Cover Crops for Integrated Weed Management in Soybean

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What is integrated weed management?

- Using multiple, complementary weed control practices

**Herbicides**
- Sequential
- Residual
- Multiple sites of action
- Well-timed

**Cultural practices**
- Crop rotation
- Cover crops
- Seeding date
- Row spacing
- Plant populations
- Good agronomic practices

Why integrated weed management?

- Herbicide resistance
- Sustainability?
- Herbicide resistance

Multiple resistant Palmer amaranth

Non-target-site resistance (Metabolic resistance)

Image: www.instructables.com/id/Fixing-Broken-Hammer/

Multiple resistant Palmer amaranth

- Nontreated
- Chlorsulfuron (Glean)
- Glyphosate
- Atrazine
- Lactofen (Cobra)
- Mesotrione (Callisto)
- 2,4-D
- Pyrambulate + bromoxynil (Huskie)

Shyam et al., 2019

Non-target-site resistance (Metabolic resistance)

- Cytochrome P450 structure: Otyepka et al 2011

- Herbicide
- Site of Action
- Susceptible
- Resistant
How cover crops control weeds

- Competition
- Allelopathy?
- Alter soil conditions

Allelopathic effect is inconsistent

<table>
<thead>
<tr>
<th>Large crabgrass height (inches)</th>
<th>Fresh residue</th>
<th>Leached residue</th>
<th>Leachate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer 2018</td>
<td>6.7</td>
<td>8.3</td>
<td>22</td>
</tr>
<tr>
<td>Fall 2019</td>
<td>1.1</td>
<td>0.9</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Palmer amaranth germination

- Warmer soils increase germination
- Fluctuating temperatures increase germination
- Light exposure increases germination

Weed suppression is related to cover crop biomass accumulation

- No cover crop
- 1 week before planting
- Day of planting
- 1 week after planting

Postemergence Palmer amaranth control

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Active ingredient</th>
<th>Site of action (WSSA group)</th>
<th>Max. labeled height (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobra</td>
<td>lactofen</td>
<td>PPO inhibitor (14)</td>
<td>2</td>
</tr>
<tr>
<td>Engenia</td>
<td>dicamba</td>
<td>Synthetic auxin (4)</td>
<td>4</td>
</tr>
<tr>
<td>Liberty</td>
<td>glufosinate</td>
<td>Glutamine synthetase inhibitor (10)</td>
<td>5</td>
</tr>
<tr>
<td>Reflex</td>
<td>fomesafen</td>
<td>PPO inhibitor (14)</td>
<td>4*</td>
</tr>
<tr>
<td>Resource</td>
<td>flumicloric</td>
<td>PPO inhibitor (14)</td>
<td>4*</td>
</tr>
<tr>
<td>Ultra Blazer</td>
<td>acifluorfen</td>
<td>PPO inhibitor (14)</td>
<td>4</td>
</tr>
</tbody>
</table>

*Label reads “6 true leaves”

Integrated pigweed management in soybean

- 2 years, 3 locations
- Row-width, cultivation, cover crop, herbicides
Integrated pigweed management in soybean

- Herbicide program provided excellent weed control
- Row width had limited affect on pigweed
- Cover crop generally reduced Palmer amaranth growth

Palmer Amaranth Growth Reduction 8 WAP by Winter Wheat - Manhattan

Palmer Amaranth Growth Reduction 8 WAP by Winter Wheat - Hutchinson

Waterhemp Growth Reduction 8 WAP by Winter Wheat - Ottawa
Comparison

<table>
<thead>
<tr>
<th></th>
<th>Pigweed control</th>
<th>Cost per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbicide</td>
<td>97+%</td>
<td>$124.64</td>
</tr>
<tr>
<td>Winter wheat</td>
<td>0-62%</td>
<td>$99.09</td>
</tr>
<tr>
<td>Winter wheat with incentive</td>
<td></td>
<td>$62.73</td>
</tr>
<tr>
<td>Winter wheat with grazing</td>
<td></td>
<td>$77.59</td>
</tr>
<tr>
<td>WW with incentive and grazing</td>
<td></td>
<td>$41.26</td>
</tr>
</tbody>
</table>

Conclusions

- Herbicide resistance is changing the way we manage weeds
- Cover crops alone may be effective for some winter annual weeds, but do not adequately control key summer annual weeds
- Cover crops may enhance weed control by herbicides
  - Reduce density/biomass, slow emergence/growth

Cover Crop Use

<table>
<thead>
<tr>
<th>Percent of cropland</th>
<th>&lt;1%</th>
<th>1-4%</th>
<th>5-9%</th>
<th>&gt;10%</th>
</tr>
</thead>
</table>

Things we don’t know:

- How do cover crops affect season-long pigweed management compared to fall-applied herbicides?
- How do cover crops impact efficacy of residual herbicides?
- How will new herbicide resistant soybean systems affect economics of integrated pigweed management?