Seedbank dynamics and long term integrated weed management

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Outline

- What is a seedbank and why should we care about it?
- Environmental signals triggering weed seed germination
- Weed emergence patterns and control timing
- Off season control
- Don’t forget...!
What is a seedbank?

- All viable seeds present in the soil
- It is the “real” weed problem in your farm
- Weeds emerging each year are just a fraction of the total number of weed seeds present
<table>
<thead>
<tr>
<th>Species</th>
<th># seeds/ft²</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foxtail</td>
<td>52</td>
<td>0-560</td>
<td></td>
</tr>
<tr>
<td>Lambsquarters</td>
<td>219</td>
<td>0-588</td>
<td></td>
</tr>
<tr>
<td>Velvetleaf</td>
<td>8</td>
<td>0-115</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Mirsky et al. 2010
What is a seedbank?

- Unlike your bank account, you want it to be empty!!!!
- What can we do to deplete the weed seedbank?
Seed dormancy

- Seed dormancy is the driving force for seedbank formation
  - Dormant seeds are incapable of germinating under favorable conditions

- Seeds can reduce or eliminate their dormancy and initiate germination in response to environmental signals:
  - Temperature fluctuation (sensing soil depth)
  - Light exposure
  - Proper soil moisture and temperature

- Crop management practices can modify those signals
Effect of light exposure during tillage on weed emergence

Buhler. 1997
Soil disturbance helps deplete weed seedbank

Adapted from Mulugeta and Stoltenberg, 1997.
Emergence patterns

- Most weed species emerge during an extended period of time
  - Differences in dormancy level
  - Soil variability

- Direct impact on weed control timing and success
Tillage modifies weed emergence patterns

**Tillage:**
- More temperature fluctuation
- Weed seed distribution within soil profile
- Fewer seeds in the bank
- More seeds in “safe sites”
- Erosion problems and reduction in organic matter

**No-tillage:**
- More plant residues
- Delays soil warming during spring
- More soil moisture
- Slower and longer emergence patterns
- More seeds in the bank
- Fewer seeds in “safe sites”
Seed distribution within soil profile

Emergence patterns in waterhemp

- **No-tillage**
  - Ames
  - Everly
  - Ohio

- **Chisel Plow**
  - Ames
  - Everly
  - Ohio

- **Moldboard Plow**
  - Ames
  - Everly
  - Ohio

**Graphs**: Seedlings per m² over Date (4/25 to 7/18).
Control timing

# weeds emerged / day

April May June July

Early planting Delayed planting
Control timing

Cumulative emergence (%)

April May June July

Early planting

Delayed planting
Control timing

- Early planting
- Weed control
- Weed control

# weeds emerged / day

Stopping seedbank increase
Seedbank increases

- Preventing weed competition is usually the main goal.

- For long term weed control, preventing weed seed production should be equally important.

- Good early season control does not translate into reductions in weed seedbanks if weeds escaping control are allowed to produce new seeds.
Off season control

- After harvest weed control
  - Mechanical or chemical
  - Broad spectrum options
  - Be careful with herbicide applications on flowering weeds
  - Likely not to kill the plants, but it might reduce seed production
  - Cost/benefit not clear yet

- Mowing timing considering weed flowering
  - Cover cropping
  - Dense canopies
Sicklepod seed production after late-season herbicide applications

**Glufosinate**

<table>
<thead>
<tr>
<th>% Control (3 WAT)</th>
<th>Application Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate (kg ai/ha)</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>0.105</td>
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</table>

**Dicamba**

<table>
<thead>
<tr>
<th>% Control (3 WAT)</th>
<th>Application Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate (kg ai/ha)</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>1.1</td>
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<td></td>
<td>0.56</td>
</tr>
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<td></td>
<td>0.28</td>
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</table>

Assessing the success of your weed management

- Weed seedbanks should decrease over time
- The only way to know is to let weeds emerge (no PRE herbicides)
- Make sure that weed populations “look” under control
- Promote early weed emergence if irrigation, tillage or reduced-tillage are part of your production system
- Be ready to control with POST actions
Don’t forget, for long term weed management, the goals are:

- Promote "withdrawals" (seed germination and decay)
- Prevent "deposits" (reduce new seed production)
Conclusions

- The seedbank is the “real” weed problem in your farm
- Agricultural management practices can promote weed seed germination, mortality or persistence
- In order to reduce weed seedbanks it is important to promote germination and especially prevent new seed production
- Reductions in the seedbank should allow reductions in weed control cost in the long run
Questions?