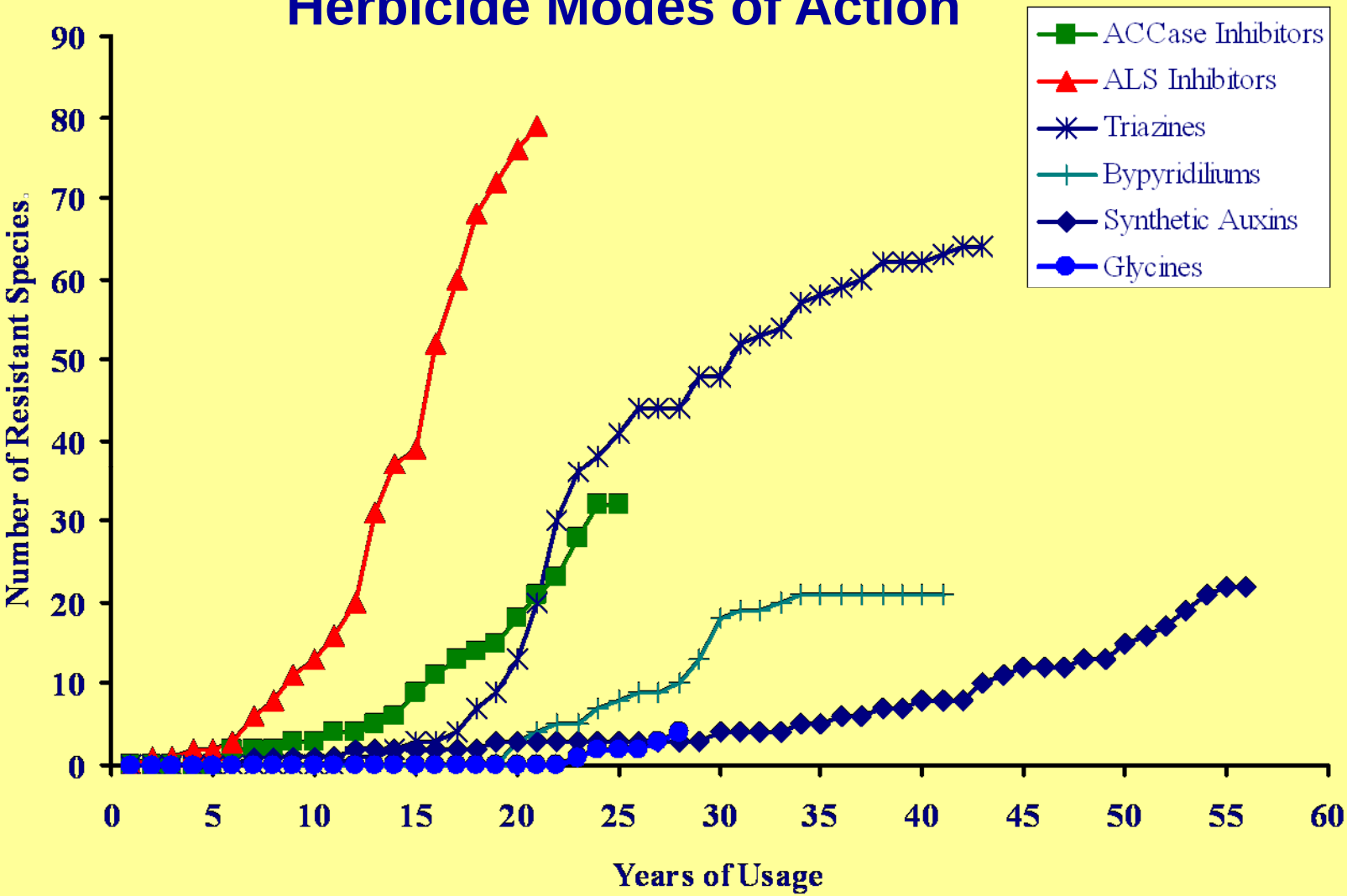
Glyphosate Resistant Weeds

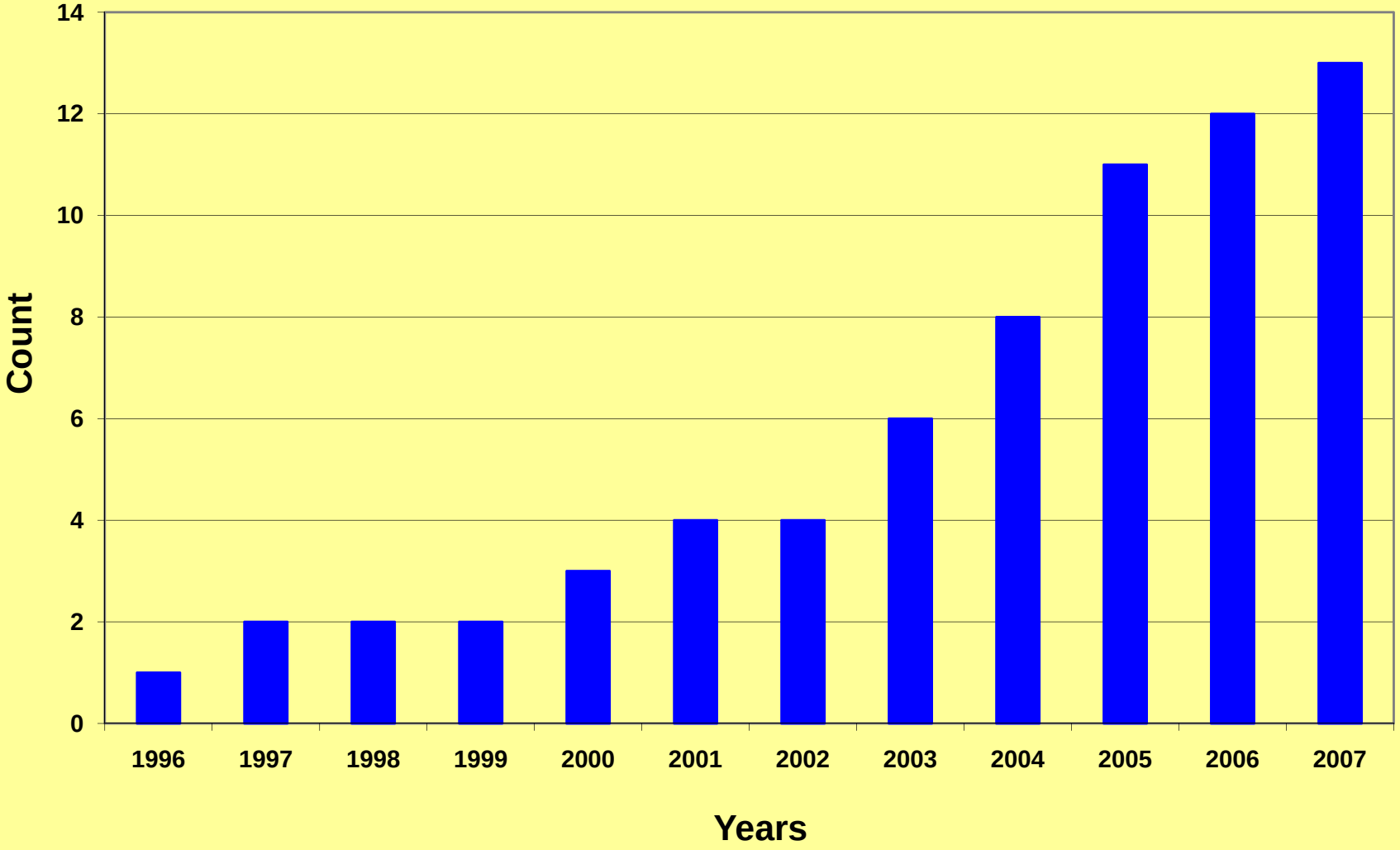
August 2009 Update

R. L. Nichols

Cumulative Summary of Weed Species Resistant to Herbicide Modes of Action



Number of Glyphosate-Resistant Species



Numbers of Glyphosate Weed Species by Continent

North America – 9

South America – 6

Europe – 4

Africa – 3

Australia – 3

Asia – 1

Number of Glyphosate-Resistant Species by Plant Family

Graminaceae – 9

Compositae – 4

Amaranthaceae – 2

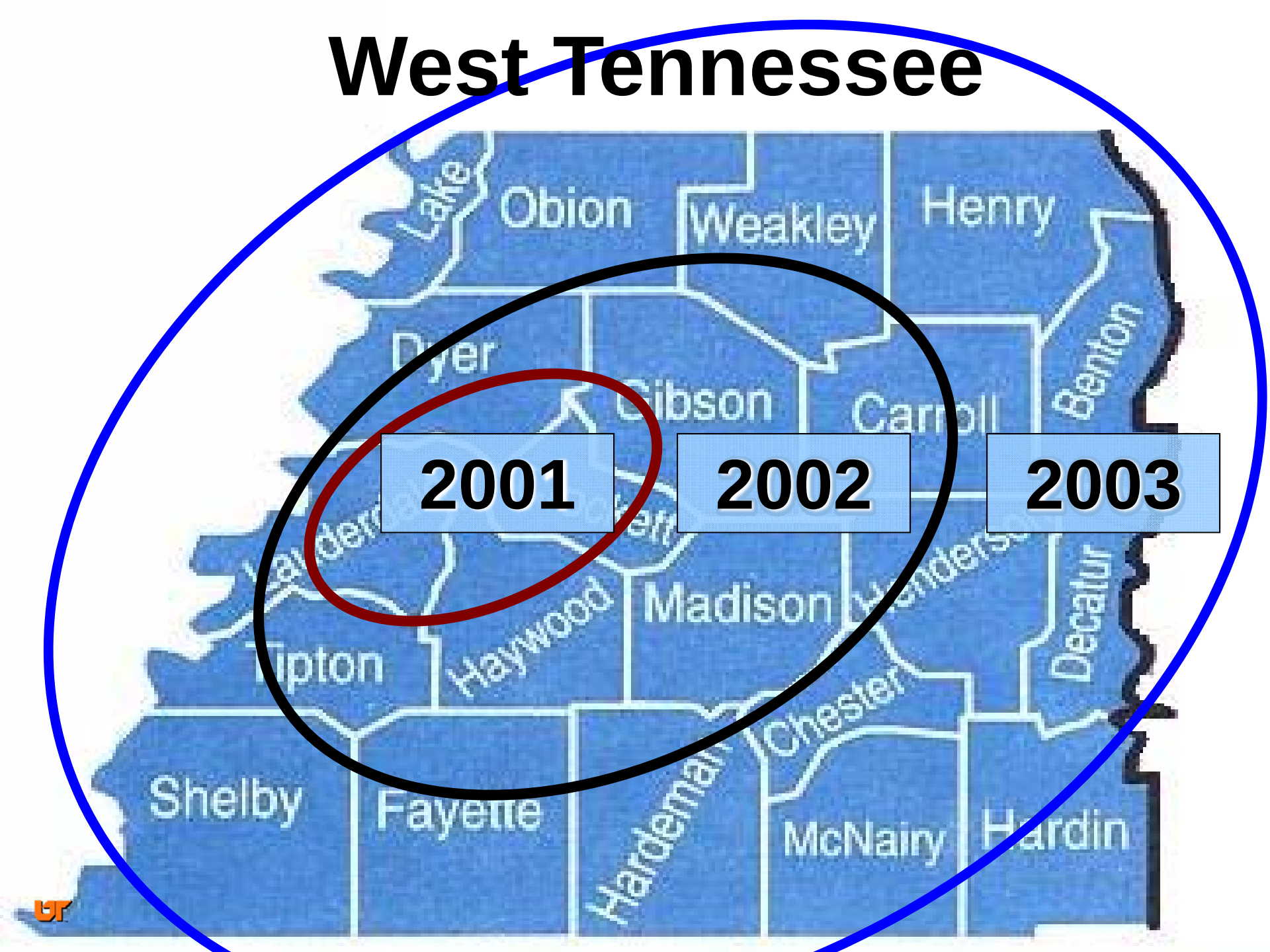
Plantaginaceae – 1

Euphorbiaceae – 1

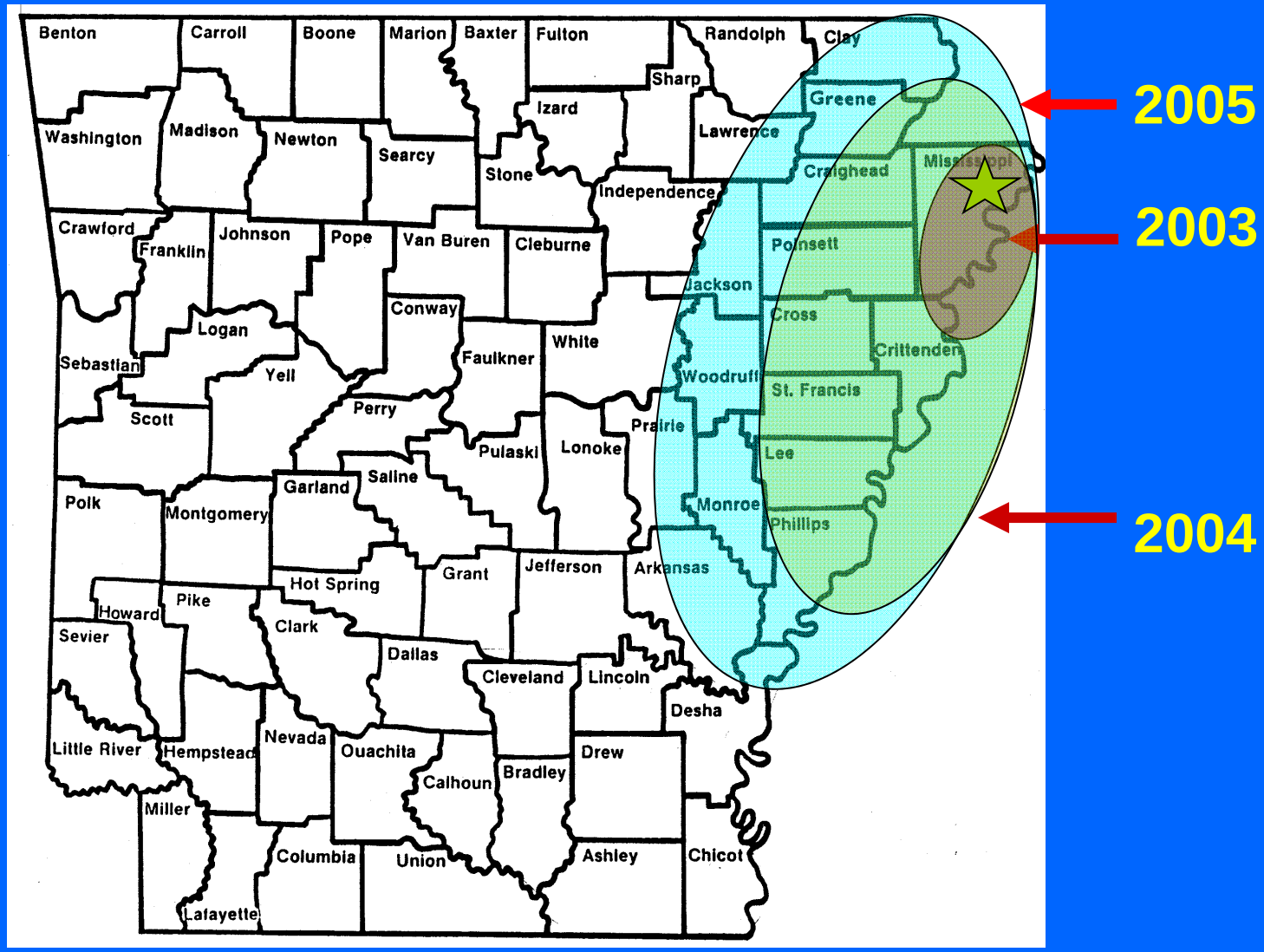
Glyphosate Resistant Weeds in U.S. Cotton

- Horseweed – 2000 (DE)
- Palmer amaranth – 2004 (GA)
- Giant Ragweed – 2005 (AR)
- Water Hemp – 2005 (MO)
- Ryegrass – 2005 (MS)
- Johnsongrass – 2007 (AR)

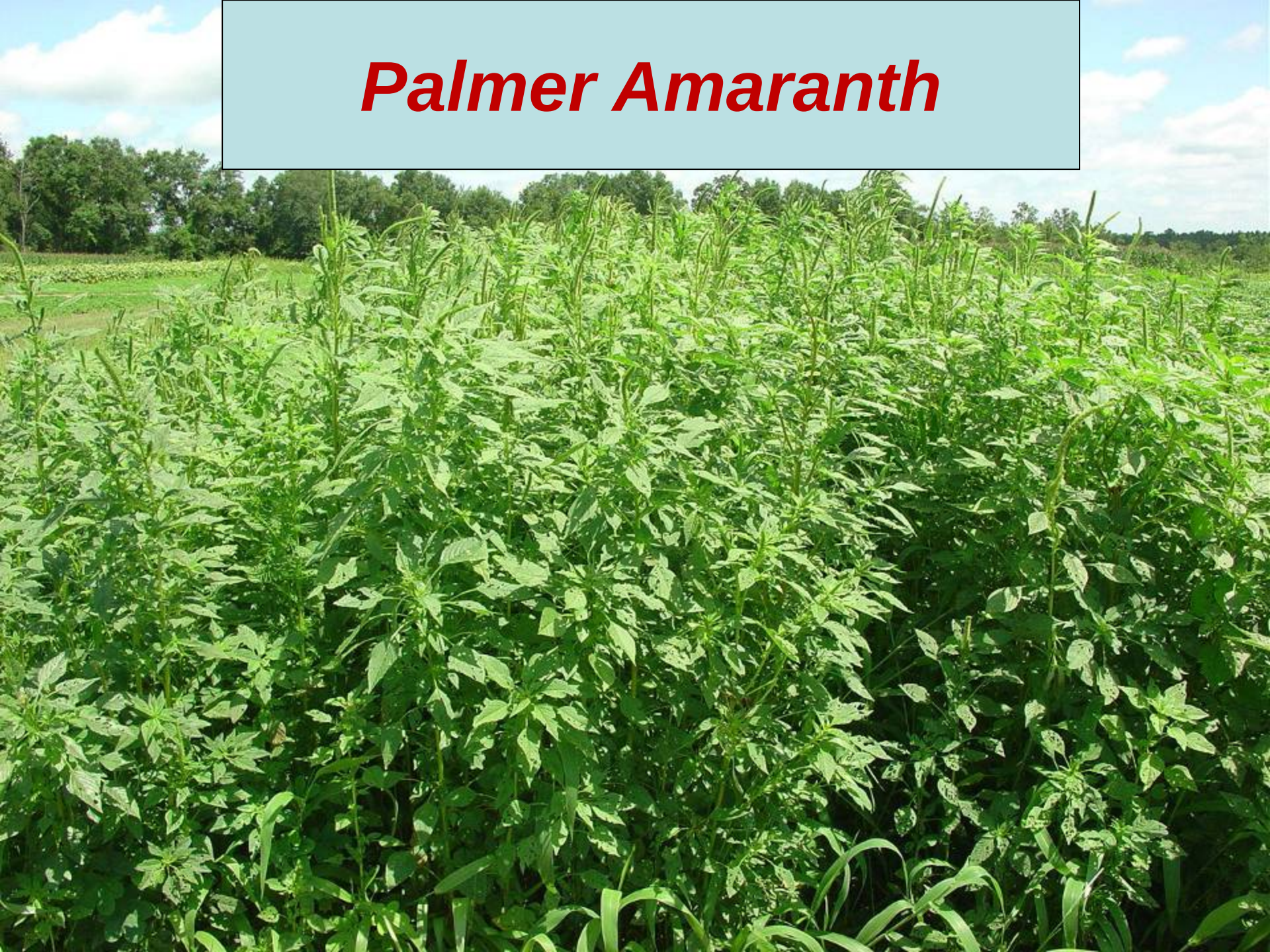
West Tennessee



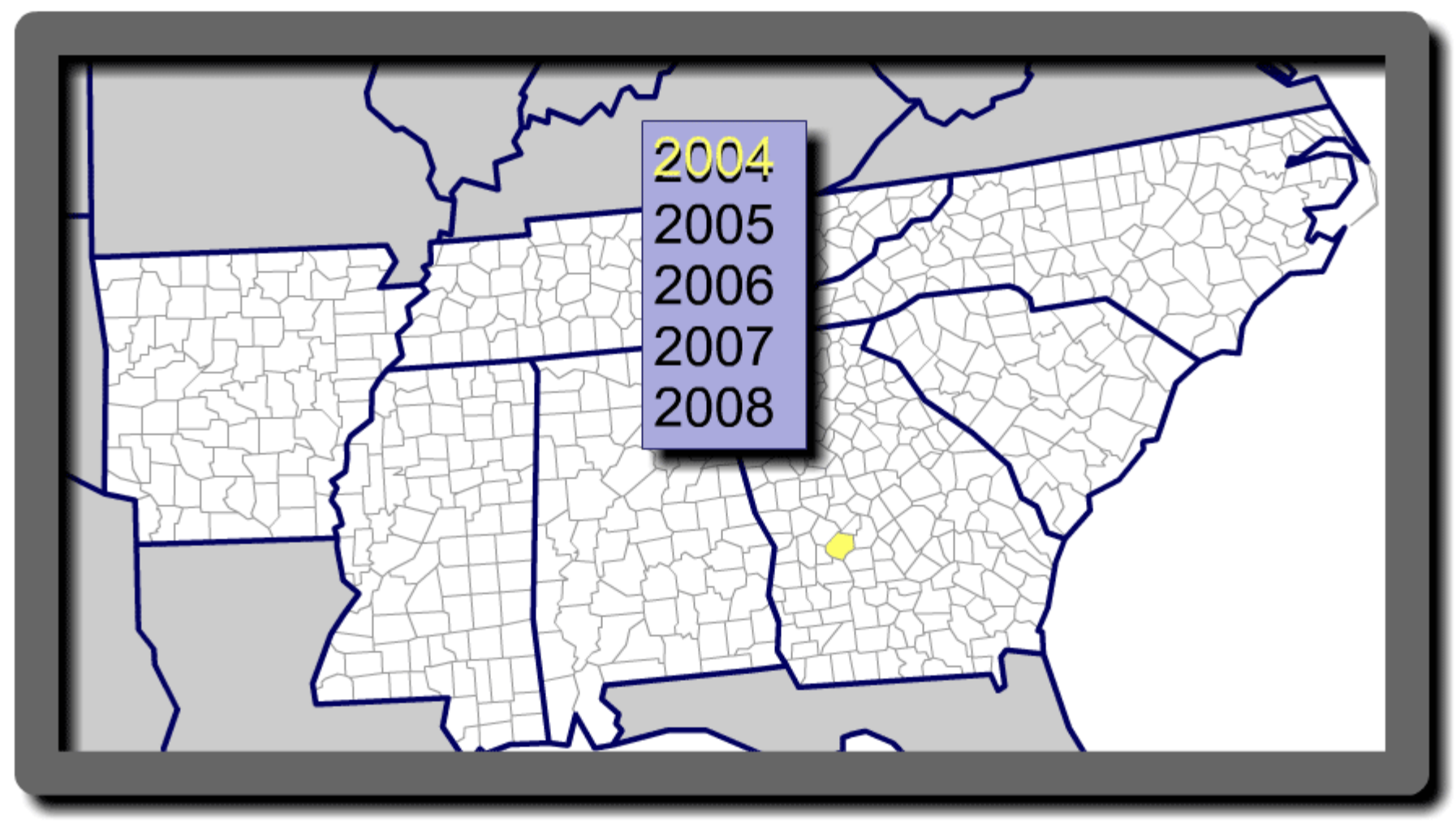
Glyphosate Resistant Horseweed



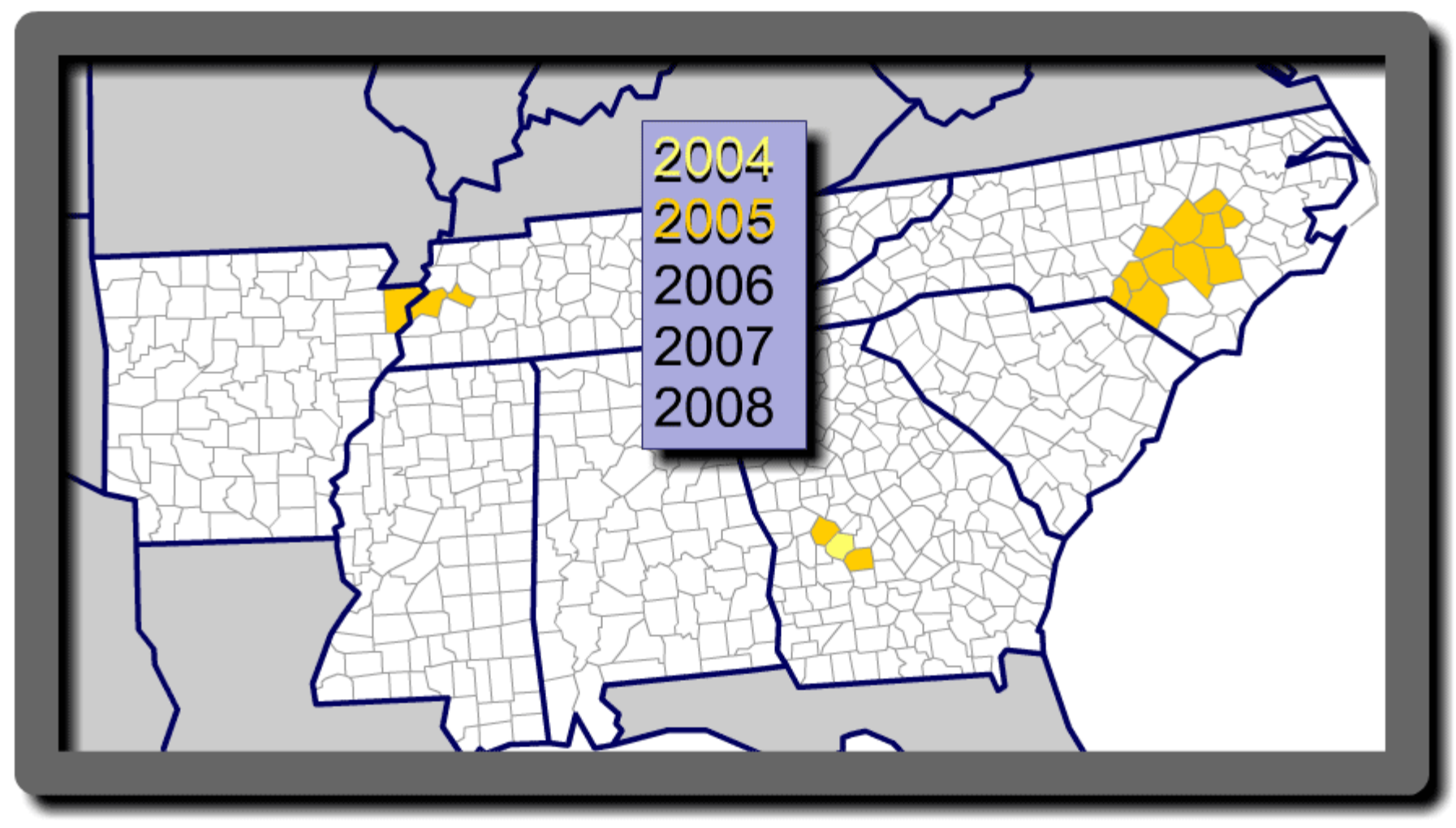
Palmer Amaranth



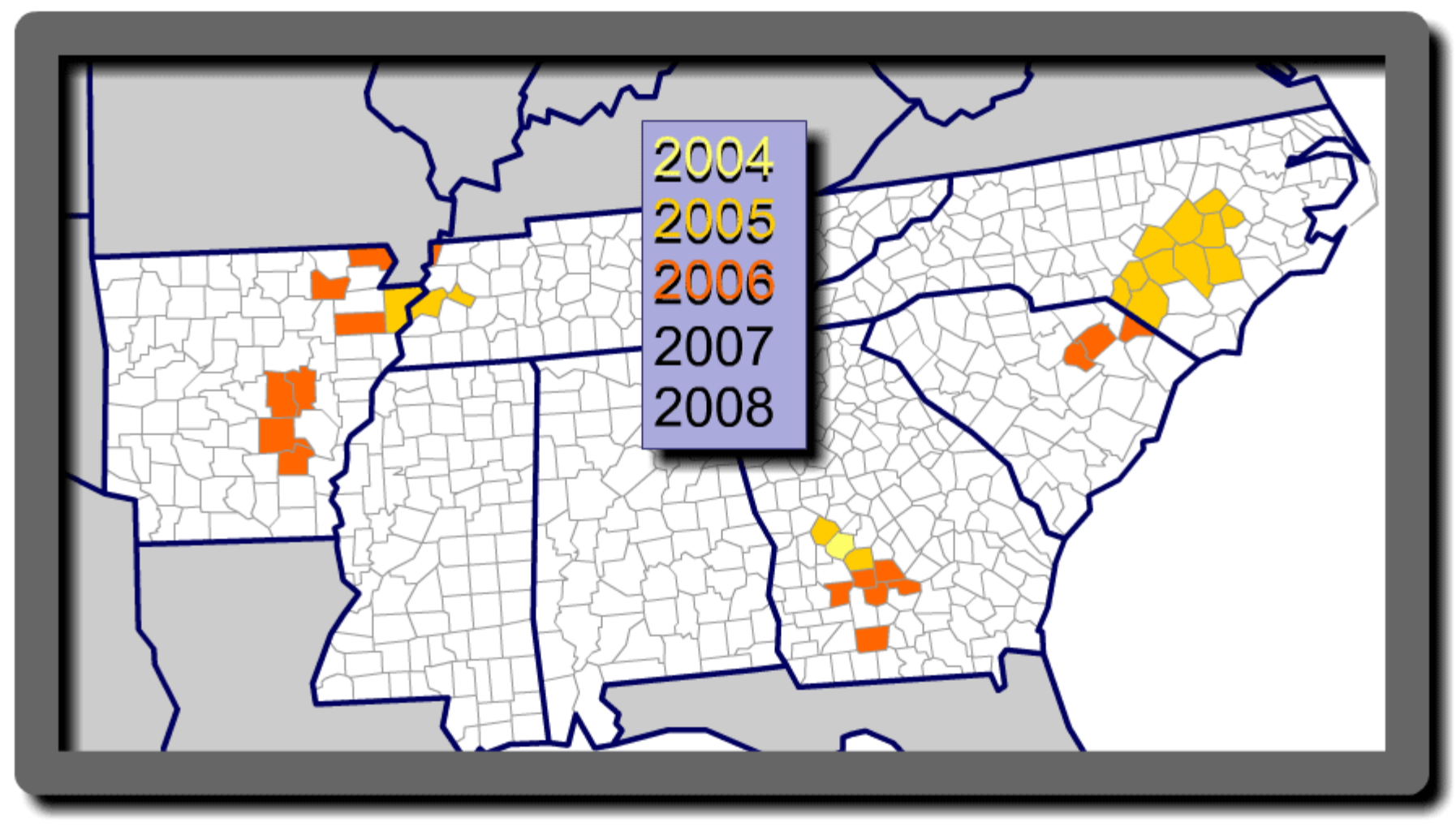
Counties Affected by Glyphosate-Resistant Palmer Amaranth – 2004



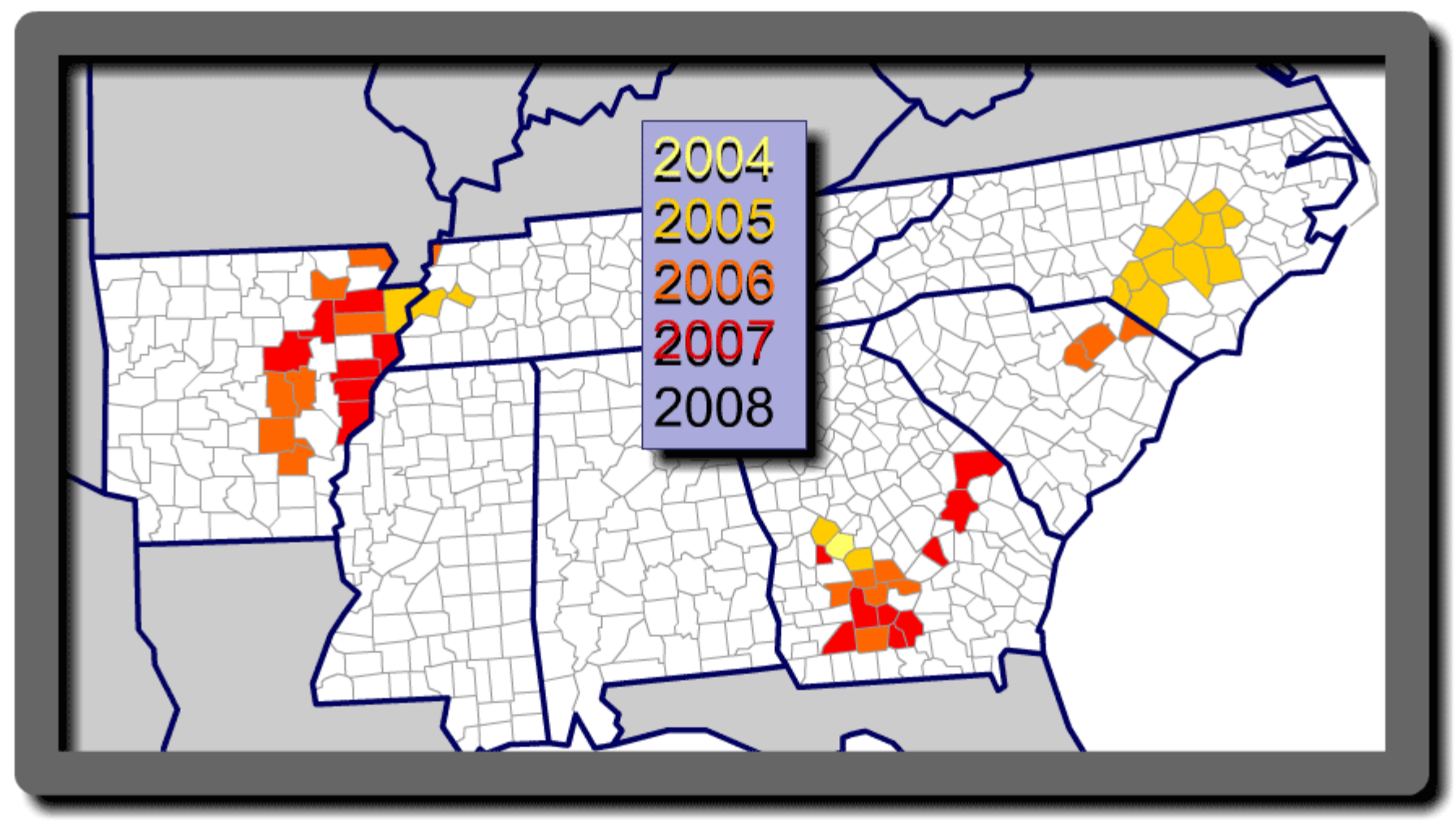
Counties Affected by Glyphosate-Resistant Palmer Amaranth – 2005



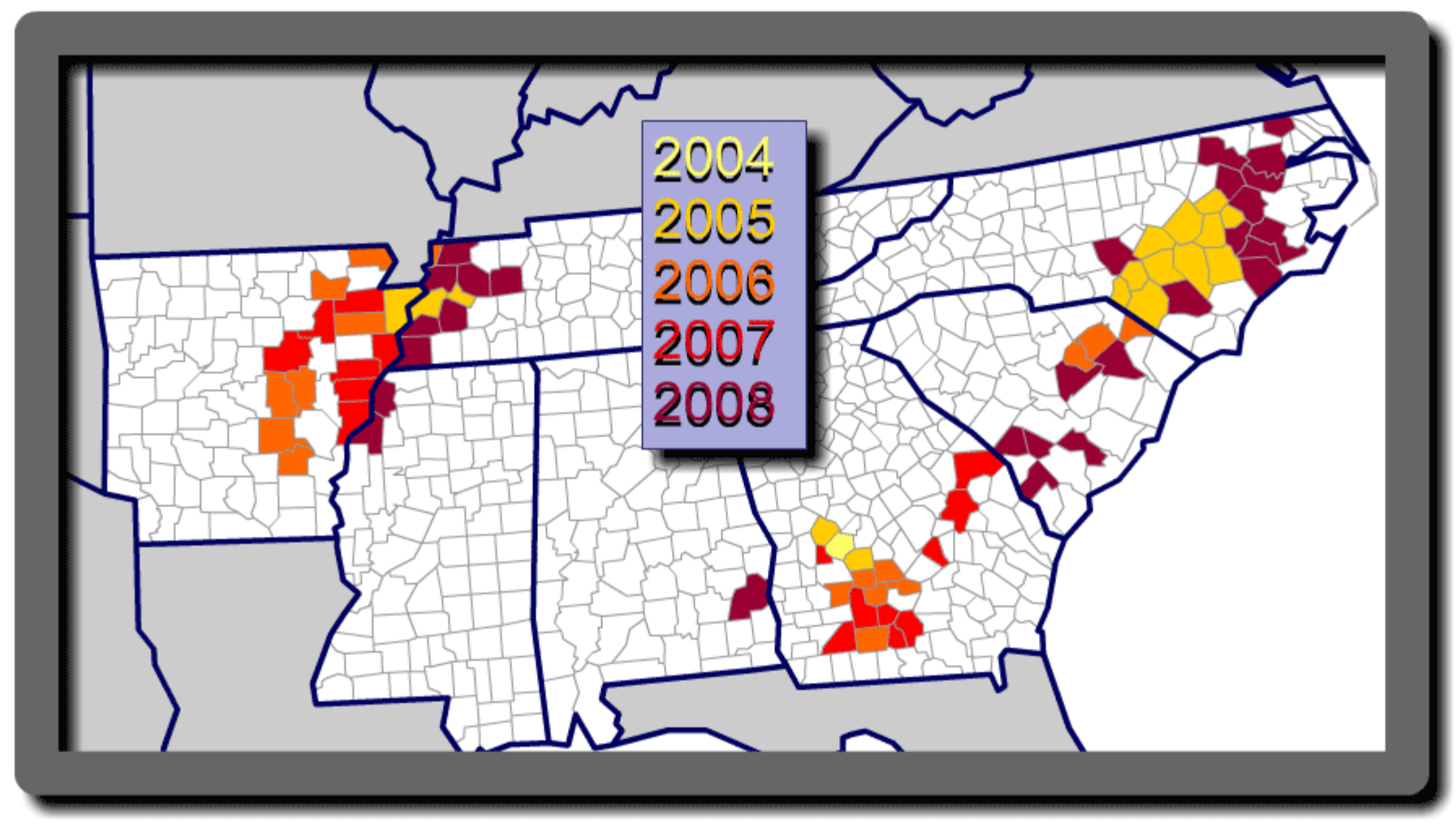
Counties Affected by Glyphosate-Resistant Palmer Amaranth – 2006



Counties Affected by Glyphosate-Resistant Palmer Amaranth – 2007



Counties Affected by Glyphosate-Resistant Palmer Amaranth – 2008



Distribution of Glyphosate Resistant Weeds in U.S. Cotton

- Horseweed – Widespread, AR, TN, NC
- Waterhemp – East TX
- Palmer amaranth – Southeast & Mid-South
- Ryegrass – Delta
- Giant Ragweed – West TN
- Johnsongrass – suspected in Delta

Economic Losses

First year is usually worst,

if occurrence is not expected

Subsequent years, increased weed management costs

Can force change in cultural practices

Why Don’t We Practice Resistance Management?

- **The Usual Problem:**
- **Costs of Post-Resistance Management Remain Unknown, until Resistance Develops**
- **Therefore, Additional Current Costs are Rejected, and the Risks of Unknown Future Costs are Accepted**

- **The New Problem:**

- **We Do Not Have the Next Mode of Action**

- **A New Mode of Action, if Discovered Today, Would Probably Not be Registered in the U.S. for 7-10 Years**

Weed Resistance Management

Managing Herbicide Resistance in Cotton Cropping Systems

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Expert Review Panel

The bulletin was reviewed by a panel of internationally recognized experts in pest resistance management from the disciplines of weed science and entomology. The authors thank the experts, listed below, for their assistance and endorsement of the indicated principles.

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Summary

Resistance occurs when a genetic change allows a population of weeds to survive a herbicide treatment to which the original population was susceptible. Individual plants of weed species that are resistant to a particular herbicide are typically present in untreated populations at very low frequencies. These few resistant individuals survive a herbicide application and reproduce, whereas susceptible individuals are killed and do not reproduce. The percentage of resistant individuals increases over time as the herbicide treatment is repeated. Weed scientists began identifying resistant weed biotypes (genotypes) about 40 years ago, and the number of weeds with resistant biotypes has increased in recent years. Use of a few modes of herbicide action in the major row crops, cotton (*Gossypium hirsutum*), corn (*Zea mays*), and soybean (*Glycine max*), has selected for resistance in certain weeds. Widespread use of the acetolactate synthase (ALS) inhibiting herbicides and glyphosate has led to resistance to one or both of these modes of action in weeds including Palmer amaranth (*Amaranthus palmeri*), common cocklebur (*Xanthium strumarium*), and horseweed (*Conyza canadensis*). Growers should diversify weed management tactics to avoid selecting more resistant weeds. Scout to detect uncontrolled weeds early and prevent movement of possibly resistant weed seed among fields. To reduce the rate of resistance buildup, practice rotation of all management factors where possible, including type of tillage, crops grown, and herbicide modes of action. Crop monoculture and continuous use of the same modes of action will accelerate resistance buildup and increase the difficulty and cost of weed control.

What is Herbicide Resistance?

Herbicide resistance is the inherited ability of a weed biotype to survive and reproduce despite exposure to a dose of herbicide that previously was effective on an unselected population. Application of a herbicide may reveal individuals within a population that already possess the capacity to survive exposure. Repeated, successive use of one herbicide, or herbicides with the same mode of action, increases the likelihood that resistant individuals will survive and reproduce.

How are Weed Populations Selected for Resistance?

The rate at which a resistant weed population is selected depends on the number and frequency of herbicide applications the population receives, the size of the population and its genetic diversity, and characteristics of the herbicide target site. Resistance buildup is accelerated when the management of crops does not include diverse tactics that limit herbicide use such as crop rotation and mechanical weed management. For example, there may be more opportunities for resistance buildup in conservation tillage because weeds are not killed by mechanical disturbance and non-selective herbicides such as glyphosate, paraquat, or glufosinate are used for pre-plant burndown.

What are Herbicide Modes of Action?

Mode of action describes the plant process affected by the herbicide that results in death of susceptible plants. The mode of action involves the physiology of the weed and typically involves interference with a specific biochemical mechanism that the weed requires for growth and development. Herbicides with similar chemical structures tend to have the same mode of action. The herbicides labeled in all major row crops represent only a few modes of action. (Table 1.) See the training module – http://www.cotton.org/tech/pest/wrm.

- Guidelines to Scout for Resistant Weeds
- Principles of Resistance Management
- Herbicide Recommendations for Cotton, Soybean, and Corn