

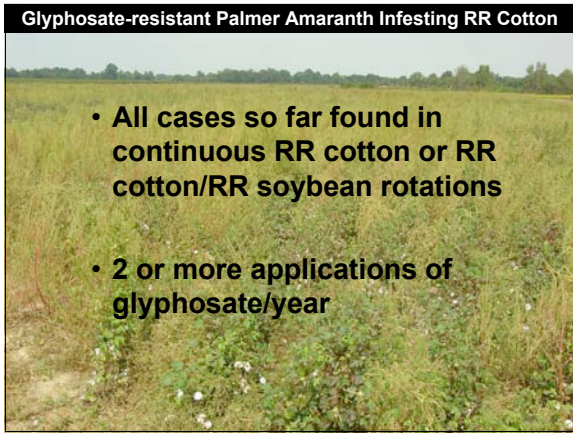
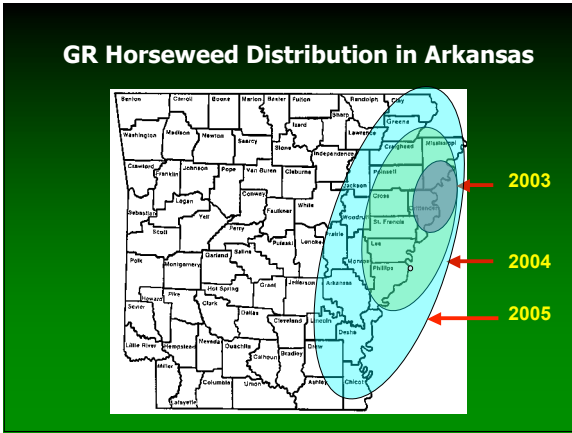
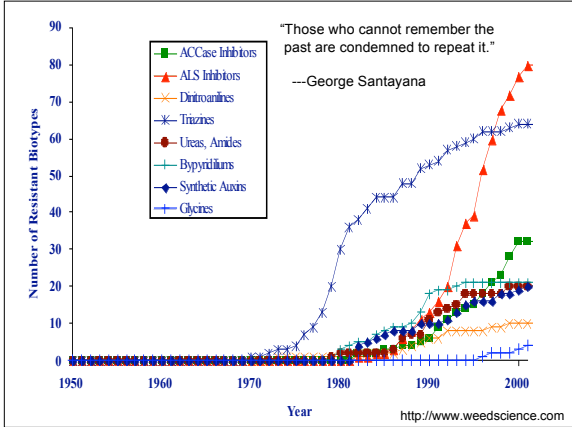
Glyphosate Resistant Weeds in the U.S.

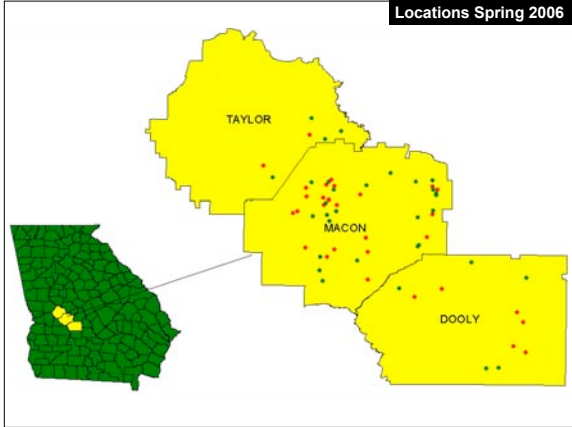
7 weeds in the U.S. are confirmed resistant

- 2 Identified in Non-Roundup Ready System
 - Rigid Ryegrass - CA
 - Italian Ryegrass - OR
- 5 Identified in the Roundup Ready System
 - Marestalk - several states
 - Common Ragweed - MO, AR
 - Palmer Amaranth - GA
 - Waterhemp - MO
 - Giant Ragweed - IN, OH

Investigations of Possible Glyphosate-Resistant Weeds

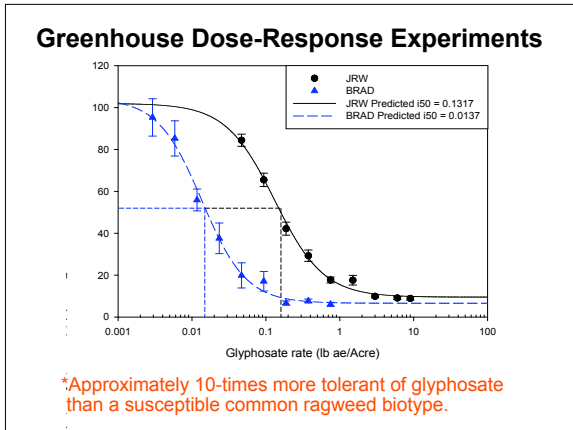
- Common Lambsquarters in AZ, IN, NY, OH, VA and CA, WY
- Common Ragweed in KY and NC
- Giant Ragweed in AR and MO
- Palmer Pigweed in NC, SC, AR, TN, MS and LA
- Waterhemp in TX and OK
- Ryegrass in MS
- Common Cocklebur in SC
- Johnsongrass in LA





MU We've got 3. What Makes Us Different ?

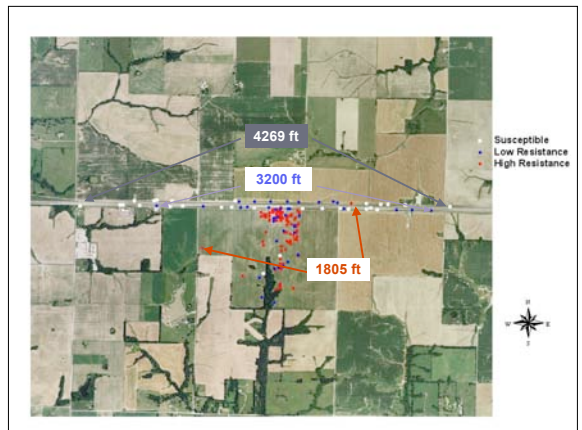
Treatments	Prospective Plantings 2006	
	Corn	Soybean
	----- million acres -----	
Illinois	11.4	10.1
Indiana	5.5	5.9
Iowa	12.5	10.4
Kansas	3.4	3.2
Nebraska	8.2	5.0
Missouri	2.75	5.3



Infested Area in 300 Acre Field



GPS Locations of Plants Sampled





Results

- ❑ 17% of plants classified as susceptible
- ❑ 25% of plants classified as Low R
- ❑ 58% of plants classified as High R
- ❑ Resistant plants initially thought to be within a 20-acre area have been confirmed over a 132-acre area



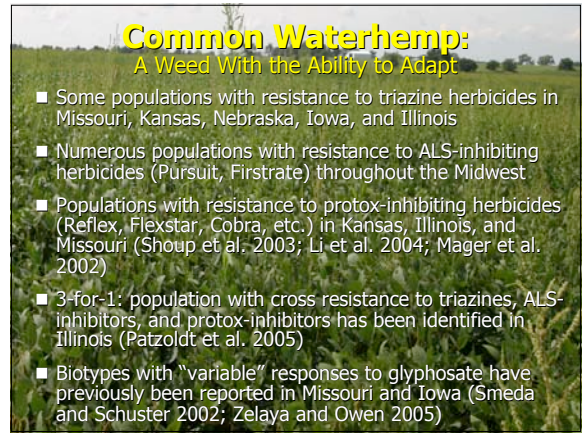
Common Waterhemp *Amaranthus rudis* Sauer (AMATA)

- Troublesome annual weed that occurs throughout the Midwest
- Identified as the most common weed in Missouri corn and soybean production (Bradley 2003)
- Emergence pattern extends late into the season (Hartzler et al. 1999; Steckel et al. 2004)
- Typically produces at least 250,000 seed per plant (Sellers et al. 2003)
- Seed able to persist after several years of burial in the soil (Buhler and Hartzler 2001)



Common Waterhemp: A Weed With the Ability to Adapt

- Some populations with resistance to triazine herbicides in Missouri, Kansas, Nebraska, Iowa, and Illinois
- Numerous populations with resistance to ALS-inhibiting herbicides (Pursuit, Firstrate) throughout the Midwest
- Populations with resistance to protox-inhibiting herbicides (Reflex, Flexstar, Cobra, etc.) in Kansas, Illinois, and Missouri (Shoup et al. 2003; Li et al. 2004; Mager et al. 2002)
- 3-for-1: population with cross resistance to triazines, ALS-inhibitors, and protox-inhibitors has been identified in Illinois (Patzoldt et al. 2005)
- Biotypes with "variable" responses to glyphosate have previously been reported in Missouri and Iowa (Smeda and Schuster 2002; Zelaya and Owen 2005)

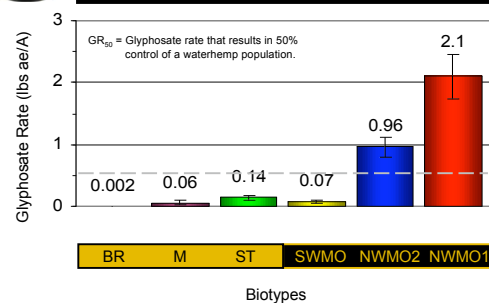


Glyphosate-Resistant Waterhemp

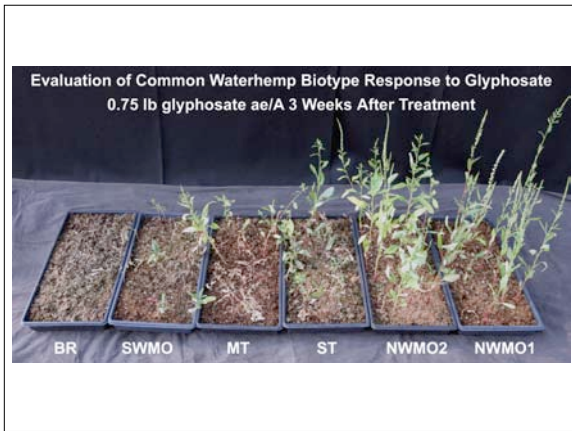
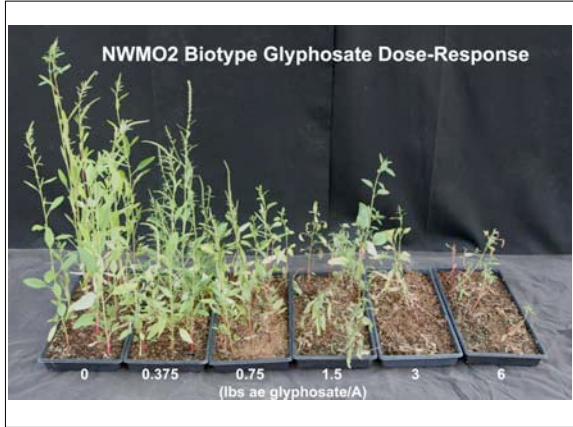
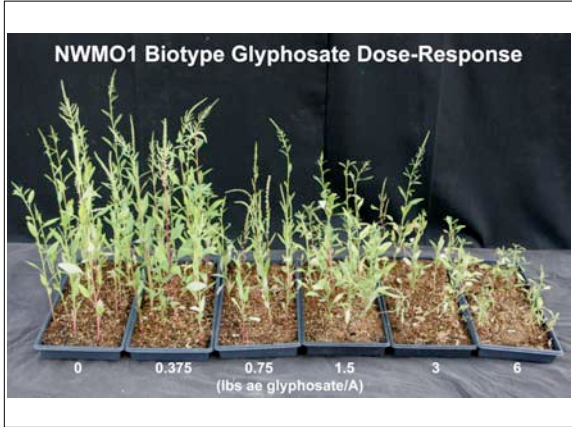
- Continuous soybeans > 15 years
- Continuous RR soybeans since 1996
- 1-2 applications of glyphosate/year



GR₅₀ of Waterhemp Biotypes (Based on Fresh Weight Reduction in 2 Greenhouse Experiments)



*Error bars represent the standard error of the mean



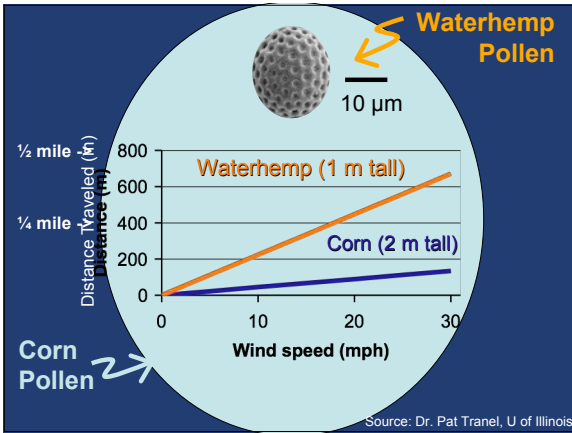
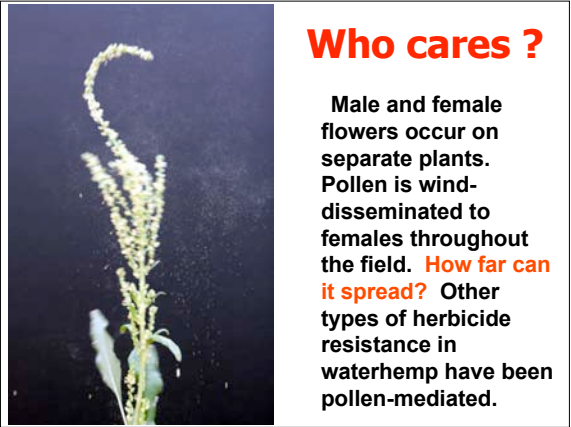
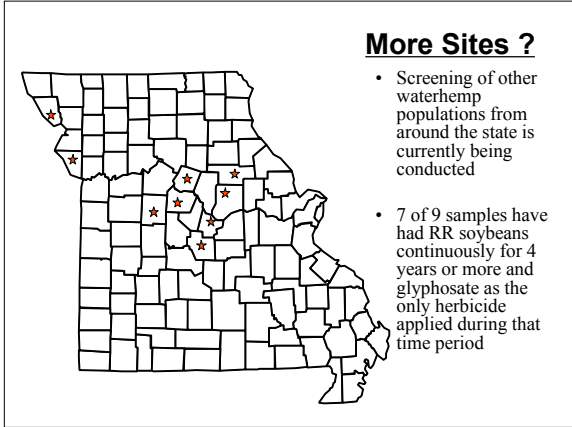
**M Influence of Glyphosate and Tank Mix Combinations on
Glyphosate-Resistant Waterhemp Survival in Soybean**

Treatments ^a	Rate	Waterhemp
	product/A	Survival ^{b,c} ----- % -----
Rndup Omax	22 fl ozs	98 a
	44 fl ozs	89 a
	88 fl ozs	63 b
	176 fl ozs	53 b
Rndup Omax + Phoenix	22 fl ozs + 8 fl ozs	94 a
Rndup Omax + Flexstar	22 fl ozs + 3/4 pt	95 a
Rndup Omax + Ultra Blazer	22 fl ozs + 1.5 pts	95 a
Rndup Omax + Aim	22 fl ozs + 1/4 fl oz	97 a
Rndup Omax + Firstrate	22 fl ozs + 0.3 oz	95 a
Rndup Omax + Butyrac	22 fl ozs + 2 fl ozs	98 a

^a All treatments applied with AMS at 2.5 lbs/A.
^b # flagged waterhemp plants/total (total=80) living 6 weeks after trtmt
^c Means followed by the same letter are not different (LSD 0.05)

88 fl ozs Roundup Original Max
3 Weeks After Treatment





Glyphosate-resistant Waterhemp

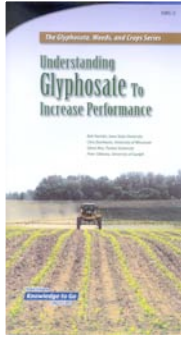
- Best programs for management of glyphosate-resistant waterhemp in soybeans were \$25 to \$30 more per acre than current programs
- PRE's in soybean are a must for this population, but best PRE-only program resulted in a return of 60.1 million waterhemp seed/A)

- **THERE IS NO GOING BACK**
 - Roundup Ready has allowed farmers to farm more acres with less equipment and less labor.
 - Cultivators are in the weeds behind the equipment yard
- **WIDESPREAD GLYPHOSATE-RESISTANT WEEDS WILL CHANGE HOW WE DO BUSINESS**
 - Cotton will probably be affected the most; there are simply not enough alternatives/hybrids
 - Soybeans a close second; limited alternatives
 - Corn probably the least impact but where are we headed?

The Glyphosate, Weeds, and Crops Series

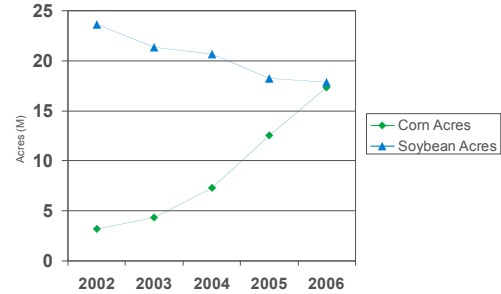
Cooperative effort among **16** different Universities and **24** weed scientists!

- Understanding Glyphosate to Increase Performance
- Facts About Glyphosate Resistant Weeds
- Economic Implications of Glyphosate Stewardship
- Biology and Management of Horseweed
- Biology and Management of Wild Buckwheat
- Biology and Management of Common Waterhemp
- Biology and Management of Common Lambsquarters
- Biology and Management of Common Ragweed
- Biology and Management of Giant Ragweed



www.glyphosateweeds crops.org/

Pre-Applied Residual Treatments on GT Corn and Soybeans



50 Data provided by Doane Marketing Research, Inc. 2006

How concerned are YOU as a crop consultant, retailer, etc. about the development of glyphosate-resistant weeds?

- 36%** A. Very concerned. I think it has the potential to be devastating to our current cropping systems.
- 48%** B. Moderately concerned. It's an issue we can't ignore.
- 14%** C. Somewhat concerned. I think we'll deal with it if it does occur.
- 2%** D. Not concerned. All we're seeing is a few isolated cases. These will not become wide-spread issues.



How concerned do you think farmers are about the development of glyphosate-resistant weeds?

- 16%** A. Very concerned. I think it has the potential to be devastating to our current cropping systems.
- 29%** B. Moderately concerned. It's an issue we can't ignore.
- 45%** C. Somewhat concerned. I think we'll deal with it if it does occur.
- 10%** D. Not concerned. All we're seeing is a few isolated cases. These will not become wide-spread issues.



Protecting Yields vs. Preventing Resistant Weeds A new approach that *should* get us to the same place.

Weedsoft Yield Loss Calculator:

Crop	Growth Stage	Height of Weeds When Controlled	Early Season	Profit
			Yield Loss	Loss
			--- Bu/A ---	---- \$/A ----
Soybean	V1	Less than 2"	0.2	\$ 1.20
	V3	4 to 8"	1.9	\$11.40
	V5	Greater than 8"	5.8	\$34.80
Corn	V1	Less than 2"	0.8	\$ 2.80
	V3	4 to 8"	4.8	\$16.80
	V5	Greater than 8"	13.2	\$46.20

<http://weedsoft.unl.edu/>