Ready corn had been grown in this field
- ❖ Atrazine premix followed by dicamba

☒ Soybean

- ❖ No-till Roundup Ready soybeans
- ❖ No burndown - all post treatments of glyphosate
- ❖ Reduced rates utilized frequently
- ❖ Sprayed 4 times with glyphosate the last two times soybeans were grown!

Montgomery County Field

◆ Weed Management Strategy for Soybean

☒ Preplant

- ❖ Glyphosate (1 qt) + 2,4-D (1 pt) + a residual herbicide for lambsquarter (Gangster, Canopy DF, Valor XLT, others)
 - $\$6 + \$2 + \$11 = \$19/A$

☒ Postemergence

- ❖ Glyphosate (2 qt) fb glyphosate (1 qt)
 - $\$12 + \$6 = \$18/A$

- ☒ Total cost is now roughly $\$37/A$, up from $\$18/A$!



Escaped marestail and waterhemp

Number of US Resistant Species by Mode of Action and Extent of Use

Herbicide HRAC Group	Total Number of Resistant Species in the US ¹		Cumulative Treatments During 1990-2005 (millions of acres) ²	Resistance Appearance Rate (# new species/M ac sprayed)
	1990	2005		
A: ACCase inhibitors	2	15	218	0.060
D: Bipyridiliums	1	4	60	0.050
B: ALS inhibitors	5	38	1007	0.033
E: PPO inhibitors	0	2	101	0.020
C1: Photosystem 2 inhibitors	11	20	962	0.009
G: Glyphosate, EPSPS inhibitor	0	7	1019	0.007
O: Synthetic auxins	2	6	844	0.005
K1: Dinitroanilines	3	5	491	0.004
K3: Chloroacetamides	0	1	726	0.001

¹ According to data published by Ian Heap on www.weedscience.org

² From use statistics published by USDA on www.pestmanagement.info/nass/app_usage.cfm

**Do you want your
kids to grow up like
this?!**

