

Biology and Management of Herbicide-Resistant Palmer amaranth in Cotton in the United States

World Cotton Research Conference

Goiania, Brazil

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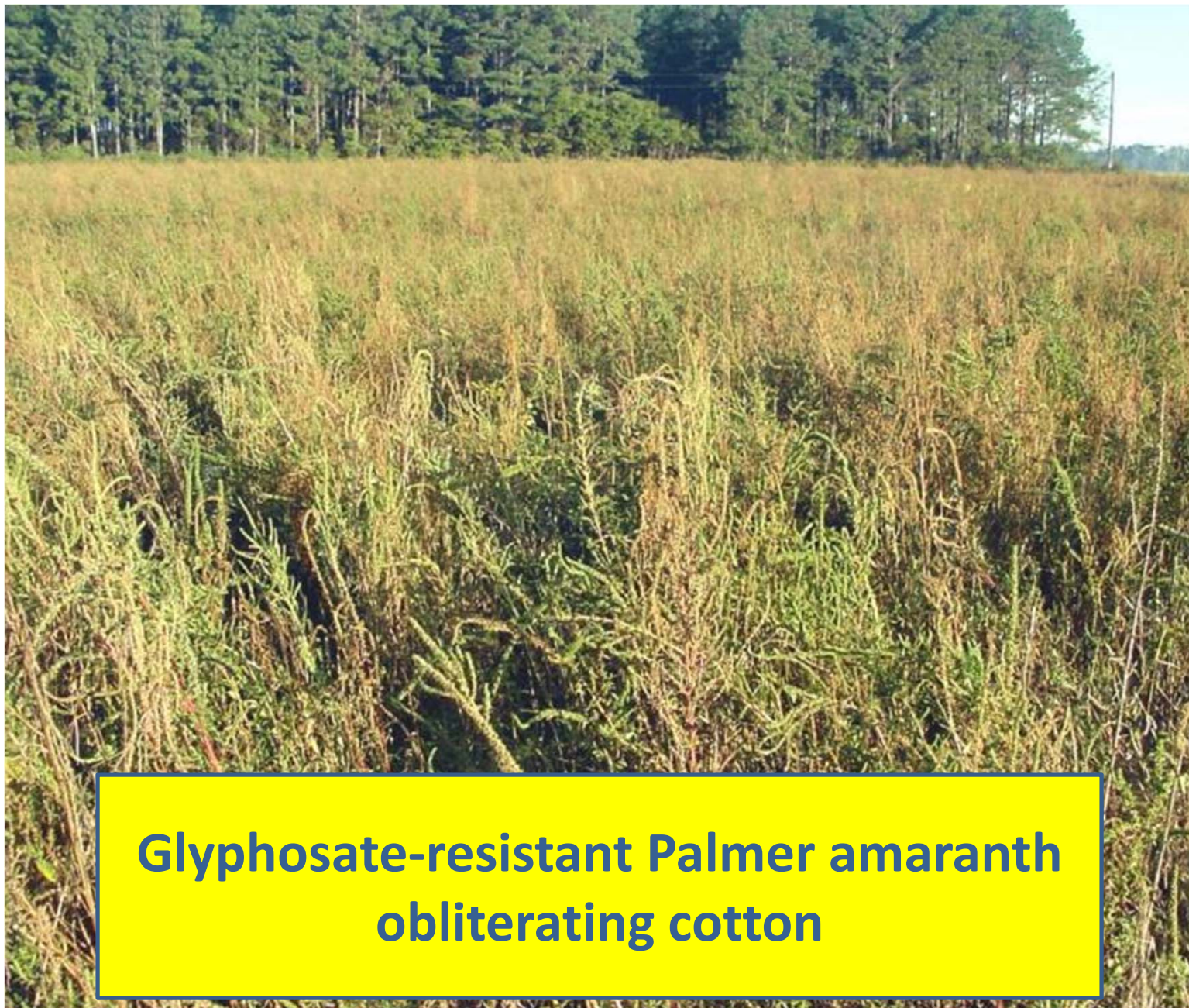
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A. York



**Glyphosate-Resistant Palmer amaranth
impeding cotton harvest**



**Glyphosate-resistant Palmer amaranth
obliterating cotton**

Dioecious Amaranth *Species*; aka Pigweeds

Palmer Amaranth



Waterhemp

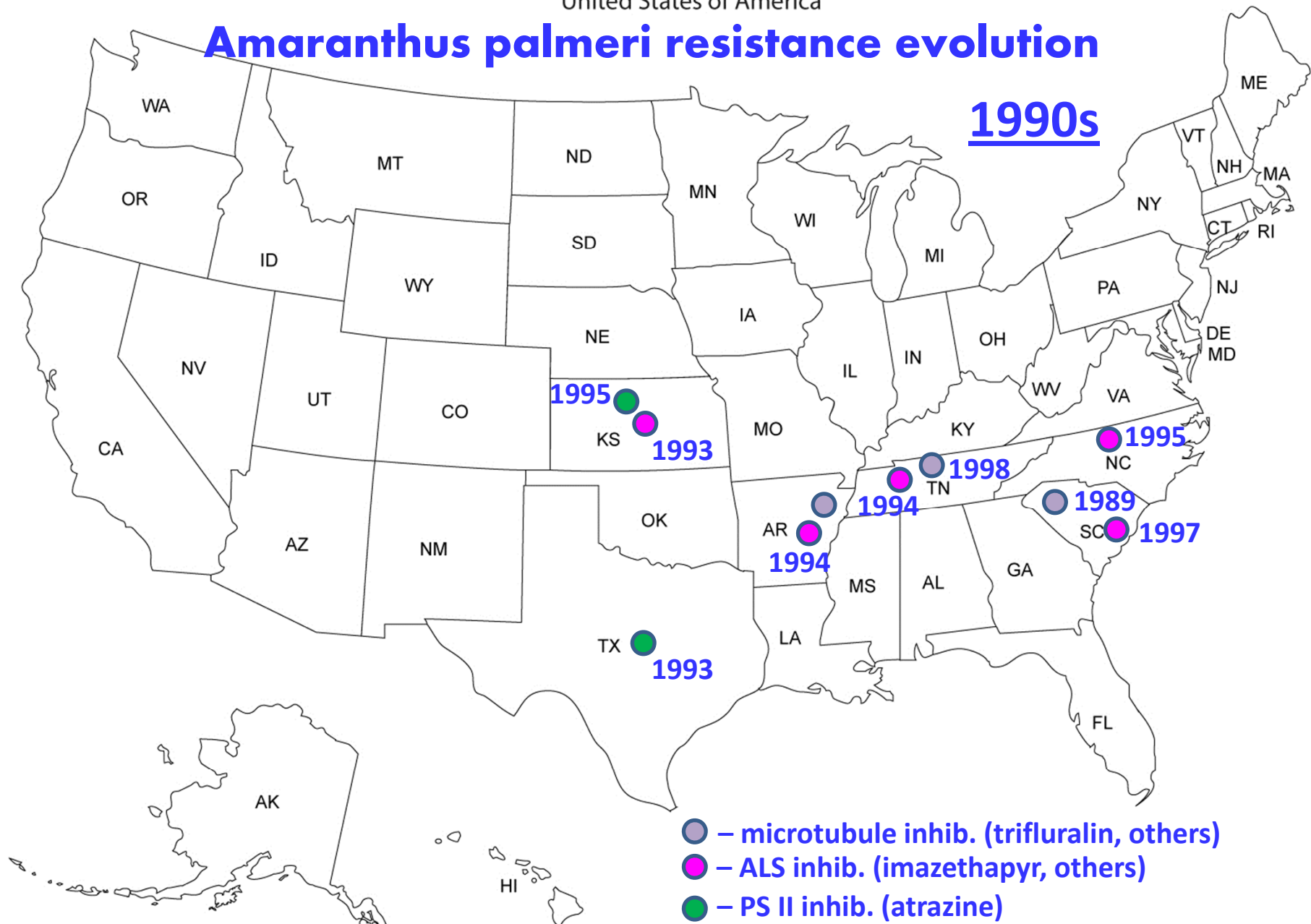


Two Dioecious amaranths in North America

- *Amaranthus tuberculatus* – Tall Waterhemp
 - Midwest; heavy soils - South Central
- *Amaranthus palmeri* – Palmer amaranth, Palmer pigweed
 - light soils - South & many soils Southwest
- The two dicots resistant to the most herbicide modes of action (6 each)
 - *A. palmeri* is invading the Midwest

Amaranthus palmeri resistance evolution

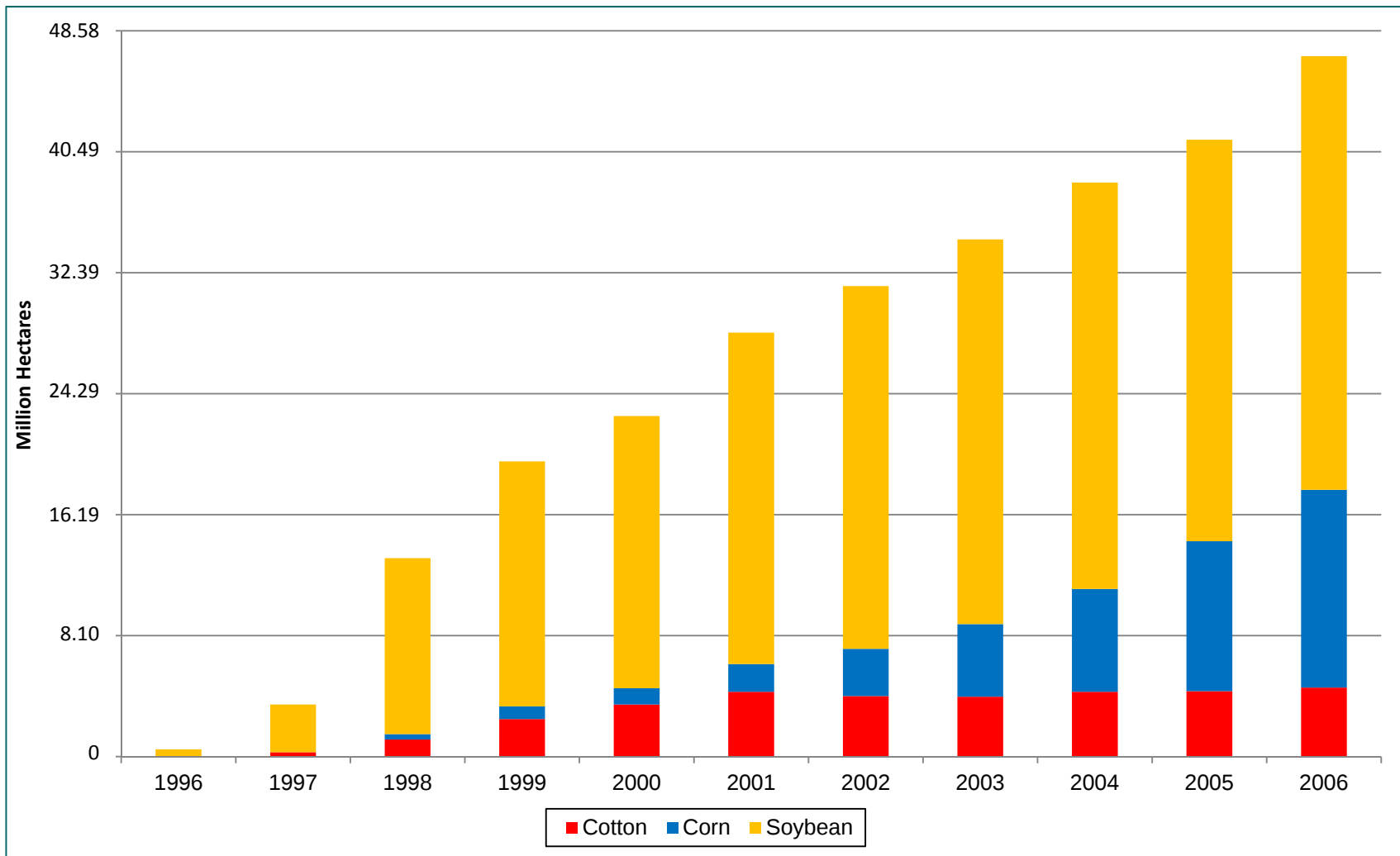
1990s



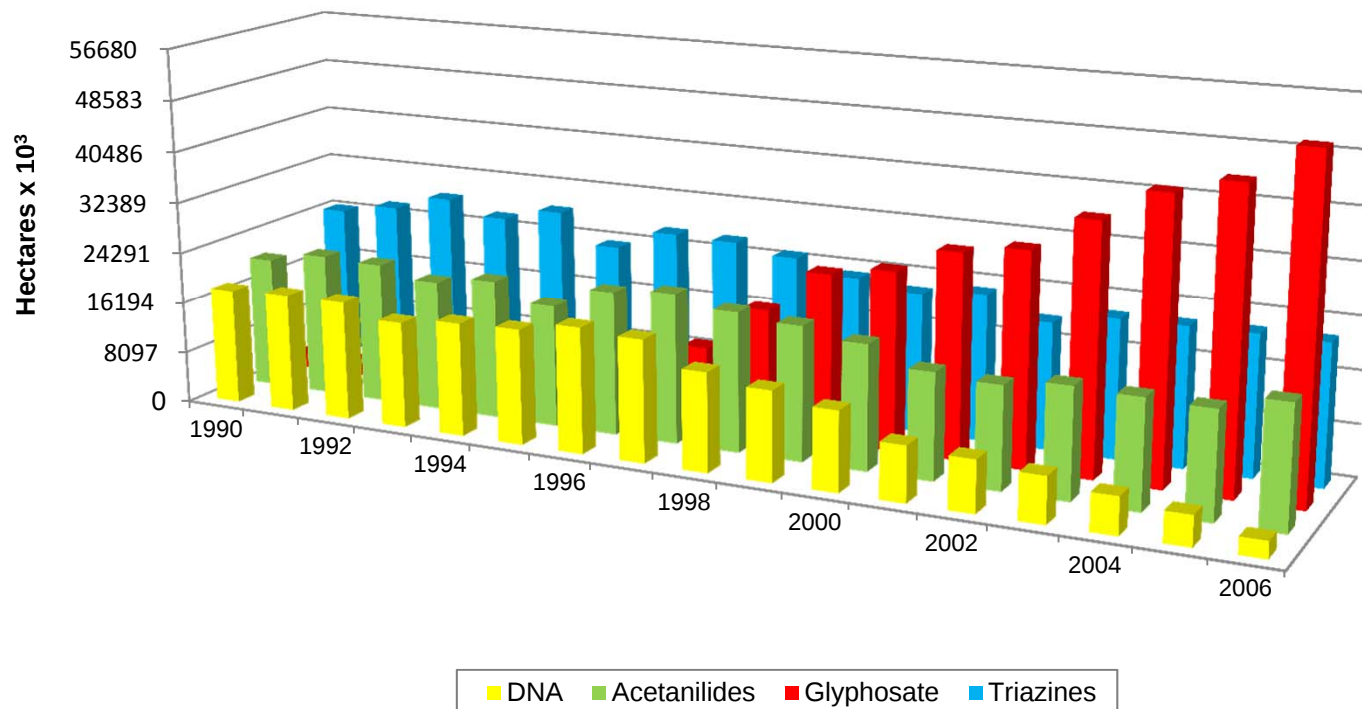
Heap (2016) The International Survey of Herbicide Resistant Weeds. Available www.weedscience.org

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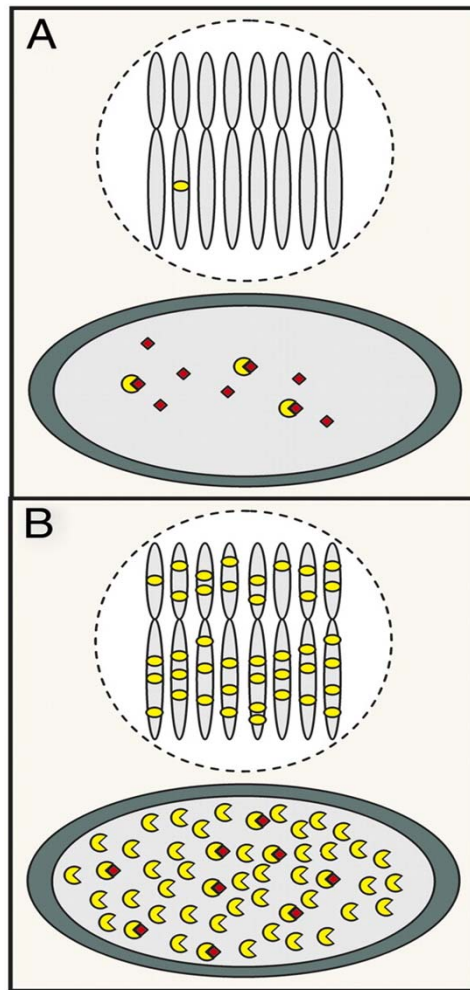
Hectares of Glyphosate-Resistant Crop Cultivars



Total Hectares Exposed to Herbicide Modes of Action for Corn, Soybean, Cotton



EPSPS Gene Duplication: Glyphosate Resistance Mechanism

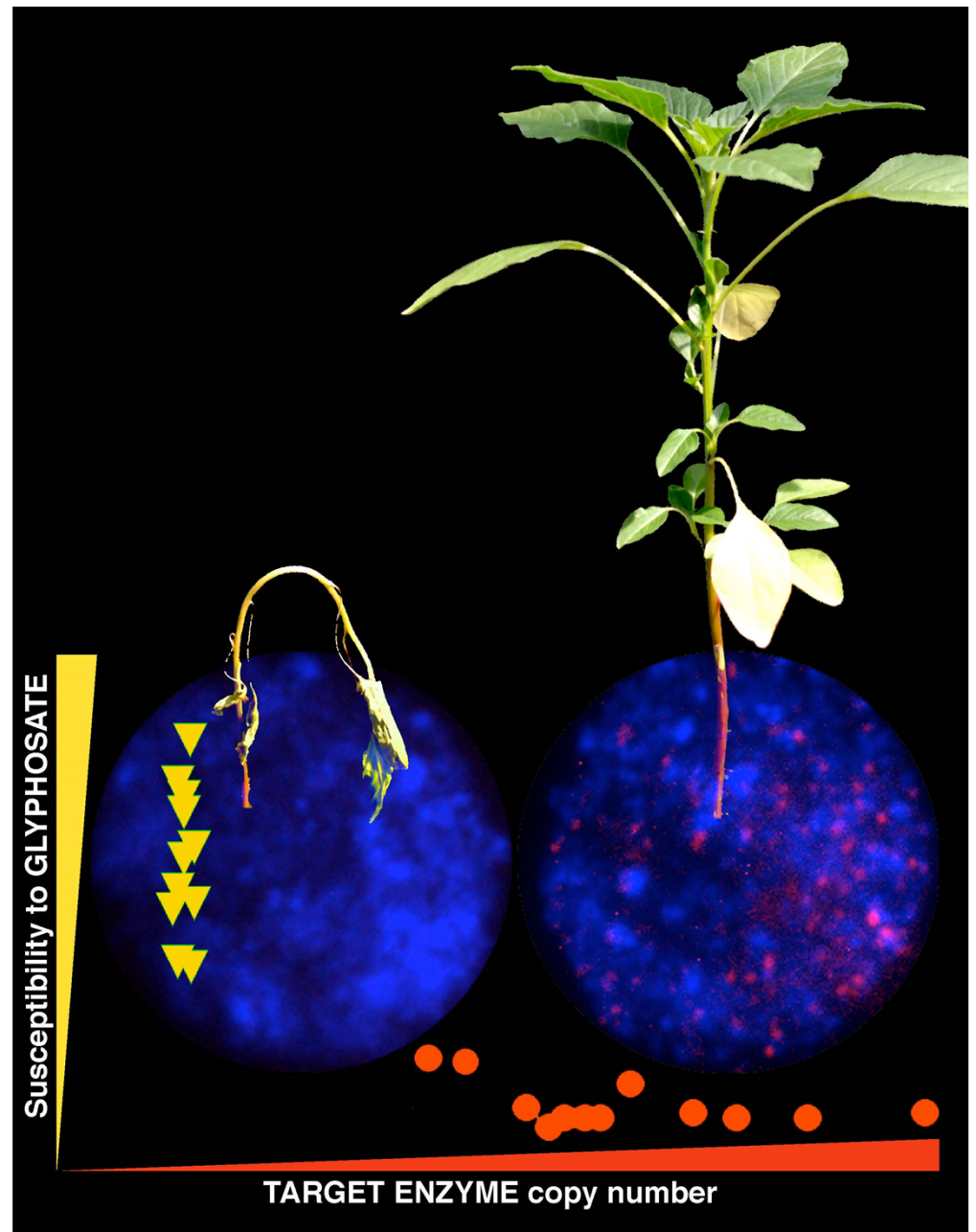


Susceptible

Powles, PNAS 2010;107:955-956

Resistant

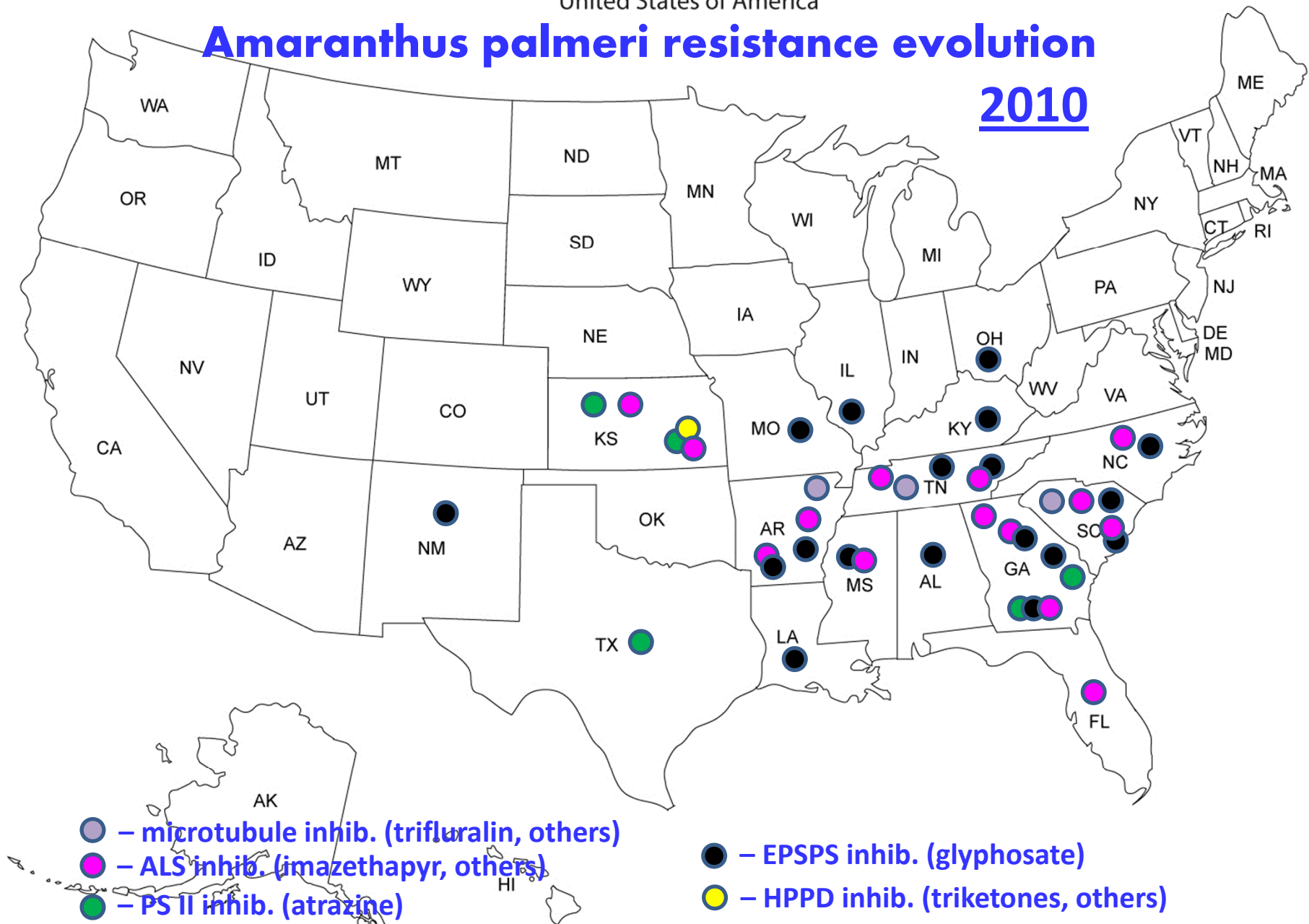
- Resistant plants have much more EPSPS
- Extra gene copies are located on multiple chromosomes
- Gaines et al. 2010. Gene amplification confers glyphosate resistance in *Amaranthus palmeri*. *Proc. Natl. Acad. Sci. USA* 107:1029-1034.



United States of America

Amaranthus palmeri resistance evolution

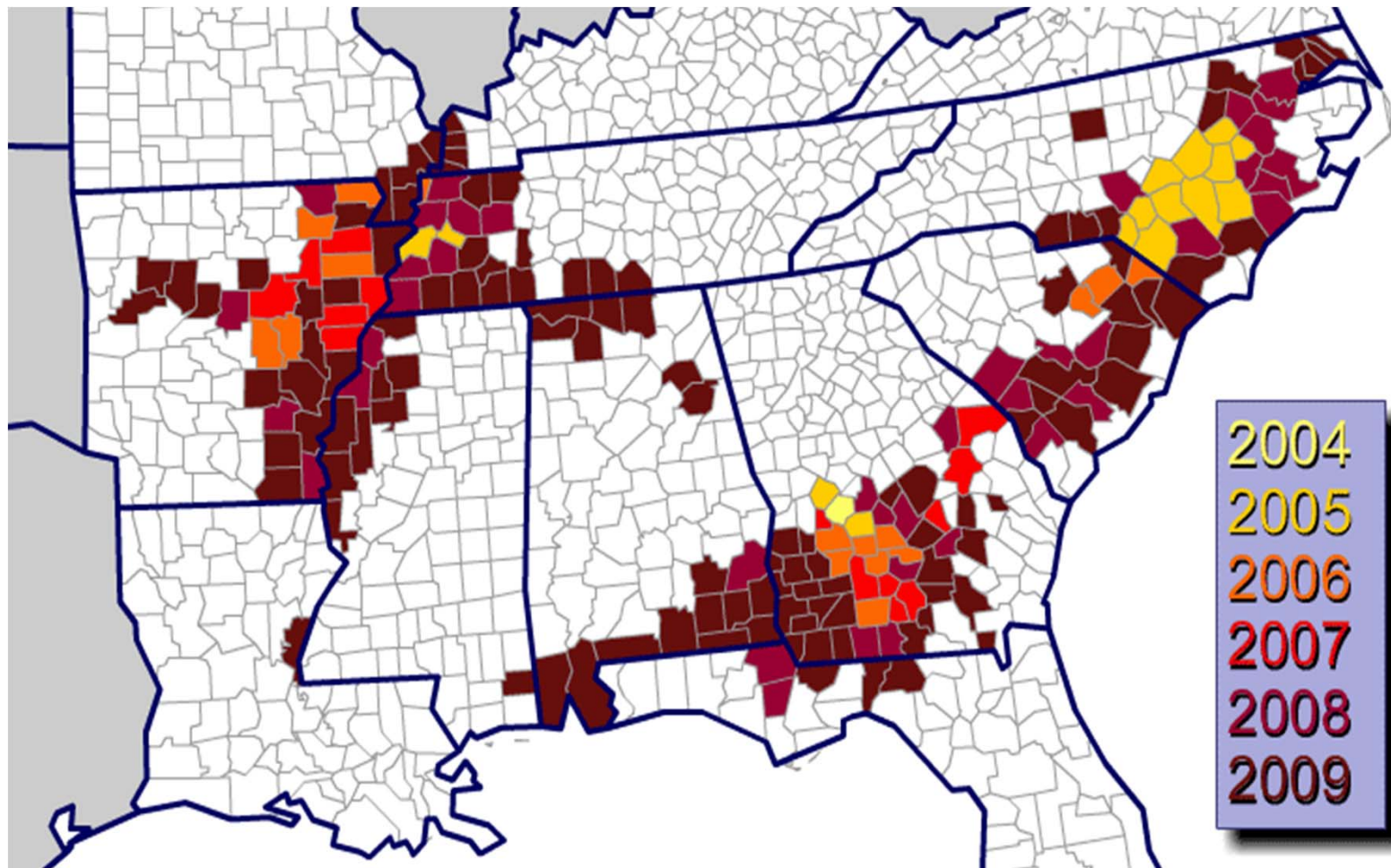
2010



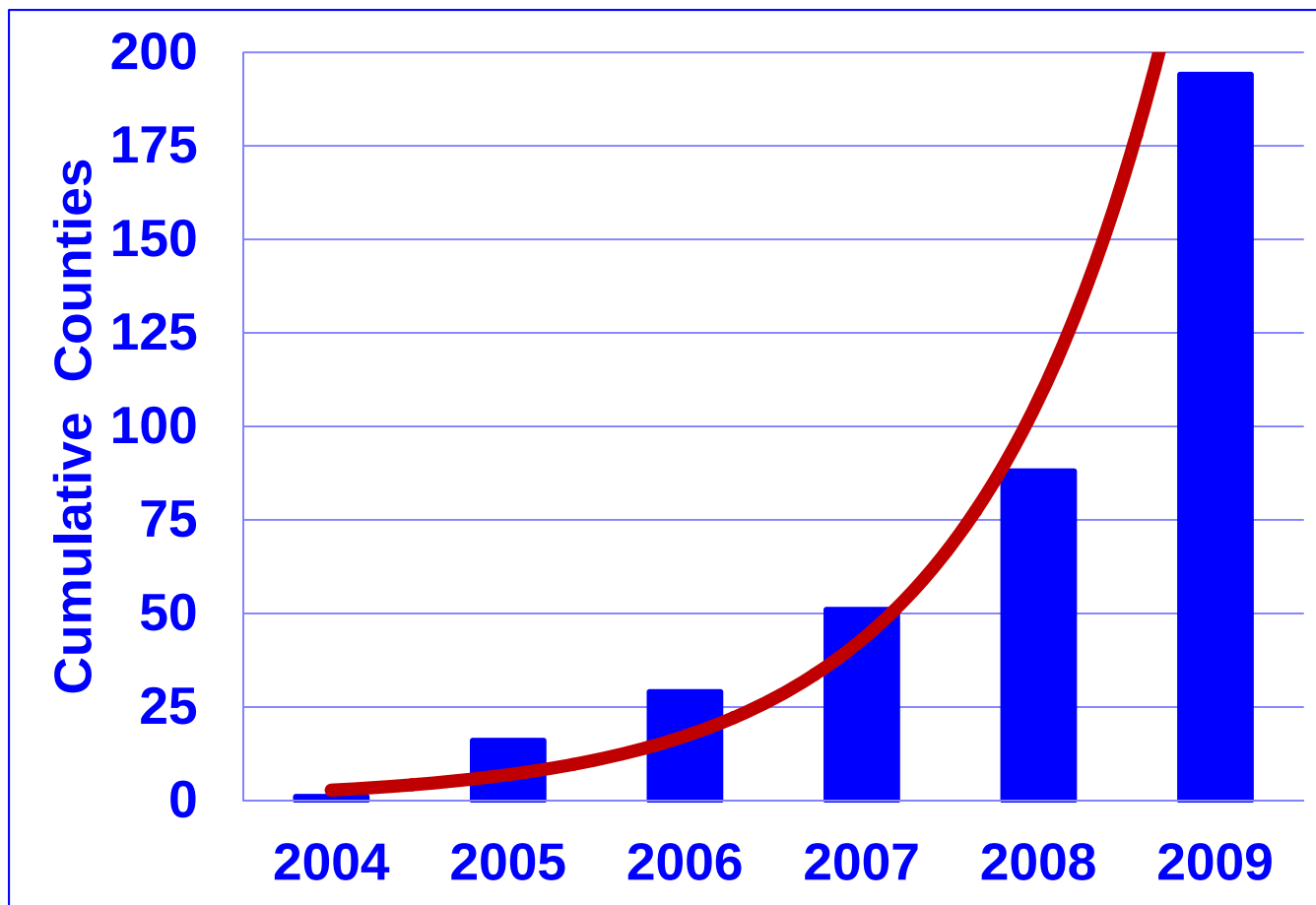
Heap (2016). Available www.weedscience.org

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Expansion of Glyphosate-Resistant Palmer amaranth – counties infested

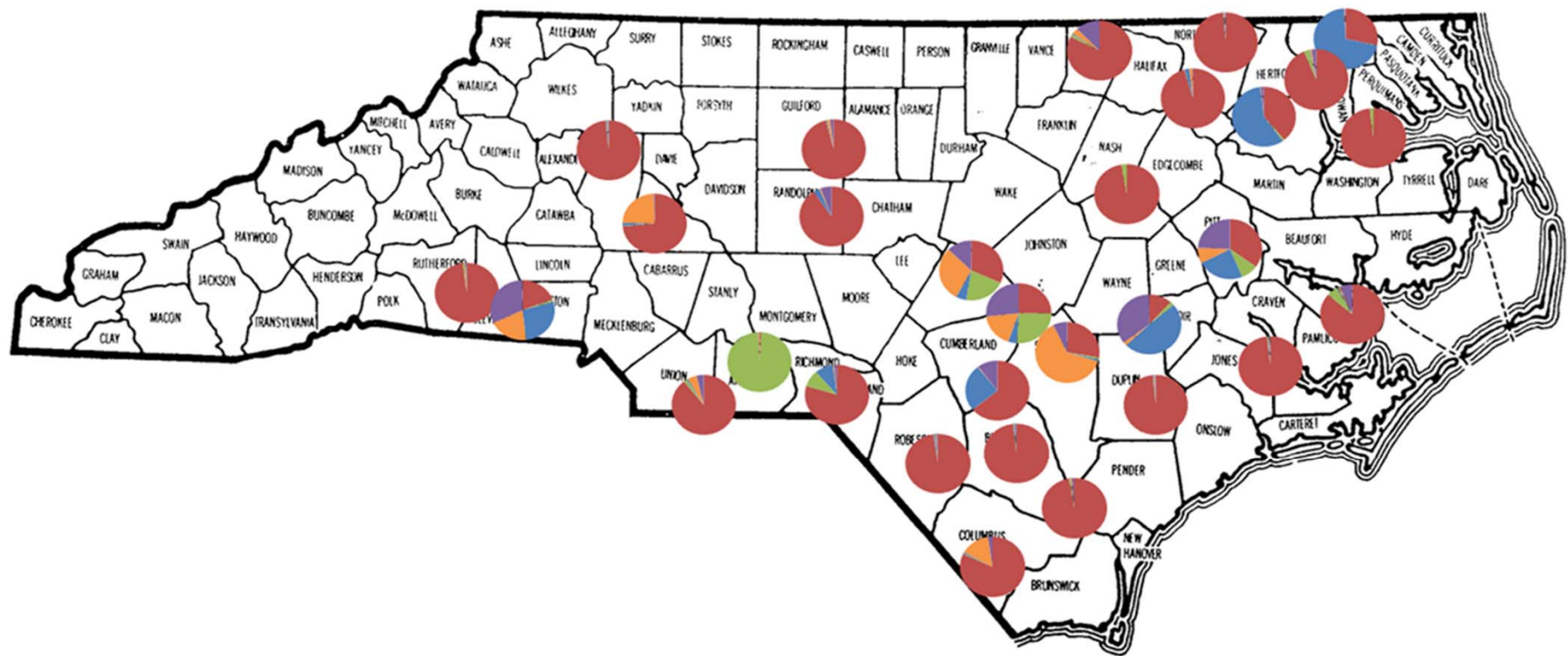


Counties with Glyphosate-Resistant Palmer Amaranth



Population Genetics of Glyphosate Resistance in Palmer amaranth

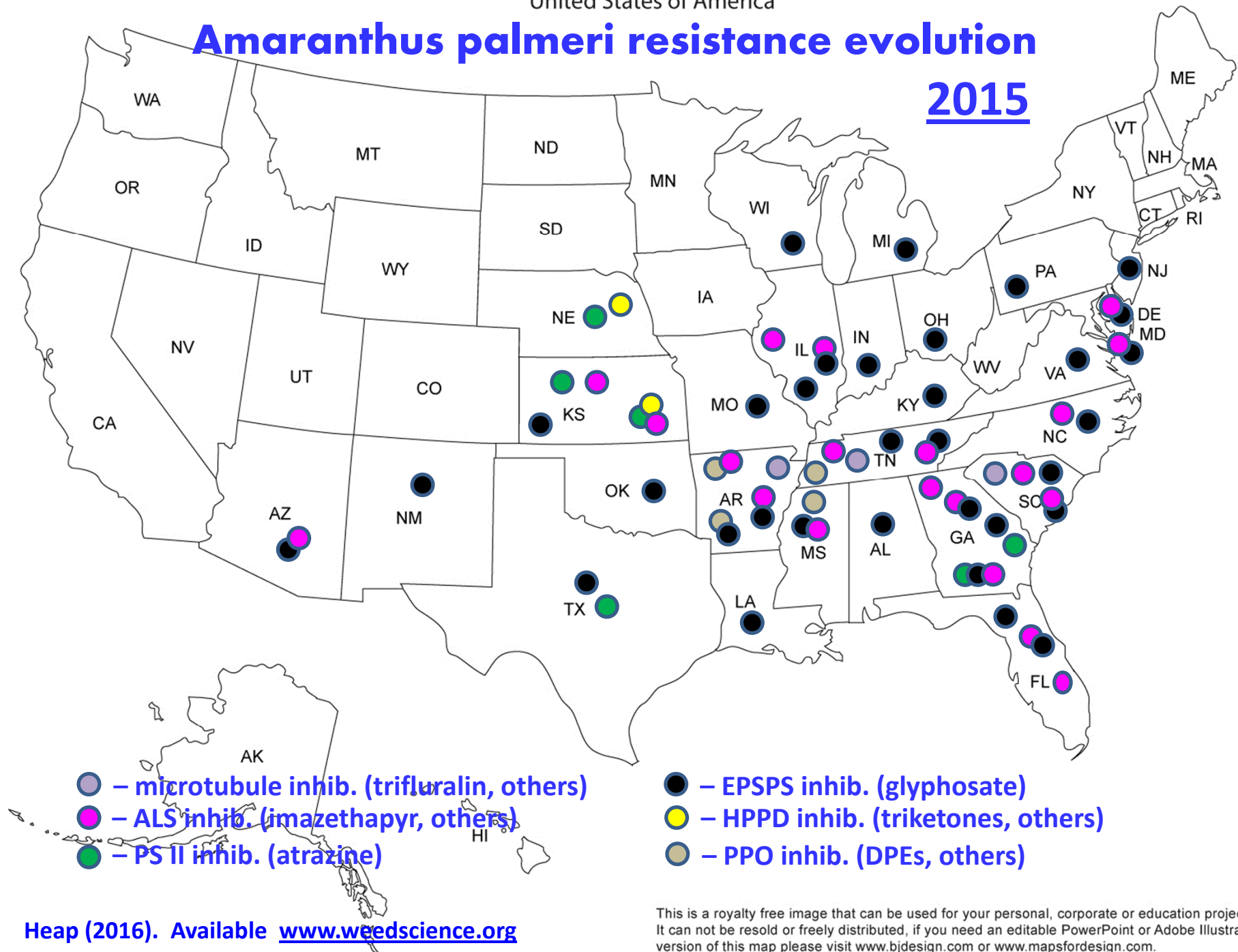
- Distribution of Genotypes in North Carolina - 2009



United States of America

Amaranthus palmeri resistance evolution

2015



Heap (2016). Available www.weedscience.org

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Impacts of Glyphosate-Resistant Palmer amaranth

- **Increase complexity and costs of weed management in cotton and soybean**
- **Compromise conservation tillage in the short-term**
- **May precipitate a cascade of resistance in post emergence broadleaf herbicides**

Glyphosate Resistant Palmer amaranth

Economic Threat to Soybeans

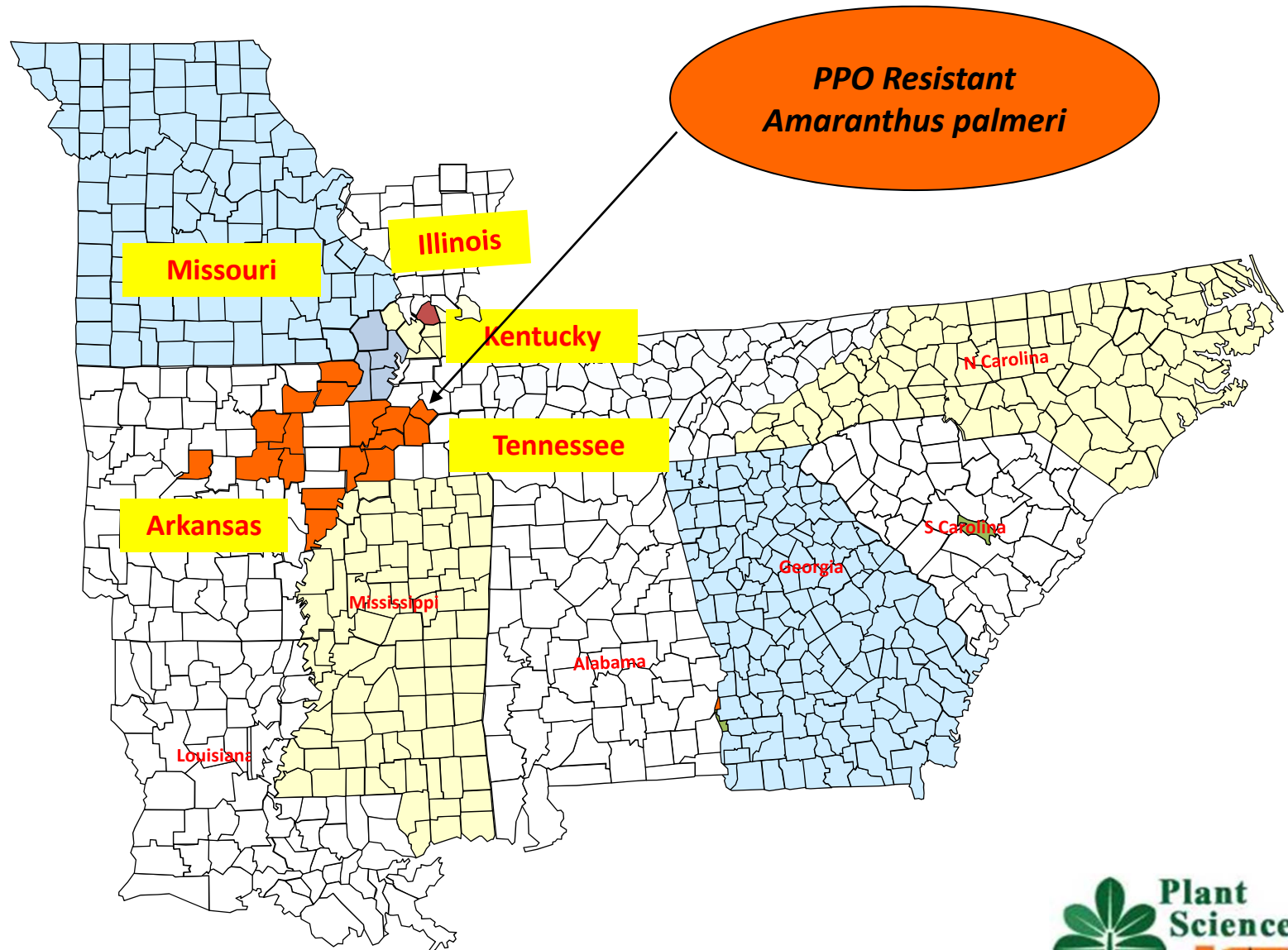
If ALS and glyphosate are compromised, **PPO herbicides are the only post emergence option except glufosinate**

Economic Threat to Cotton

PPO herbicides are not an over-the-top option. If ALS herbicides and glyphosate are compromised, there are **no selective post emergence options except glufosinate**

Nichols, R. L. 2010 – “Pigposium”,
Forest City, Arkansas

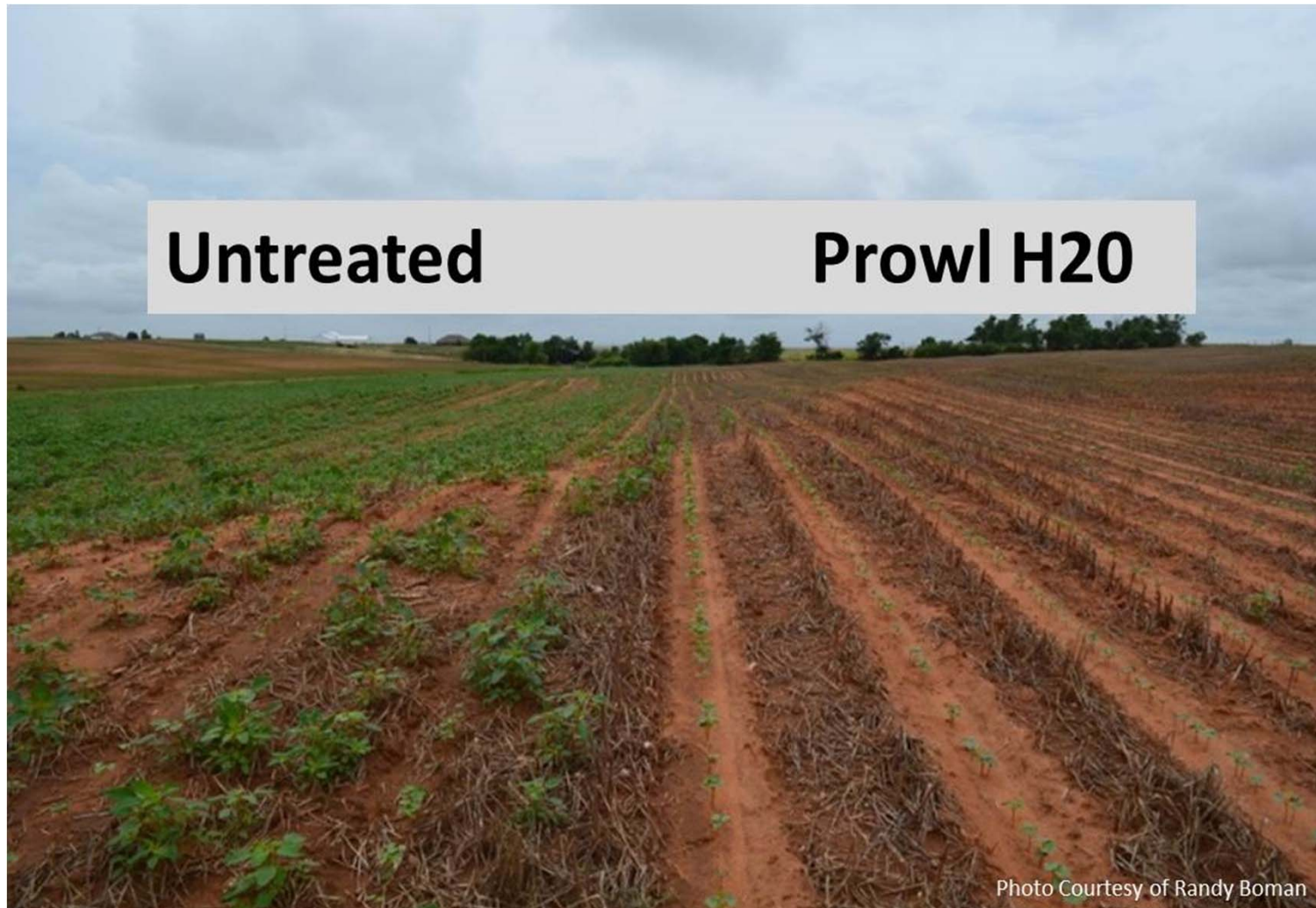
Glyphosate and PPO - Resistant Palmer amaranth





**Palmer amaranth Resistant to Glyphosate
and PPO Inhibiting Herbicides**

Soil-Active Herbicides are a Must



Greater Selection Pressure on Glufosinate

- **Glyphosate is still a very useful herbicide, but**
- **Palmer amaranth is the 'driver' weed in the system.**
- **When glyphosate, ALS, and PPO herbicides fail, the only post option is glufosinate.**
- **Traits that will be used:**
- **Gytol Liberty Link, Wide Strike, and Xtend Flex.**



2015 – Demonstration No-till Drip Field

(Confirmed glyphosate resistant pigweed in 2014)

Total costs to control resistant pigweed in cotton this year



Liberty Link Systems
ST 4946 GLB2

\$129/acre



Roundup Ready Flex System (no dicamba)
DP 1522 B2XF

\$126/acre

Conservation Tillage

- **Most Economical;
Saves Money, Soil, and
Water**
- **Herbicides Replace
Tillage**
- **Have Depended on
Glyphosate**
- **Replace with Cover
Crops and Alternative
Herbicides**



Using Heavy Rye Covers For Sustainability

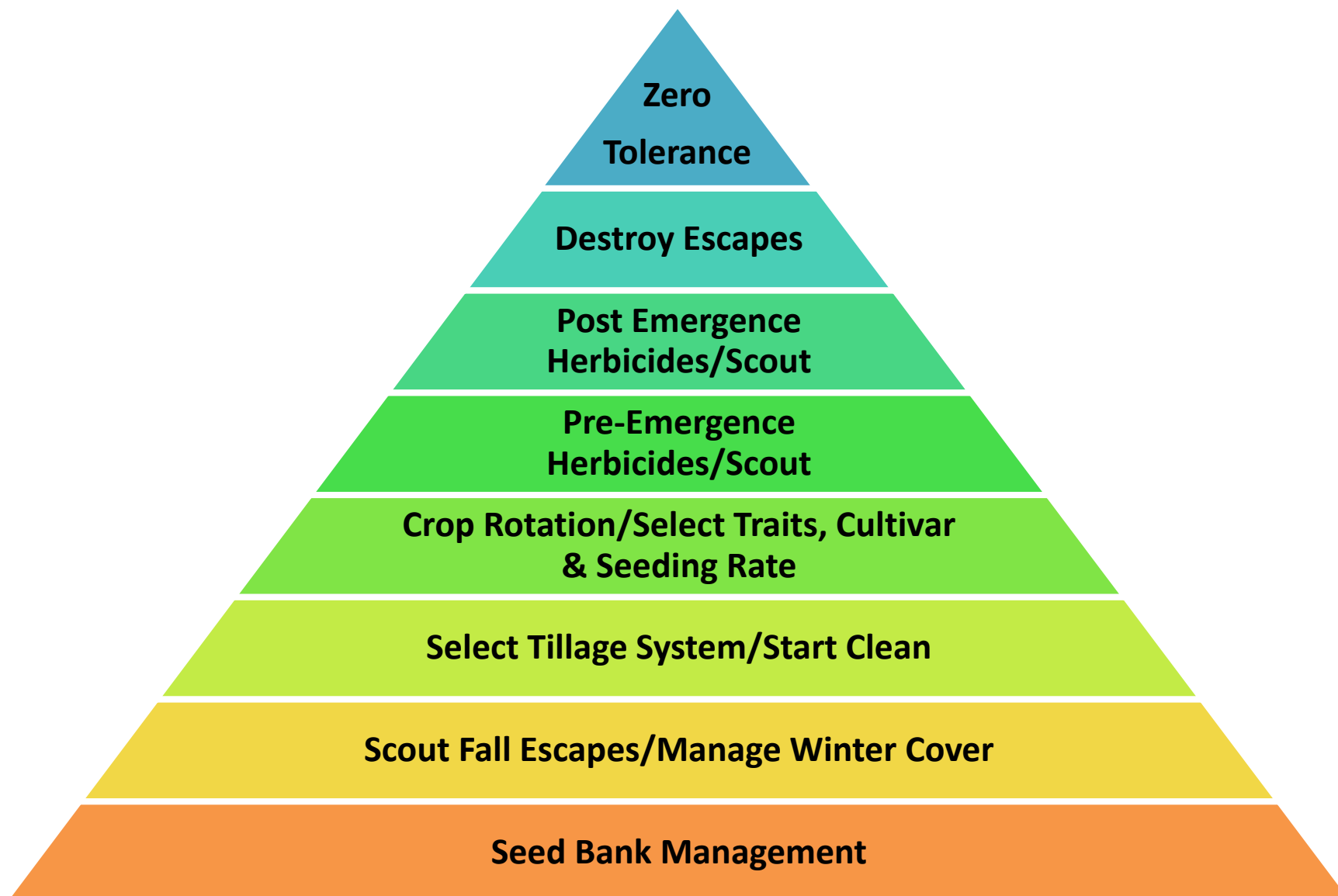


Rye Cover

Weedy Cover

Managing the Weed Seed Bank - The New Paradigm -

- **Not sufficient to control emerged weeds**
- **Unless the number of emerged weeds is decreasing every year, then it's increasing**
- **At some point 99% control will fail**
- **Rogue escapes in the crop**
- **Control emerged weeds following harvest**



Community-Based Programs

“Zero”

U of A UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE

No
Escapes
Allowed



No
Seed
Produced

Soil Weed Seedbank
Reduction Program

“Tolerance”





Control with Trait-Based Auxin Herbicide Weed Management Program

Alan York, NCSU



Control with Trait-Based Auxin Herbicide Weed Management Program

Current Situation

- **Need New Weed Management Programs.**
- **Need to Save Conservation Tillage.**
- **Need to Implement Resistance Management -
Manufacturers and Growers.**
- **Does Resistance Management Include
Trait Management?**

Weed Management Theme

Herbicide Stewardship



Protecting
Crops
Environment
Technology