Glyphosate-Resistant Populations of *Amaranthus palmeri* in the United States

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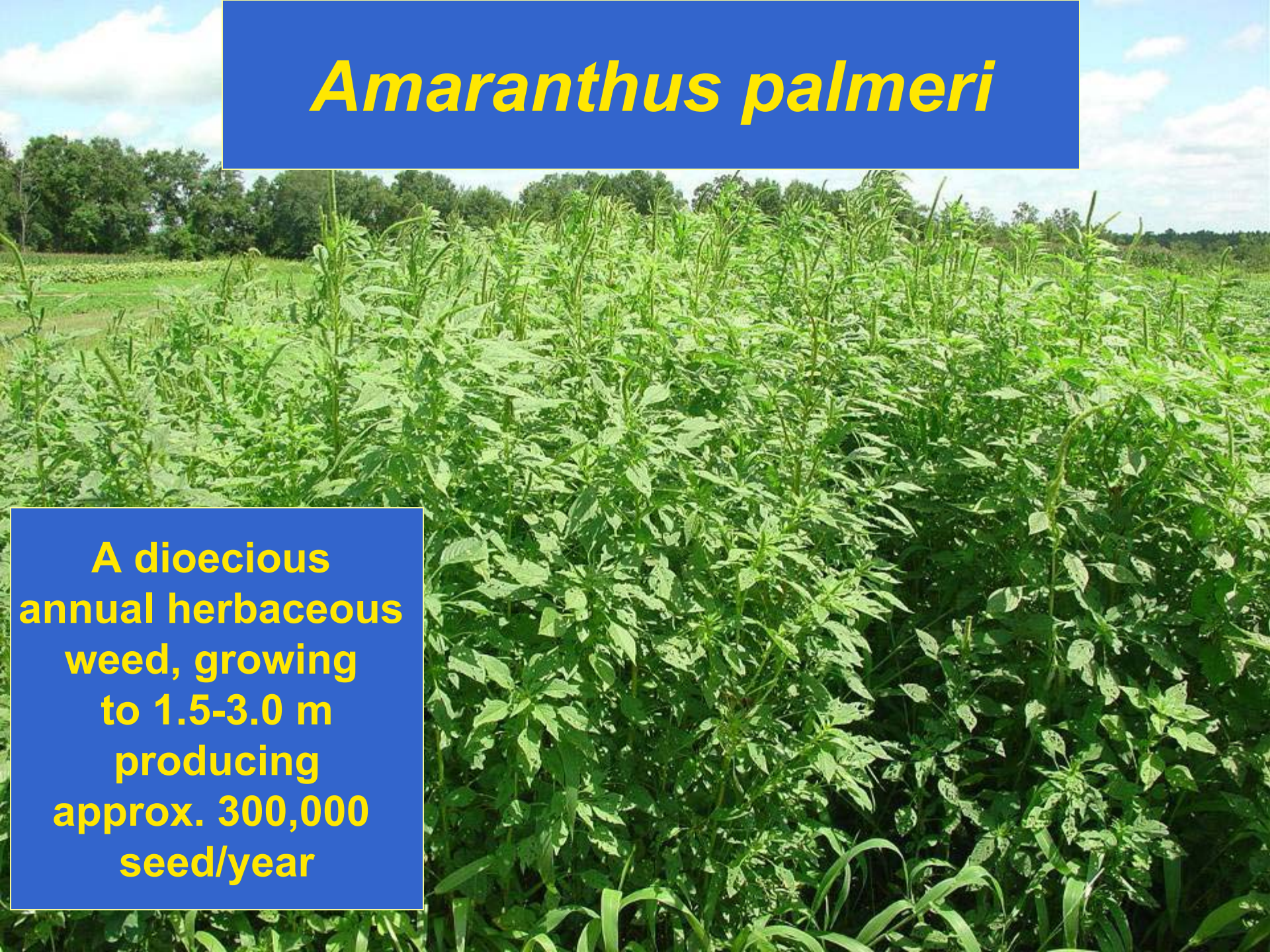
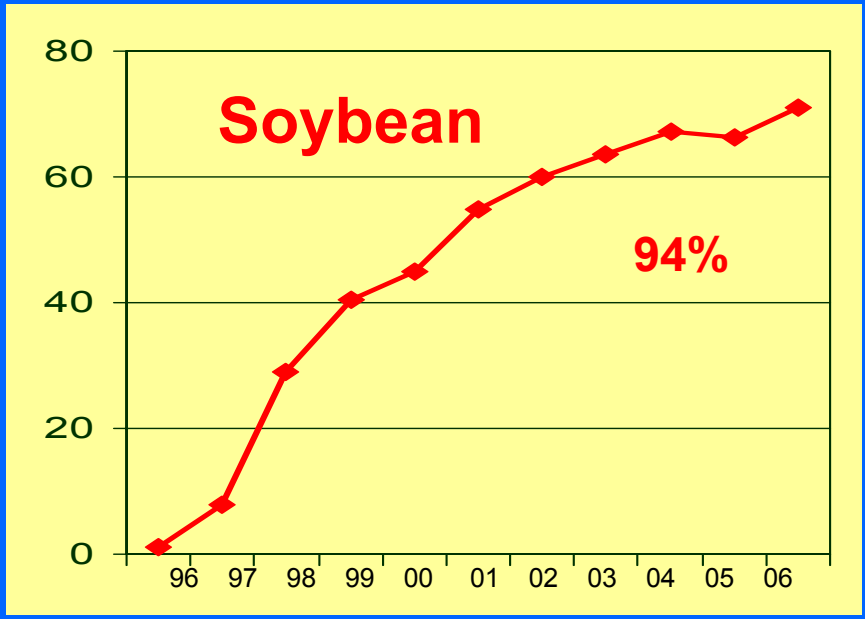
Pigweed Species *(Amaranthus sp.)*

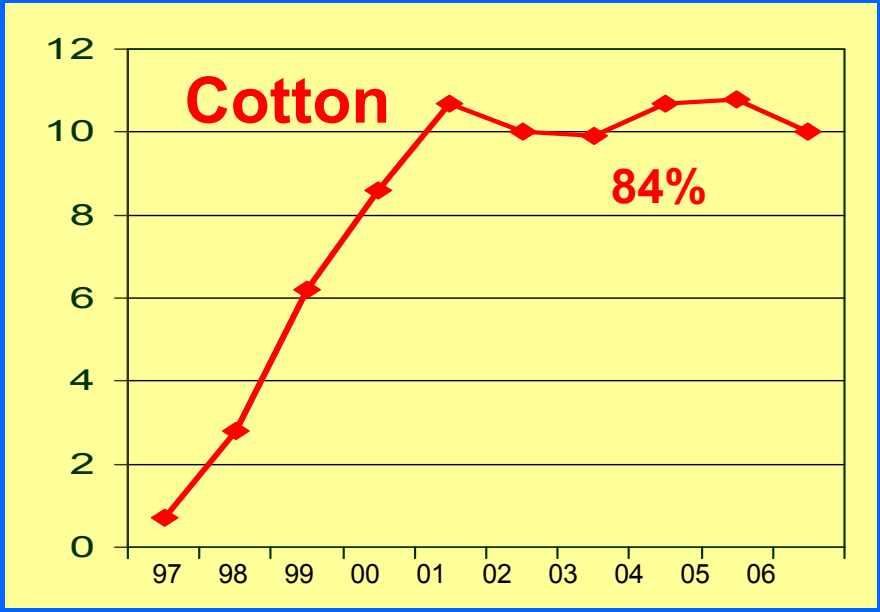
Amaranthus palmeri

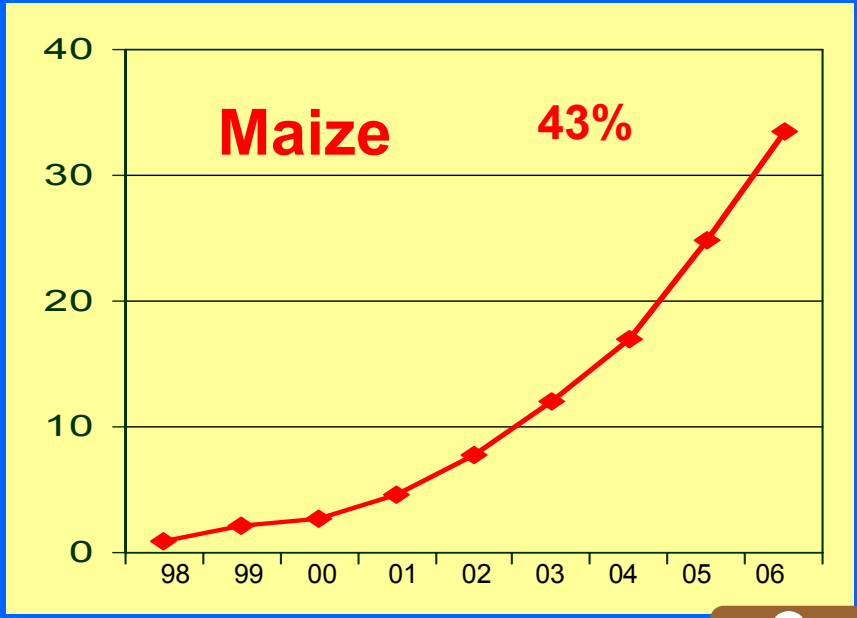


A dioecious annual herbaceous weed, growing to 1.5-3.0 m producing approx. 300,000 seed/year

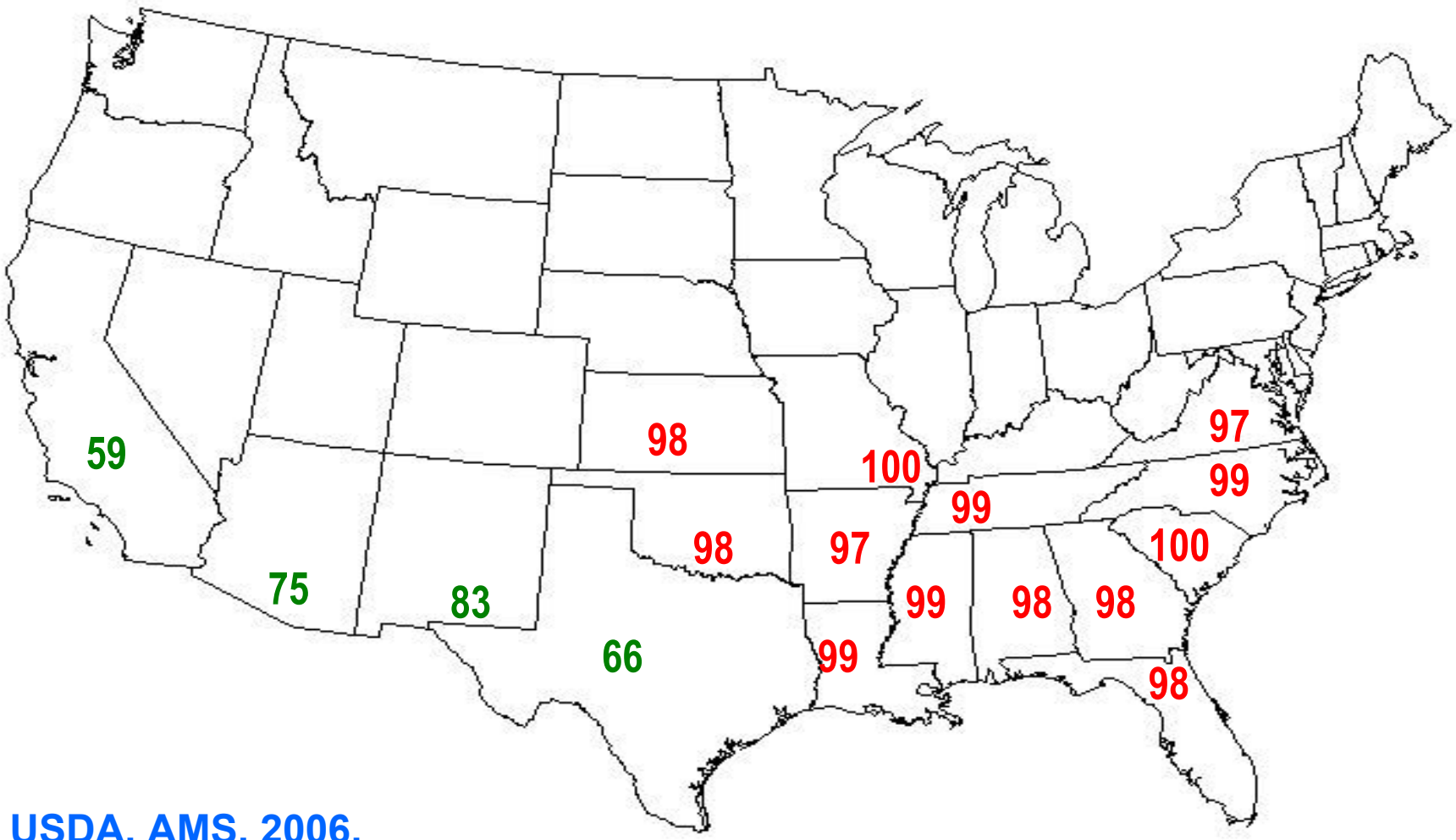
Adoption of Glyphosate-Resistant Cultivars in the United States







Percent of cotton planted to Roundup Ready cultivars

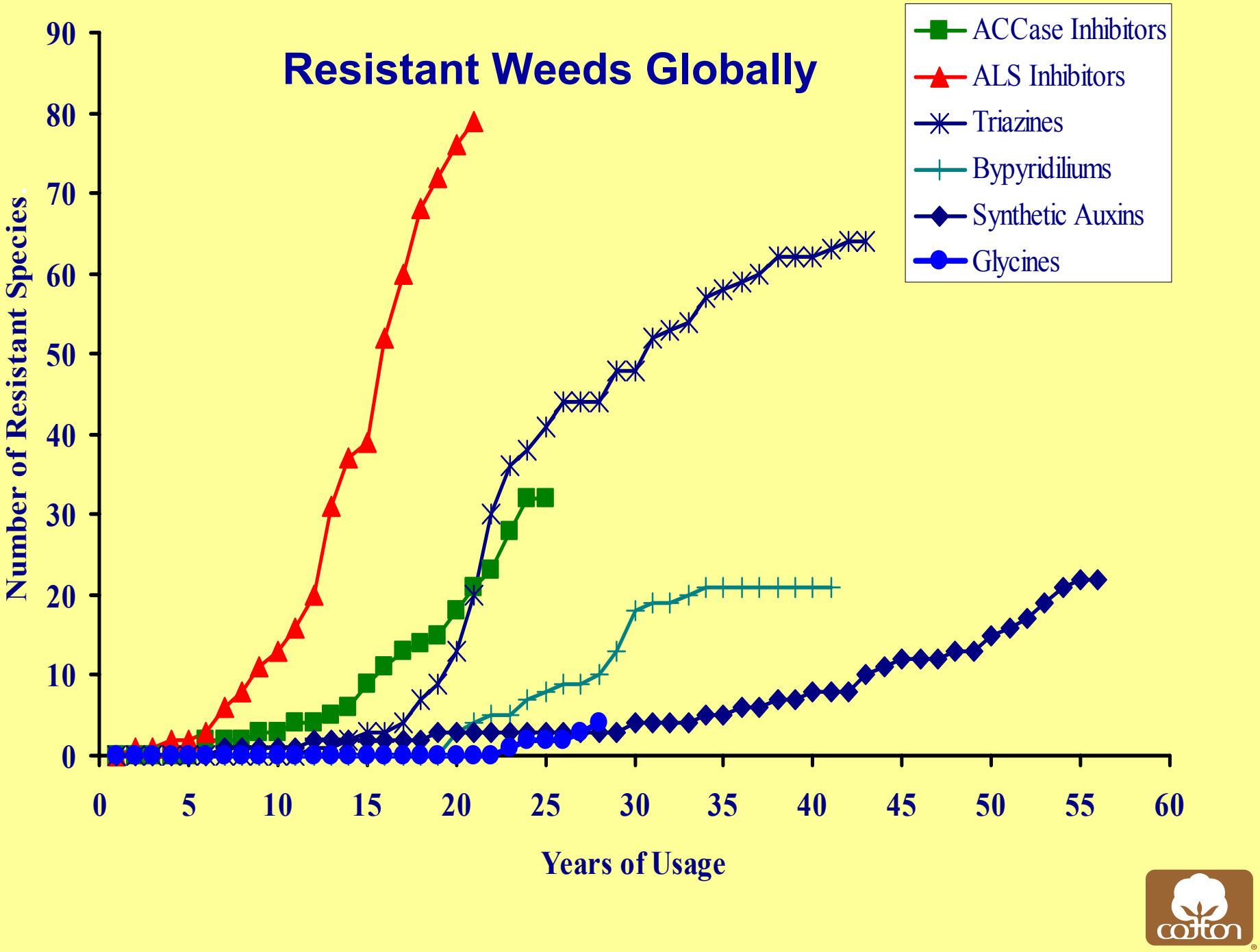


USDA, AMS. 2006.

Weed Resistance

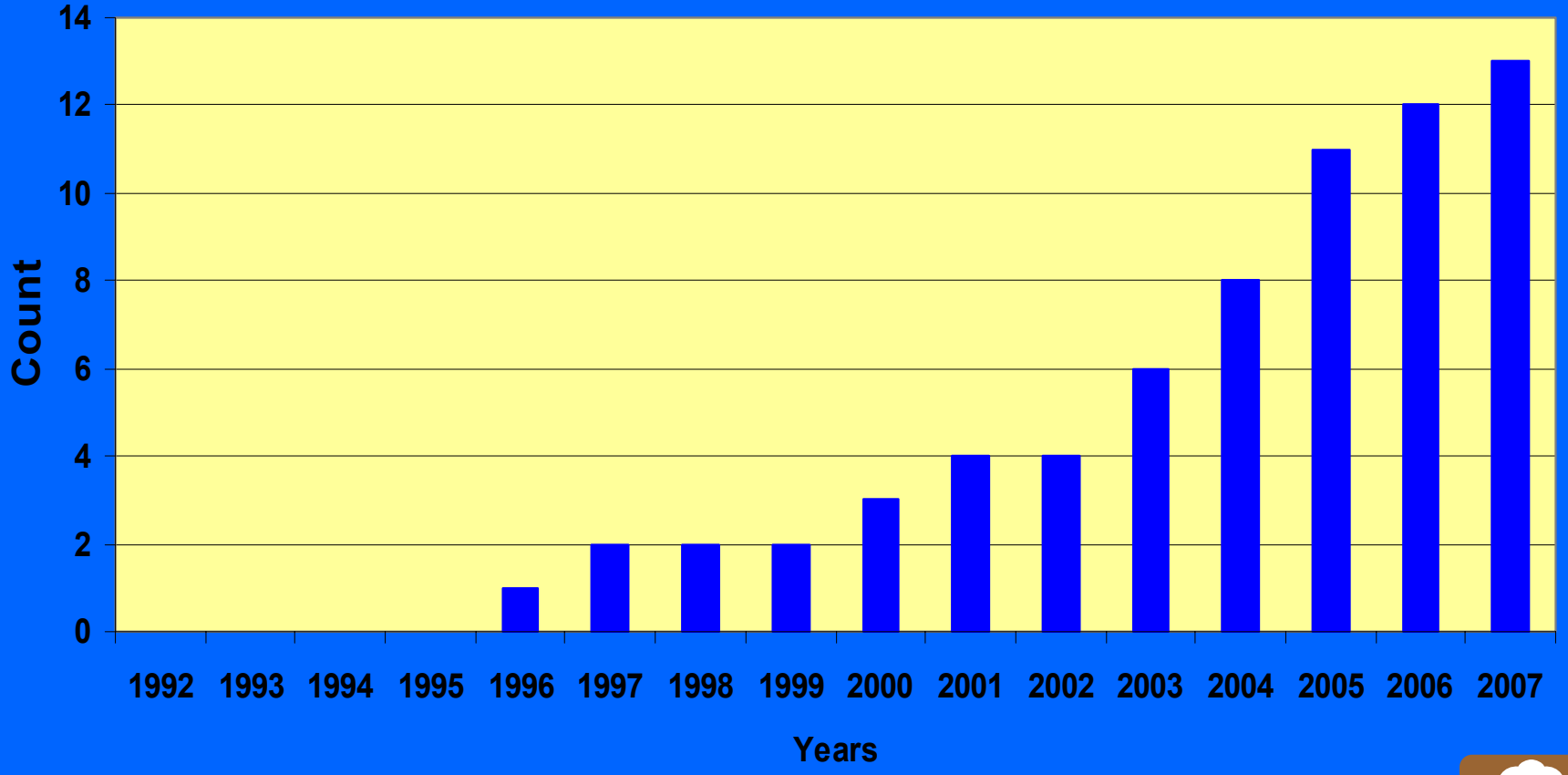
"Inherited ability of a weed population to survive and reproduce after exposure to a herbicide dose (rate) that would control an unselected population"

--- Weed Science Society of America


Resistant Weeds Globally
ACCase Inhibitors
ALS Inhibitors
Triazines
Bypyridiliums
Synthetic Auxins
Glycines
Number of Resistant Species
Years of Usage
0
10
20
30
40
50
60
70
80
90
0
5
10
15
20
25
30
35
40
45
50
55
60

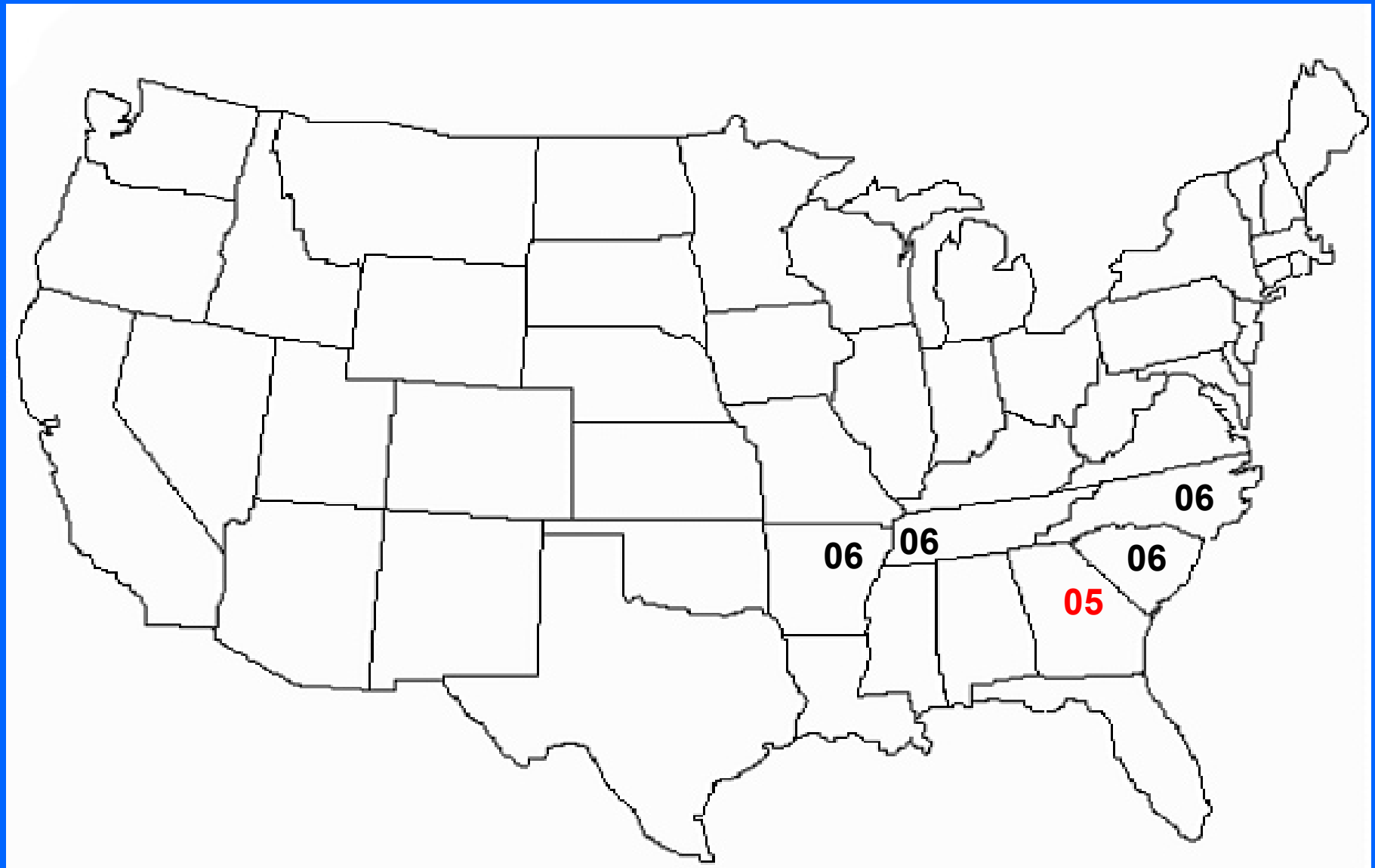
Major Challenge

Glyphosate Resistant Weeds

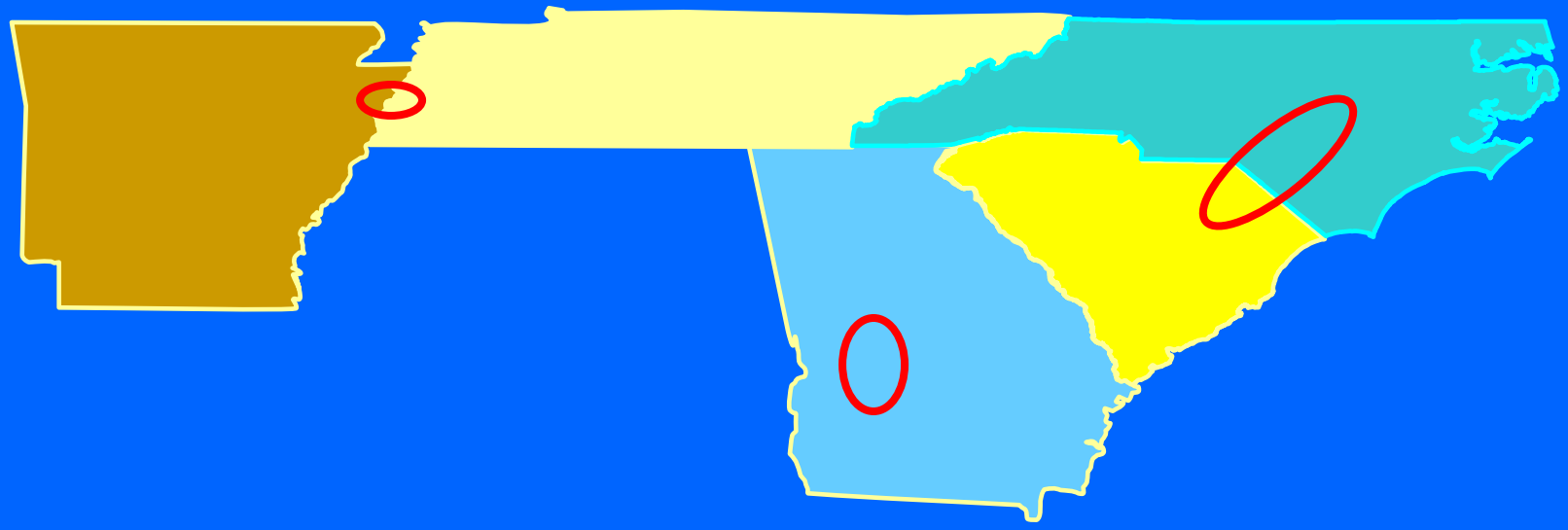


Field Failure- Macon County Georgia

Glyphosate-resistant Palmer amaranth



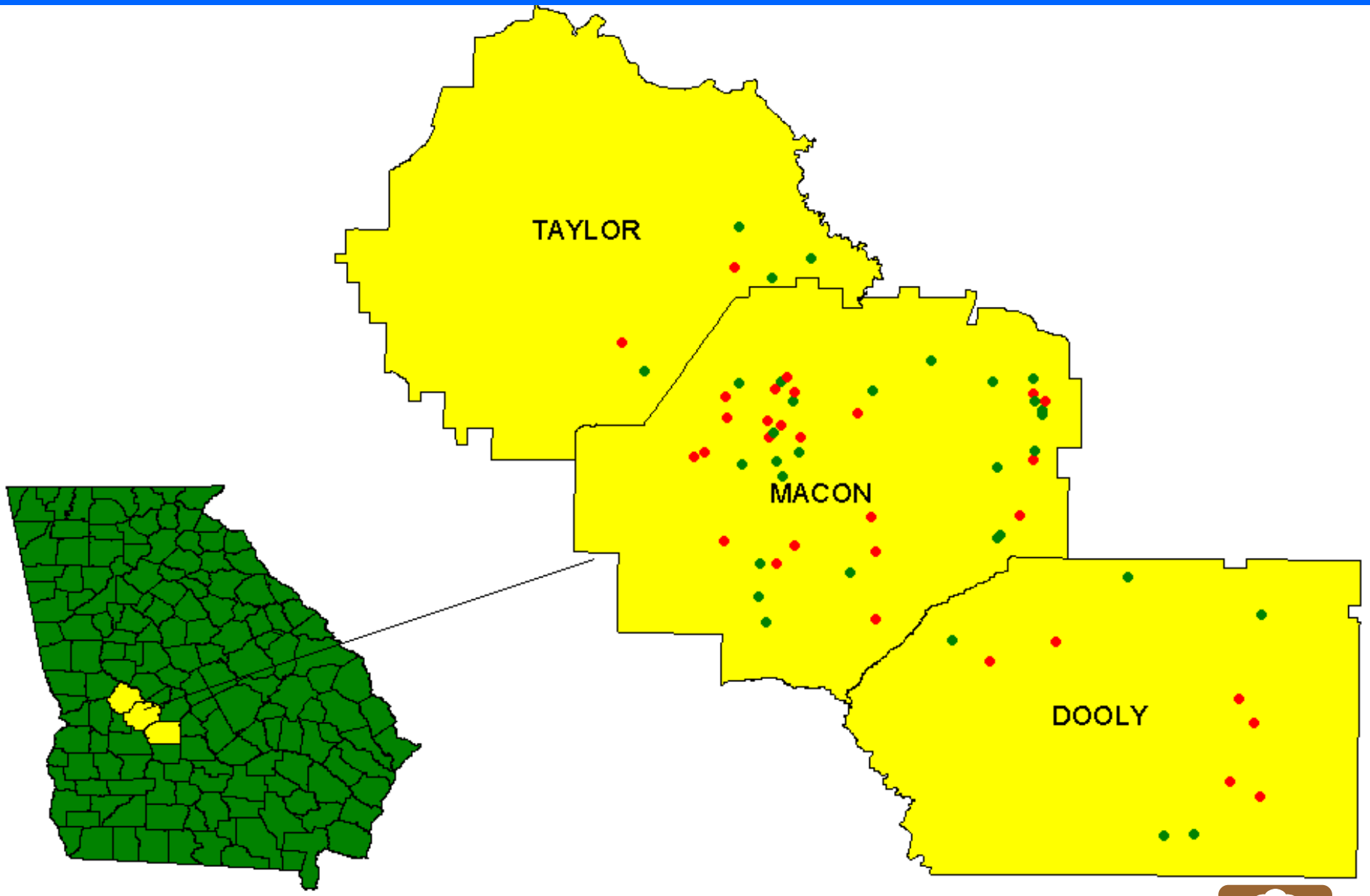
Distribution of Glyphosate-Resistant Palmer Amaranth



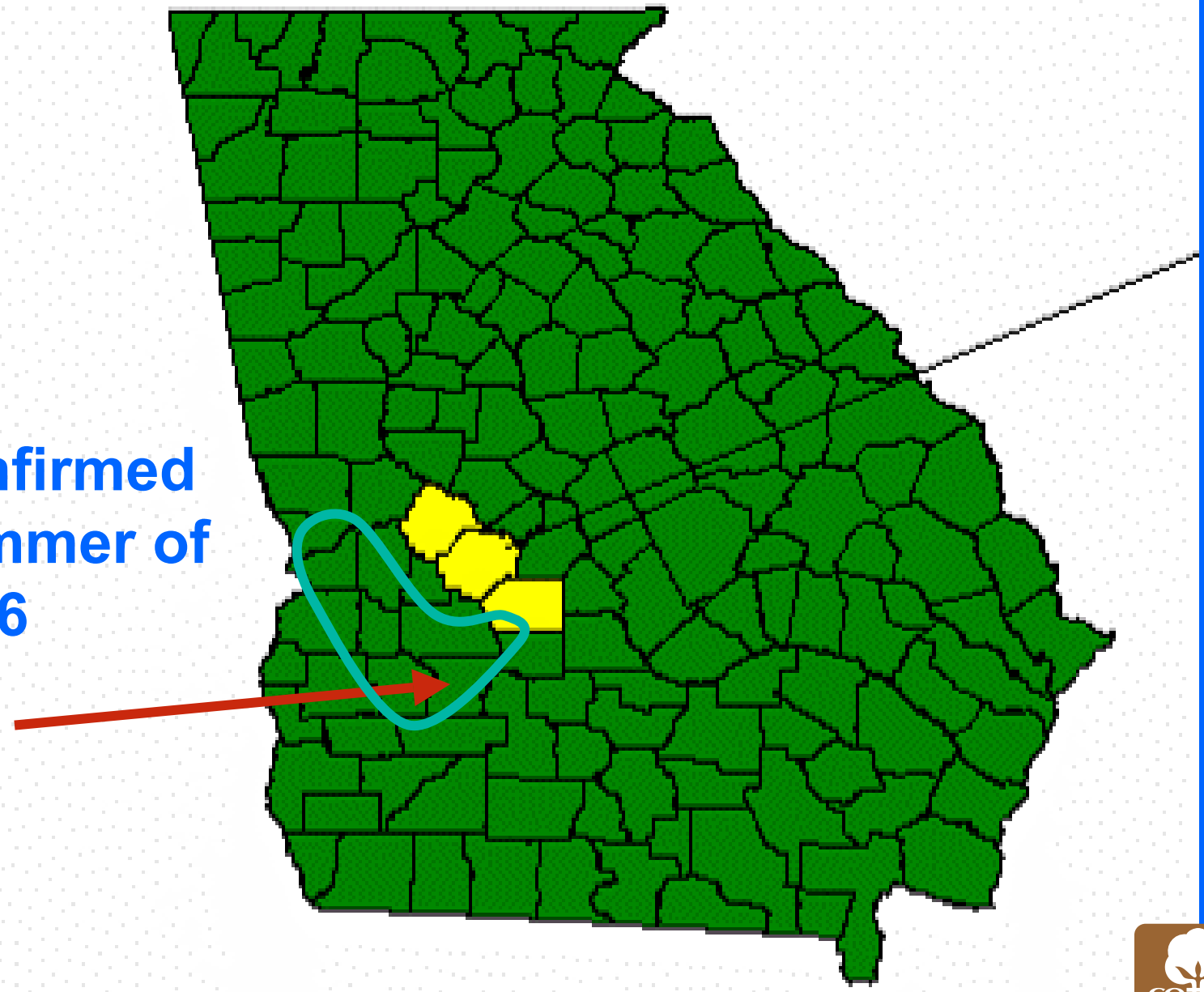
Glyphosate-Resistant *Amaranthus palmeri* *(unofficial 2/08)*

- Georgia - 11 counties
- North Carolina - 15 counties
- South Carolina - 3 counties
- Arkansas - 11 county
- Tennessee - 3 counties

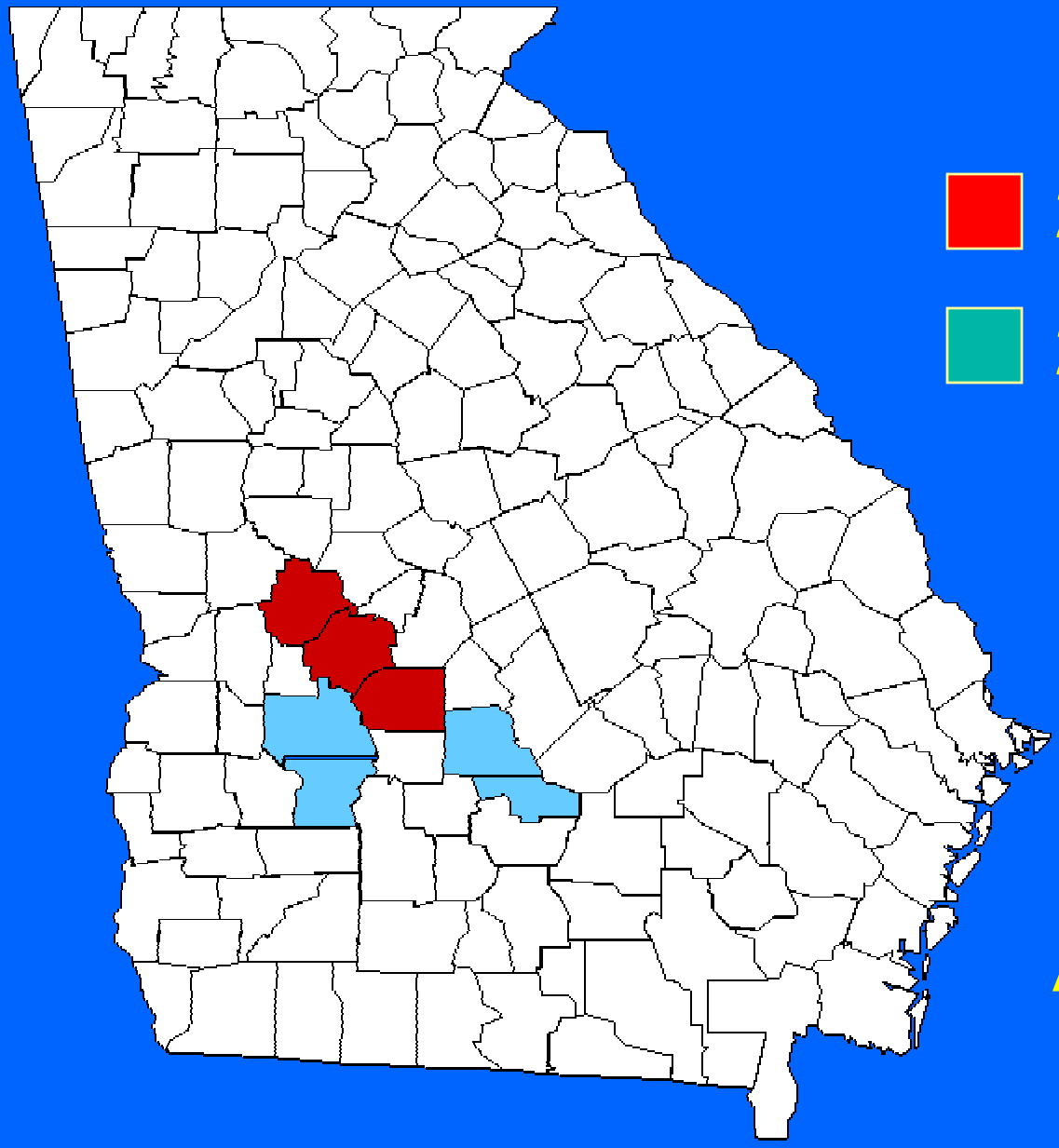
Locations Spring 2006



Fall Locations 2006



Confirmed Glyphosate-Resistant Palmer Sites



As of 3-15-07

55 of 120 sites


1.3 kg ae glyphosate/ha

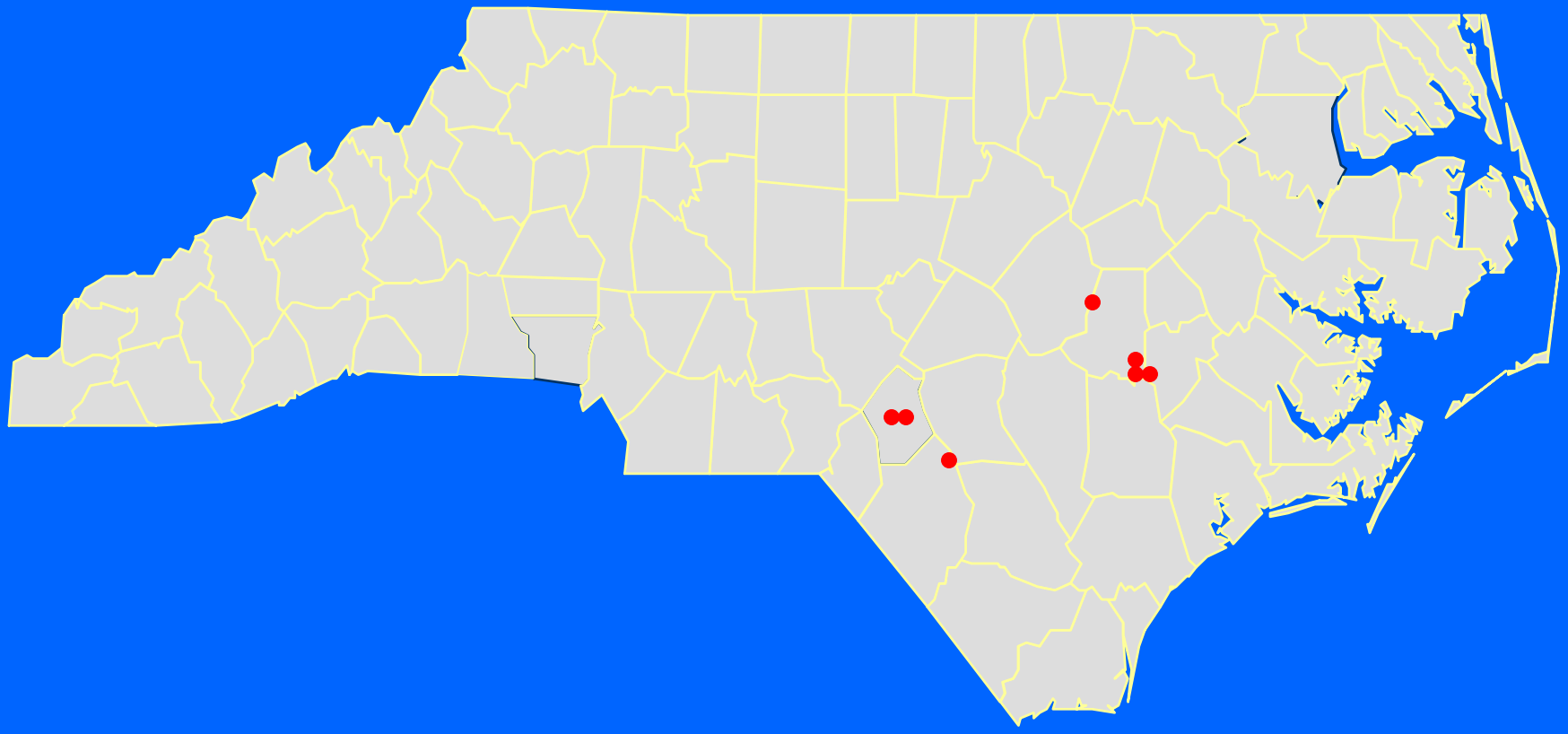

2.6 kg ae glyphosate/ha


5.2 kg ae glyphosate/ha

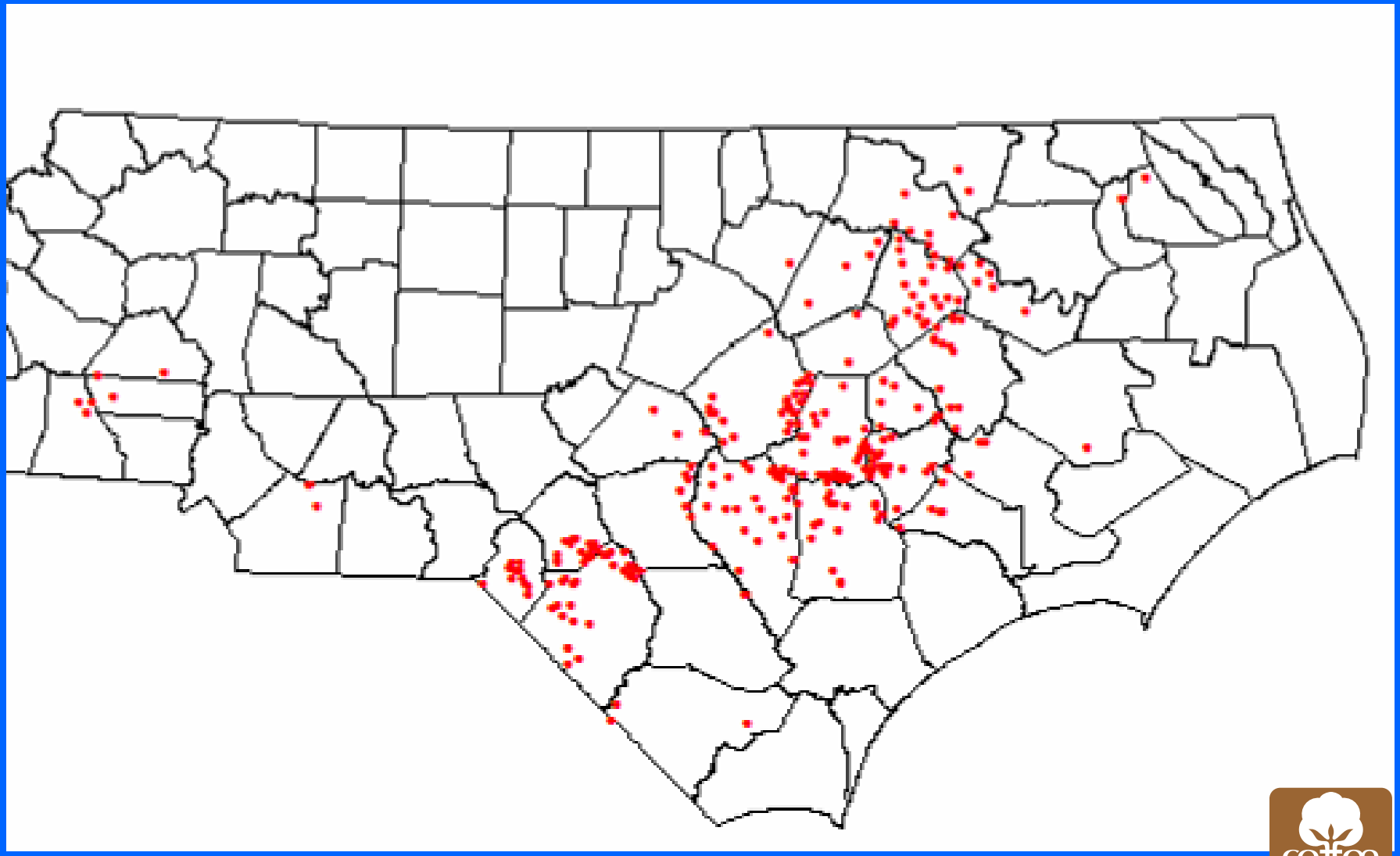

7.8 kg ae glyphosate/ha


10.4 kg ae glyphosate/ha

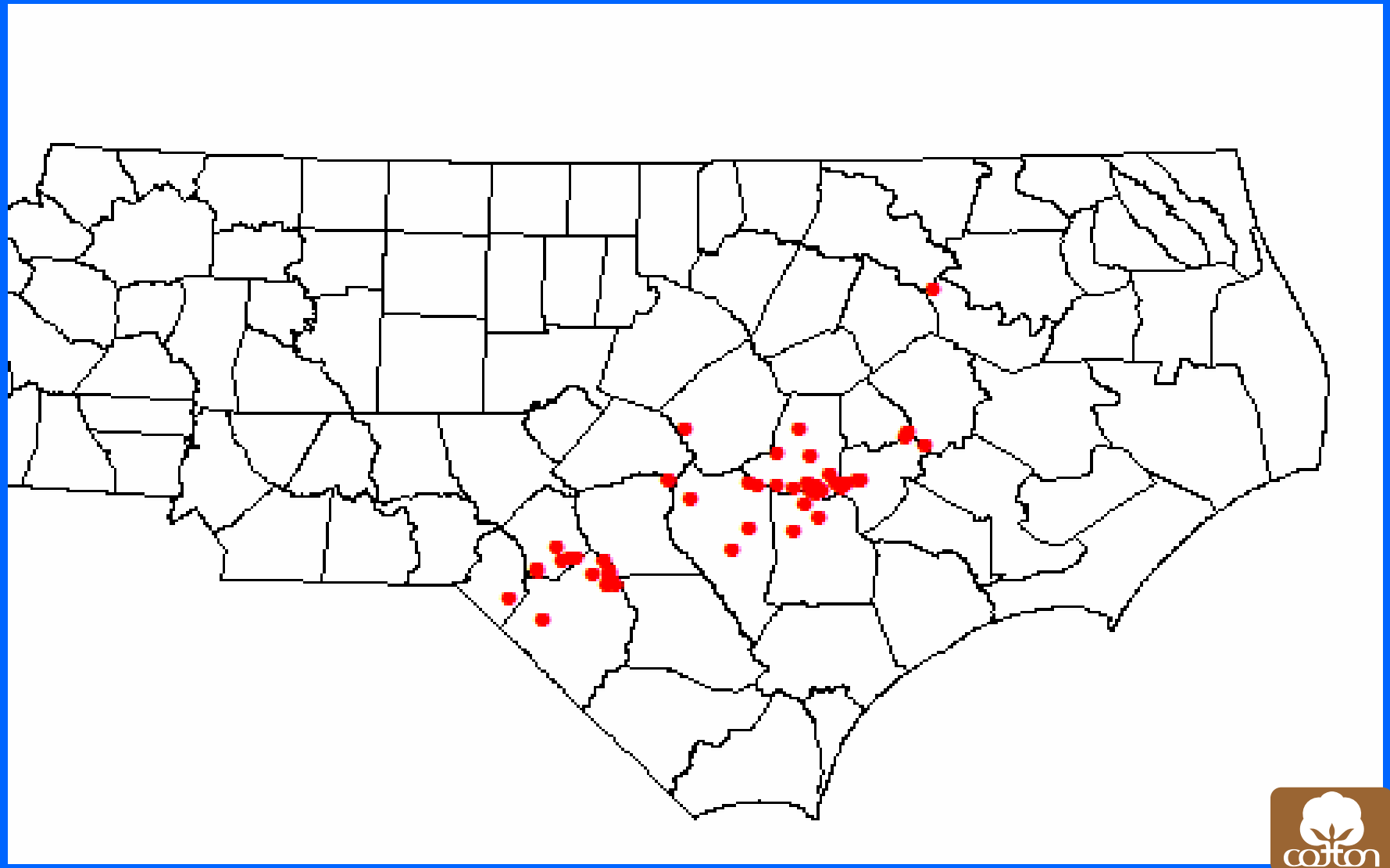
Suspected Glyphosate-Resistant Palmer Amaranth -- 2005



Fall Seed Collection 2005 (290 Fields)



Resistant Locations 2006 (52 fields)



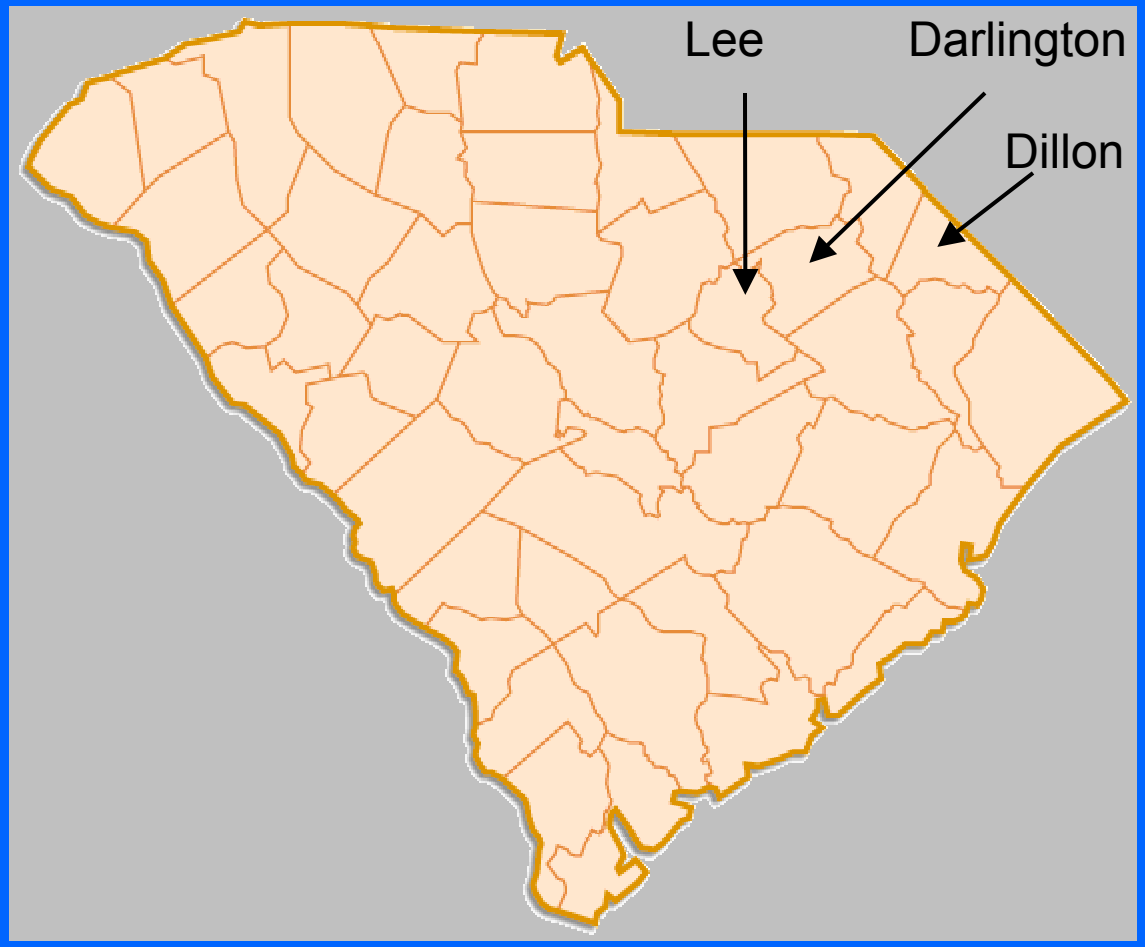
Cotton, Hoke County - Untreated (13 days after application) to 0.3 m weeds

Cotton, Hoke County - 3.4 kg/ha glyphosate (4X)
13 days after application to 0.3m weeds

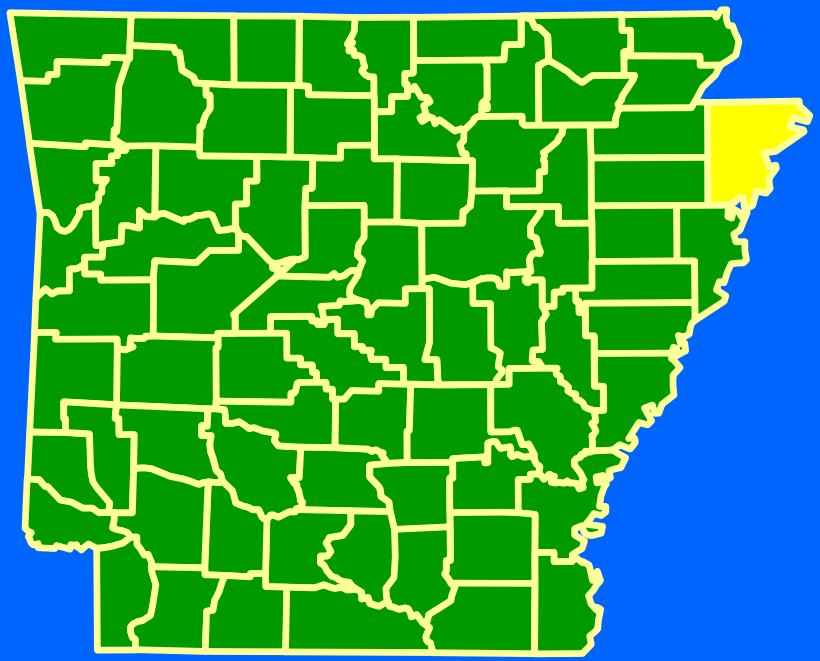
Cotton, Hoke County, North Carolina
Glyphosate-Resistant Palmer Amaranth

Soybean, Wayne County, North Carolina
Glyphosate-Resistant Palmer Amaranth

Glyphosate-resistant Palmer amaranth
South Carolina, 2006

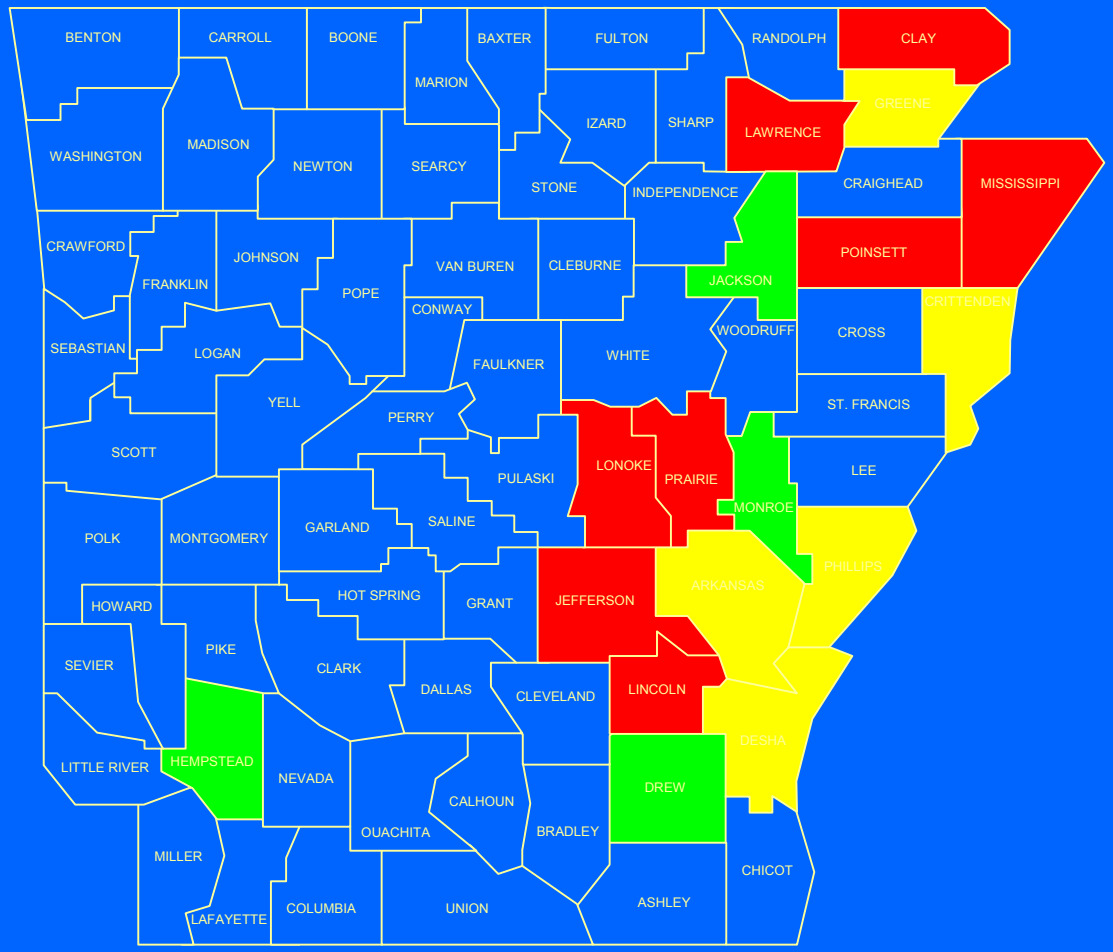


Location of Glyphosate Resistant Palmer Amaranth Population



Mississippi County, Arkansas

Glyphosate Resistant Palmer amaranth Distribution



Resistant vs. Susceptible Biotypes

Mississippi County **Richland County**

Possible Strategies
Glyphosate-Resistant Palmer Amaranth

There is no new chemistry

1. Use More Modes of Action
2. New Cover Crop Strategies
3. Use Precision Cultivation
4. Rotate with Other Crops to Reduce Populations

U.S. Cotton Extension Weed Scientists

with review by an International Panel of Resistance Management Experts developed

Guidelines for Managing Weed Resistance

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.