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

- microtubule inhib. (trifluralin, others)
- ALS inhib. (imazethapyr, others)
- PS II inhib. (atrazine)

Hectares of Glyphosate-Resistant Crop Cultivars

Million Hectares of Glyphosate-Resistant Crop Cultivars

- Cotton
- Corn
- Soybean
Total Hectares Exposed to Herbicide Modes of Action for Corn, Soybean, Cotton
EPSPS Gene Duplication: Glyphosate Resistance Mechanism

Powles, PNAS 2010;107:955-956
• Resistant plants have much more EPSPS
• Extra gene copies are located on multiple chromosomes
Amaranthus palmeri resistance evolution

- Microtubule inhib. (trifluralin, others)
- ALS inhib. (imazethapyr, others)
- PS II inhib. (atrazine)
- EPSPS inhib. (glyphosate)
- HPPD inhib. (triketones, others)

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
Amaranthus palmeri resistance evolution

- Microtubule inhib. (trifluralin, others)
- ALS inhib. (imazethapyr, others)
- PS II inhib. (atrazine)
- HPPD inhib. (triketones, others)
- EPSPS inhib. (glyphosate)
- PPO inhib. (DPEs, others)

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.
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

PPO Resistant Amaranthus palmeri

States affected:
- Missouri
- Illinois
- Kentucky
- Tennessee
- Arkansas
- Mississippi
- Louisiana
- Alabama
- Georgia
- North Carolina
- South Carolina

Plant Sciences UT
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
Zero Tolerance

Destroy Escapes

Post Emergence Herbicides/Scout

Pre-Emergence Herbicides/Scout

Crop Rotation/Select Traits, Cultivar & Seeding Rate

Select Tillage System/Start Clean

Scout Fall Escapes/Manage Winter Cover

Seed Bank Management
Community-Based Programs

“Zero”
UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE

Soil Weed Seedbank Reduction Program

“Tolerance”
Control with Trait-Based Auxin Herbicide Weed Management Program
Control with Trait-Based Auxin Herbicide Weed Management Program
• 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