Palmer Amaranth Growth and Fecundity in Competition with Various Row Crops in North Carolina

February 12, 2019

Denis J. Mahoney
David L. Jordan
Andrew T. Hare
Nilda R. Burgos
Katherine M. Jennings
Ramon G. Leon
Matthew C. Vann
Introduction

• Palmer amaranth (*Amaranthus palmeri* S. Wats)
  • #1 most troublesome weed (WSSA 2016)
• Nutrient, light, and water competition (Knight et al. 2017; Meyers et al. 2010)
• Reduce yields (Ward et al. 2013)
• Resistance!!!! (Heap et al. 2019)
Introduction

• Rapid growth
  • 0.14 – 0.21 cm GDD\(^{-1}\) (Horak and Loughin 2000; Spaunhorst et al. 2018)

• Total height
  • 160 – 269 cm with no competition (Horak and Loughin 2000; Keeley et al. 1987; Sellers et al. 2003; Spaunhorst et al. 2018)
  • 130 – 166 cm in cotton (Norsworthy et al. 2016; Webster and Grey 2015)
  • 177 – 197 cm in sweet potato (Meyers et al. 2010)
Introduction

• Fecundity
  • No competition
    • Up to 170,000 seeds plant$^{-1}$ (Spaunhorst et al. 2018)
    • 250,000 seeds plant$^{-1}$ (Sellers et al. 2003)
    • Up to 613,000 seeds plant$^{-1}$ (Keeley et al. 1987)
Introduction

• Fecundity
  • No competition
    • Up to 170,000 seeds plant\(^{-1}\) (Spaunhorst et al. 2018)
    • 250,000 seeds plant\(^{-1}\) (Sellers et al. 2003)
    • Up to 613,000 seeds plant\(^{-1}\) (Keeley et al. 1987)
  • In competition
    • 120,000 seeds plant\(^{-1}\) in cotton (Norsworthy et al. 2016)
    • 312,000 seeds plant\(^{-1}\) in cotton (Webster and Grey 2015)
Introduction

• Previous research
  • Midwestern and mid-southern states
    • AR, IN, KS, MO
  • Majority completed with no crop competition
  • Limited research comparing gender differences
  • Measurements over time in competition
  • One crop at a time
    • Cotton, soybean, or sweet potato
Objectives

• Measure height, width, and biomass of male and female Palmer amaranth over time in competition with corn, cotton, peanut, and soybean

• Quantify female seed production
Methods and Materials

• Crops planted June 5\textsuperscript{th}
• 91-cm row spacing
• Plot size
  • B9 – 12 rows x 9.1 m
  • C11 – 8 rows x 6 m

<table>
<thead>
<tr>
<th>Crop</th>
<th>Variety</th>
<th>Population ha(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>DynaGro Liberty Link</td>
<td>\approx 84,000</td>
</tr>
<tr>
<td>Cotton</td>
<td>Delta Pine Bolgrad II Xtendflex</td>
<td>\approx 95,000</td>
</tr>
<tr>
<td>Peanut</td>
<td>Bailey</td>
<td>\approx 244,000</td>
</tr>
<tr>
<td>Soybean</td>
<td>Asgrow RR2 Xtend (AG69X6)</td>
<td>\approx 135,000</td>
</tr>
</tbody>
</table>
Methods and Materials

• 1 WAP, 8 plants were selected per plot
• Selected to ensure 2 m² weed free area around
• Initial “clean up” spray June 20th (2 WAP)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Herbicides</th>
<th>g ai/ae ha⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>Glufosinate + glyphosate</td>
<td>451 + 868</td>
</tr>
<tr>
<td>Cotton</td>
<td>Glufosinate + glyphosate</td>
<td>451 + 868</td>
</tr>
<tr>
<td>Peanut</td>
<td>Bentazon + paraquat + NIS</td>
<td>561 + 140 + 0.25%</td>
</tr>
<tr>
<td>Soybean</td>
<td>Glyphosate</td>
<td>1,104</td>
</tr>
</tbody>
</table>
Methods and Materials

• Selected seedlings were covered to ensure protection
Methods and Materials

• Urea ammonium nitrate (32%) provided 2 WAP
  • Corn – 135 kg N ha\(^{-1}\)
  • Cotton – 67 kg N ha\(^{-1}\)
  • Peanut and Soybean – N/A
• Opposite from selected plants
Methods and Materials

• 3 WAP, 8 more plants were selected per plot
• Selected to ensure 2 m² weed free area around
• Plants selected on “wide-side” row-edge
• Kept weed-free with hoeing, mowing, and pulling

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</thead>
<tbody>
<tr>
<td>Corn</td>
<td>Glufosinate + glyphosate</td>
<td>451 + 947</td>
</tr>
<tr>
<td>Cotton</td>
<td>Glufosinate + glyphosate</td>
<td>451 + 947</td>
</tr>
<tr>
<td>Peanut</td>
<td>Acifluorfen + clethodim + COC</td>
<td>421 + 210 + 1%</td>
</tr>
<tr>
<td>Soybean</td>
<td>Acifluorfen + clethodim + COC</td>
<td>421 + 210 + 1%</td>
</tr>
</tbody>
</table>
Methods and Materials

• **Data collection**
  - Height - 2, 3, 5, 7, 9, 11, 13, 16 WAP
  - Width - 3, 5, 7, 9, 11, 13, 16 WAP
  - GDD$_{10}$ (Norsworthy et al. 2008)
  - Biomass
  - Seed production

• **RCBD with 4 replications**
Methods and Materials

• **SigmaPlot 13.0**
  - 4 parameter logistic model (Spaunhorst et al. 2018)
  - Height vs GDD_{10}

• **PROC GLIMMIX** (SAS 9.4)
  - Total height, biomass, seed production
  - Means separated according to Fisher’s protected LSD (P < 0.05)
Results
Results

Crop

\[ f_1 = \text{min} + \frac{\text{max} - \text{min}}{1 + \left(\frac{x}{\text{EC50}}\right)^{-\text{Hillslope}}} \]

\[ f = \begin{cases} \text{if}(x \leq 0, \text{if} \left(\text{Hillslope} > 0, \text{min}, \text{max}\right), f_1) \end{cases} \]

GDD

0 200 400 600 800 1000 1200 1400 1600 1800

Height (cm)

0

50
100
150
200
250

Corn

Cotton

Peanut

Soybean

\[ r^2 = 0.99 \]
Results

Crop

\[ f_1 = \min + \frac{\max - \min}{1 + \left(\frac{x}{\text{EC}_{50}}\right)^{-\text{Hillslope}}} \]

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Results

Crop

\[ f_1 = \min + \frac{\max - \min}{1 + \left( \frac{x}{\EC_{50}} \right)^{-\text{Hillslope}}} \]

\[ f = \begin{cases} \min, & \text{if } x \leq 0 \\ \max, & \text{if } \text{Hillslope} > 0 \\ f_1, & \text{otherwise} \end{cases} \]

GDD

0 200 400 600 800 1000 1200 1400 1600 1800

Height (cm)

0

50

100

150

200

250

Corn

Cotton

Peanut

Soybean

\[ r^2 = 0.99 \]
Results

Crop

\[ f_1 = \min + \frac{\max - \min}{1 + (x/EC_{50})^{-\text{Hillslope}}} \]

\[ f = \begin{cases} \min & \text{if } x \leq 0 \\ \max & \text{if } \text{Hillslope} > 0 \\ f_1 & \text{otherwise} \end{cases} \]

\[ GDD_{10} \]

0 200 400 600 800 1000 1200 1400 1600 1800

Height (cm)

0
50
100
150
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250

Corn
Cotton
Peanut
Soybean

\[ r^2 = 0.99 \]
Results

Crop
Results
Crop x gender biomass

- **Corn**: Biomass (G)
- **Cotton**: Biomass (G)
- **Peanut**: Biomass (G)
- **Soybean**: Biomass (G)
Results
Seed production (Field B9)

SEED PRODUCTION (000'S)

- Corn
- Cotton
- Peanut
- Soybean

Crop Science
Discussion

• **Height**
  • Corn > cotton > peanut = soybean
  • Females > males (Keeley et al. 1987; Korres et al. 2017; Webster and Grey 2015)

• **Growth rate**
  • Female = male
  • Corn > cotton > peanut = soybean
Discussion

• Biomass
  • Female > male in cotton and peanut (Webster and Grey 2015)
  • Cotton = peanut >> soybean = corn

• Fecundity
  • Cotton = peanut ≈ soybean > corn
Implications and Future research

• Implications
  • Cropping system may alleviate pressure..
  • Will this affect progeny?

• Future research
  • Repeat in 2019
  • Determine effects on progeny
Literature Cited


