Influence Of Tillage Methods On Management Of *Amaranthus* Species In Soybean

Jaime Farmer, Vince Davis, Larry Steckel, William Johnson, Marx Loux, Jason Norsworthy and Kevin Bradley
Introduction

• The challenge of managing herbicide-resistant weeds has led to a renewed interest in cultural control methods like tillage for weed control

• Herbicide-resistant *Amaranthus* species are some of the most troublesome weed species in U.S. soybean production

• Further research is needed to understand the effects of different tillage types on weed seed distribution in the soil seedbank

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Objectives

1. Determine the effects of four tillage treatments, with and without residual herbicide programs, on season-long emergence of *Amaranthus* species in glufosinate-resistant soybean.

2. Determine the effects of four tillage treatments on the vertical distribution of weed seed in the soil profile.
Materials and Methods

• Identical field trial conducted in 2014 in Arkansas, Illinois, Indiana, Ohio, Tennessee, Wisconsin, and Missouri (2 sites)

• Tillage Treatments Evaluated:
  1. Deep Tillage: fall moldboard plow fb spring pass w/field cultivator
  2. Conventional Tillage: fall chisel plow fb spring pass w/field cultivator
  3. Minimum Tillage: one pass of a vertical tillage tool in the spring
  4. No-Tillage: burndown herbicide at about same time as spring tillage
Field Trial Locations

Soybeans 2013 Production by County for Selected States

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Materials And Methods

Each tillage treatment also received two herbicide treatments:

1. **Residual Program**: Preemergence (PRE) application of flumioxazin followed by postemergence (POST) application of glufosinate + S-metolachlor

2. **POST-only**: POST applications of glufosinate during the season

Split-plot arrangement of treatments with four replications:

- Whole Plots → tillage types
- Sub-plots → herbicide treatments
Materials And Methods

• Weed counts taken in two, 1-m² quadrats within the middle two rows of each plot every 2 weeks following planting up to R6 stage or soybean senescence

• After each count, the entire trial was sprayed with glufosinate and emerged seedlings were removed to ensure no weed escapes
Materials And Methods

• 6 soil cores taken to a depth of 25-cm from each plot in the spring after tillage and prior to planting and herbicide application

• Soil cores cut into six sections corresponding to depths of 0-1, 1-5, 5-10, 10-15, 15-20 and 20-25 cm

• Soil segments were pulverized and spread as a thin layer of topsoil over commercial potting medium

• Emerged weed seedlings counted, identified to species, then removed every two weeks

• Seedling emergence monitored over 3 months
Influence of Tillage Type and Herbicide Program on Cumulative Waterhemp Emergence (Columbia, Missouri 2014)

**Tillage Type**

- **No-Till**
  - Residual Program: 398
  - POST-only: 657
- **Minimum**
  - Residual Program: 378
  - POST-only: 571
- **Conventional**
  - Residual Program: 60
  - POST-only: 595
- **Deep**
  - Residual Program: 18
  - POST-only: 66

*Bars represent the standard error of the mean.*
Influence of Tillage Type and Herbicide Program on Cumulative Waterhemp Emergence (Moberly, Missouri 2014)

*Bars represent the standard error of the mean.*

<table>
<thead>
<tr>
<th>Tillage Type</th>
<th>Residual Program</th>
<th>POST-only</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-Till</td>
<td>364</td>
<td>609</td>
</tr>
<tr>
<td>Minimum</td>
<td>164</td>
<td>726</td>
</tr>
<tr>
<td>Conventional</td>
<td>121</td>
<td>304</td>
</tr>
<tr>
<td>Deep</td>
<td>30</td>
<td>253</td>
</tr>
</tbody>
</table>

Total Waterhemp Emerged (#/m²)
Influence of Tillage Type and Herbicide Program on Cumulative Waterhemp Emergence (Belleville, Illinois 2014)

*Bars represent the standard error of the mean.*
Influence of Tillage Type and Herbicide Program on Cumulative *Amaranthus* Species Emergence (Lafayette, Indiana 2014)

*Bars represent the standard error of the mean.*

<table>
<thead>
<tr>
<th>Tillage Type</th>
<th>Residual Program</th>
<th>POST-only</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-Till</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>Conventional</td>
<td>0</td>
<td>24</td>
</tr>
</tbody>
</table>

Total *Amaranthus* Species Emerged (#/m²)
Influence of Tillage Type and Herbicide Program on Cumulative Palmer Amaranth Emergence (Jackson, Tennessee 2014)

*Bars represent the standard error of the mean.*
### Summary of the Effects of Different Tillage Systems on *Amaranthus* Species Emergence

<table>
<thead>
<tr>
<th>Location</th>
<th>Minimum Tillage</th>
<th>Conventional Tillage</th>
<th>Deep Tillage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missouri (Columbia)</td>
<td>26% ↑</td>
<td>38% ↓</td>
<td>92% ↓</td>
</tr>
<tr>
<td>Missouri (Moberly)</td>
<td>8% ↓</td>
<td>66% ↓</td>
<td>71% ↓</td>
</tr>
<tr>
<td>Illinois</td>
<td>313% ↑</td>
<td>175% ↑</td>
<td>44% ↓</td>
</tr>
<tr>
<td>Indiana</td>
<td>N/A</td>
<td>60% ↓</td>
<td>N/A</td>
</tr>
<tr>
<td>Tennessee</td>
<td>80% ↓</td>
<td>80% ↓</td>
<td>85% ↓</td>
</tr>
</tbody>
</table>

----- % Increase/Decrease Compared to No-till -----
Evaluation of the Vertical Distribution of *Amaranthus* Seed in the Soil Profile
**Percentage Of Waterhemp Emerged By Depth**  
*(Columbia, Missouri)*

<table>
<thead>
<tr>
<th>Tillage Type</th>
<th>0-1 cm</th>
<th>1-5cm</th>
<th>5-10cm</th>
<th>10-15cm</th>
<th>15-20cm</th>
<th>20-25cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep</td>
<td>18</td>
<td>13</td>
<td>62</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional</td>
<td>30</td>
<td>18</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>35</td>
<td>12</td>
<td>43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No-Till</td>
<td>44</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Bars represent the standard error of the mean.*
Percentage Of Waterhemp Emerged By Depth
(Moberly, Missouri)

![](chart)

*Bars represent the standard error of the mean.*
## Percentage Of Waterhemp Emerged By Depth

*(Belleville, Illinois)*

<table>
<thead>
<tr>
<th>Depth</th>
<th>Deep</th>
<th>Conventional</th>
<th>Minimum</th>
<th>No-Till</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 cm</td>
<td>40</td>
<td>12</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>1-5 cm</td>
<td>40</td>
<td>29</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>5-10 cm</td>
<td>20</td>
<td>0</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>10-15 cm</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15-20 cm</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20-25 cm</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Bars represent the standard error of the mean.*
Summary of the Effects of Different Tillage Systems on the Vertical Distribution of *Amaranthus* Species in the Soil Profile

<table>
<thead>
<tr>
<th>Tillage Type</th>
<th>Depth in the Soil Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-5 cm</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>No-till</td>
<td>71 to 81%</td>
</tr>
<tr>
<td>Minimum Tillage</td>
<td>77 to 100%</td>
</tr>
<tr>
<td>Conventional Tillage</td>
<td>71 to 77%</td>
</tr>
<tr>
<td>Deep Tillage</td>
<td>20 to 25%</td>
</tr>
</tbody>
</table>

-------- % of the Total Seed Emerged --------

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Conclusions

• Deep tillage treatments can be a useful tool for managing herbicide-resistant *Amaranthus* species by placing these seeds deep in the soil profile.

• Minimum tillage implements such as vertical tillage tools are less effective than conventional and deep tillage at distributing weed seed below the top 5-cm of the soil profile.
Thanks To The Many Individuals Who Have Worked Hard On This Study!

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