Glyphosate-Resistant Palmer Amaranth
Initial concerns in 2005
Untreated                      Glyphosate 0.75 lb ae/A
12 inches at treatment
14 DAT
Parkton, NC  2005
Untreated  

Glyphosate 3.0 lb ae/A

14 DAT

Parkton, NC  2005
290 Fields Sampled in Fall 2005
49 of 290 Fields Resistant
Located in 11 Counties
Known susceptible population
Percent fresh weight reduction, greenhouse: North Carolina.

Susceptible

\( I_{50} = 89 \text{ g/ha} \)

\[ y = 6.747 + \frac{101.0643 - 6.7470}{1 + (x/88.9212)^{2.1698}} \]

\( R^2 = 0.984 \)

Resistant

\( I_{50} = 1939 \text{ g/ha} \)

\[ y = 1.8664 + \frac{121.9982 - 1.8644}{1 + (x/1939.2205)^{1.8546}} \]

\( R^2 = 0.989 \)

\( R \text{ level} = 21.8X \)
Impacts

High level of awareness

Lot of worrying

Some action
Untreated                      Glyphosate 0.75 lb ae/A

12 inches at treatment

14 DAT

Parkton, NC  2005
What are telling our growers?

- Raising awareness
- Early detection
Detect Resistance Early
Is this weed resistant?
Wanna risk it?
What are telling our growers?

• Raising awareness
• Early detection
• Rotation; strive for good control in corn or soybeans; try to reduce seed bank
Cotton yield vs Palmer density

1 weed/20 ft of row reduced yield 7%
1 weed/square yard reduced yield 50%

Culpepper, UGA, 2006
What are telling our growers?

- Raising awareness
- Early detection
- Rotation; strive for good control in corn or soybeans; try to reduce seed bank
- Multiple MOA’s; strong focus on PRE’s and residual control
North Carolina, 2006

Mid-July

Untreated

Treated – no residual

Mid-Oct
Glyphosate-resistant Palmer amaranth
Robeson County, 2007
Palmer Amaranth Resistance Management

- Reduce the seedbank
- Residual control is important
- Reduce selection pressure on ALS inhibitors
# Herbicide programs for Palmer amaranth control in RR Soybean

<table>
<thead>
<tr>
<th>Glyph. resist.</th>
<th>ALS resist.</th>
<th>Preplant or Preemergence</th>
<th>Postemergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes or No</td>
<td>Authority MTZ(^1), Boundary, Dual Magnum, Envive, Intro, Outlook, Prefix, Prowl, Sencor, Valor SX, or Valor XLT(^1)</td>
<td>Lighter infestations: Glyphosate</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Authority MTZ(^1), Boundary, Envive, Intro, Prefix, Valor SX, or Valor XLT(^1)</td>
<td>Glyphosate + Harmony GT(^2), Glyphosate + Flexstar(^3), or Glyphosate + Reflex(^3)</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Authority MTZ(^1), Boundary, Envive, Intro, Prefix, Valor SX, or Valor XLT(^1)</td>
<td>Glyphosate + Flexstar or Glyphosate + Reflex</td>
</tr>
</tbody>
</table>

\(^1\) Do not plant cotton in following year.

\(^2\) An ALS inhibitor.

\(^3\) Do not apply Flexstar or Reflex POST if Prefix used PRE.
## Herbicide programs for Palmer amaranth control in non-RR Soybean

<table>
<thead>
<tr>
<th>Sickle-pod</th>
<th>ALS resist.</th>
<th>Palmer infestation</th>
<th>Preplant or Preemergence</th>
<th>Postemergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>Light</td>
<td>Authority MTZ(^1,2), Boundary, Dual Magnum, Envive, Intrro, Outlook, Prefix, Sencor(^2), Valor SX(^3), or Valor XLT(^1,3)</td>
<td>Flexstar(^4), Reflex(^4), Storm, or Ultra Blazer; can add Harmony GT(^5) to any of these</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heavy</td>
<td>Authority MTZ(^1,2), Boundary, Envive, Prefix, Sencor(^2), Valor SX(^3), or Valor XLT(^1,3)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>Light or heavy</td>
<td>Authority MTZ(^1,2), Boundary, Envive, Prefix, Sencor(^2), Valor SX(^3), or Valor XLT(^1,3)</td>
<td>Flexstar(^4), Reflex(^4), or Ultra Blazer</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes or No</td>
<td>Light or heavy</td>
<td>Authority MTZ(^1,2), Boundary, or Sencor(^2)</td>
<td>Flexstar + Classic or Reflex + Classic</td>
</tr>
</tbody>
</table>

---

1. Do not plant cotton in following year.
2. Add Dual, Intrro, Outlook, or Prowl for grass control.
3. Add Prowl for grass control.
4. Do not apply Flexstar or Reflex POST if Prefix used PRE.
5. An ALS inhibitor.
Non-glyphosate programs, 2007
## Recommended southeastern US herbicide programs for Palmer amaranth control in RR cotton

<table>
<thead>
<tr>
<th>Glyph. resist.</th>
<th>ALS resist.</th>
<th>Preplant or Preemergence</th>
<th>Postemergence 1- to 4-leaf</th>
<th>Layby (Palmer &lt; 3”)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>Staple*, Reflex**, Valor SX***, Direx, Cotoran, or Prowl</td>
<td>Light infestation: Glyphosate</td>
<td>Valor, Suprend, Direx, or Layby Pro plus MSMA or glyphosate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Heavy infestation: Glyph. + Dual Mag.</td>
<td></td>
</tr>
</tbody>
</table>

* Limit to one application per year.
** Caution if Valor preplant.
*** Preplant only.
### Recommended southeastern US herbicide programs for Palmer amaranth control in RR cotton

<table>
<thead>
<tr>
<th>Glyph. resist.</th>
<th>ALS resist.</th>
<th>Preplant or Preemergence</th>
<th>Postemergence 1- to 4-leaf</th>
<th>Layby (Palmer &lt; 3”)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>Reflex* + Direx, Reflex* + Prowl, Direx + Staple**, or Valor SX***</td>
<td>No Palmer emerged: Glyph. + Dual Mag.</td>
<td>Valor, Suprend, Direx, or Layby Pro plus MSMA or glyphosate</td>
</tr>
</tbody>
</table>

* Caution if Valor preplant.
** Limit to one application per year.
*** Valor preplant only. Can follow with Direx, Cotoran, or Prowl preemergence.
## Recommended southeastern US herbicide programs for Palmer amaranth control in RR cotton

<table>
<thead>
<tr>
<th>Glyph. resist.</th>
<th>ALS resist.</th>
<th>Infestation level</th>
<th>Preplant or Preemergence</th>
<th>Postemergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Reflex* + Direx, Reflex* + Prowl, Cotoran + Prowl, or Valor SX**</td>
<td>No Palmer emerged: Dual Mag.*** + glyph.</td>
<td>Valor, Direx, or Layby Pro plus MSMA or glyphosate</td>
</tr>
</tbody>
</table>

* Caution if Valor preplant.

** Valor preplant only. Can follow with Direx, Cotoran, or Prowl preemergence.

*** Shoot for 1-leaf cotton (label specifies minimum 3-inch cotton).
2007
Glyph. + 2,4-D burndown
Gram. + Reflex PRE
Glyph. + Dual first POST
Glyph.   Second POST
Direx + MSMA Layby
PRE Herbicides

- Strongly recommended in RR systems (cotton, corn, soybean)
- Significant aid in resistance management
- Can offer other benefits
Time of Glyphosate Application on RR Corn.
Average of 6 locations, NC.**

<table>
<thead>
<tr>
<th>Time of first application</th>
<th>No PRE</th>
<th>1/2X Bicep PRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timely*</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1 wk delay</td>
<td>90</td>
<td>97</td>
</tr>
<tr>
<td>2 wk delay</td>
<td>86</td>
<td>96</td>
</tr>
</tbody>
</table>

* 2- to 3.5-inch weeds.

** Parker, York, and Jordan. 2006. Weed Technol. 20:564-570.
Time of First Glyphosate Application on RR Flex Cotton. Average of 3 locations, NC.

<table>
<thead>
<tr>
<th>Time of first application</th>
<th>No PRE</th>
<th>Prowl PRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-leaf</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>1 wk delay</td>
<td>98%</td>
<td>95%</td>
</tr>
<tr>
<td>2 wk delay</td>
<td>94%</td>
<td></td>
</tr>
<tr>
<td>3 wk delay</td>
<td>83%</td>
<td>91%</td>
</tr>
</tbody>
</table>

% yield

Time of first application
Research Areas

- Salvage treatments
- No-till vs conventional tillage
- Chloroacetamides
- Residuals, especially PRE
- Flex/LL
- Physiology/ecology