LAYERED RESIDUAL HERBICIDES

Sarah Lancaster
Assistant Professor and Extension Specialist

Dicamba update - traits

• XtendFlex
• Resistant to
  • Dicamba
  • Glyphosate
  • Glufosinate
Herbicide registrations

**Corn**
- Impact Core
  - Impact + acetochlor
  - 20-40 fl oz/A through 11”
- AMS plus MSO
- Sinate
  - Impact + Liberty
  - 21-28 fl oz/A through V7/24”
  - AMS plus MSO or HSOC

**Soybean**
- Kyber
  - Same products as Fierce MTZ (pyroxasulfone + flumioxazin + metribuzin)
- Panther MTZ
  - Same products as Dimetric Charged (metribuzin + flumioxazin)

http://www.xtendimaxapplicationrequirements.com/#/vralist
Other label updates

- Anthem Flex – sunflowers and soybean added to label
- Anthem Maxx – apply through V6 soybean (was V3)
- Authority Edge – soybean and sunflower added to label
- BroadAxe – rotation restriction for dry beans added (4 months)
- Outlook – increase to 31 fl oz/A/yr (was 21 fl oz/A/yr)
- Zidua – apply through V8 corn (anticipated)

Atrazine registration review

- Interim decision released Sept 2020
- Two more assessments
  - Endangered species assessment (deadline 9/28/21)
  - Endocrine disruptor screening
- Changes most likely to affect Kansas farmers
  - 15 MPH weed speed restriction
  - 5-foot buffer from edge of streams/rivers and endangered species habitat
  - Medium-sized droplets or larger
What are the two most challenging weeds in your crops?

Corn herbicide application calendar

- **Fall**: Control emerged winter annuals
- **EPP**: If no fall applications
- **PRE**: Spend your money HERE
- **EPOST**: Plan to apply 21-28 days after PRE
- **LPOST**: Scout fields to determine need
Residual herbicide activity

Herbicide persistence

- The length of time a herbicide is active in soil
- Needs to be in a ‘sweet spot’ for residual herbicides
  - Want extended control
  - Don’t want carryover
Herbicide persistence

- Described by the half-life (t₁/₂)
- Time required for one-half of the herbicide to dissipate

Half-life of some residual herbicides

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Example</th>
<th>SOA group</th>
<th>Half-life</th>
<th>Control duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pendimethalin</td>
<td>Prowl H₂O</td>
<td>3</td>
<td>44 d</td>
<td></td>
</tr>
<tr>
<td>Atrazine</td>
<td>Aatrex 4L</td>
<td>5</td>
<td>60 d</td>
<td></td>
</tr>
<tr>
<td>Acetochlor</td>
<td>Harness</td>
<td>15</td>
<td>4-20 d*</td>
<td>8-12 weeks</td>
</tr>
<tr>
<td>S-metolachlor</td>
<td>Dual II Magnum</td>
<td>15</td>
<td>30-50 d</td>
<td>10-14 weeks</td>
</tr>
<tr>
<td>Dimethenamid-P</td>
<td>Outlook</td>
<td>15</td>
<td>20 d</td>
<td></td>
</tr>
<tr>
<td>Pyroxasulfone</td>
<td>Zidua</td>
<td>15</td>
<td>16-26 d</td>
<td></td>
</tr>
<tr>
<td>Flumioxazin</td>
<td>Valor</td>
<td>14</td>
<td>12-18 d</td>
<td></td>
</tr>
<tr>
<td>Saflufenacil</td>
<td>Sharpen</td>
<td>14</td>
<td>1-36 d</td>
<td></td>
</tr>
<tr>
<td>Ioxaflutole</td>
<td>Balance Flexx</td>
<td>27</td>
<td>0.5-2.4 d</td>
<td></td>
</tr>
</tbody>
</table>

Herbicide Handbook, 2014
Ma et al., 2004
Microbial degradation

- Influenced by:
  - Sorption
  - Previous applications

Taylor-Lovell et al. 2002

Microbial degradation

- Influenced by:
  - Moisture

Taylor-Lovell et al. 2002
Microbial degradation

- Influenced by:
  - Soil temperature

---

Residual herbicide activity

- POST WEED EMERGENCE
- Residual herbicide
- Crop canopy

- May
- June
- July
- Aug

Adapted from Hartzler and Anderson 2019

Martín-Benito et al. 2019
Weed escapes still produce seed

Up to 7 MILLION seeds per acre

Residual herbicide activity

Adapted from Hartzler and Anderson 2019
Which herbicides have you used as a layered residual?
## Herbicides to consider as layered residuals

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Example</th>
<th>SOA group</th>
<th>Activation</th>
<th>Crop</th>
<th>Restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrazine</td>
<td>Aatrex 4L</td>
<td>5</td>
<td>NA</td>
<td>Corn, Grain sorghum</td>
<td>12&quot; 2-5 lf</td>
</tr>
<tr>
<td>Acetochlor</td>
<td>Harness</td>
<td>15</td>
<td>1/4-3/4&quot;</td>
<td>Grain sorghum, Soybean</td>
<td>11&quot;** 11&quot; R2</td>
</tr>
<tr>
<td>S-metolachlor</td>
<td>Dual II Magnum</td>
<td>15</td>
<td>1/2-1&quot;</td>
<td>Grain sorghum, Soybean</td>
<td>12&quot; 75 d PHI V3</td>
</tr>
<tr>
<td>Dimethenamid-P</td>
<td>Outlook</td>
<td>15</td>
<td>NA</td>
<td>Corn, Grain sorghum, Soybean</td>
<td>12&quot; 12&quot; V5</td>
</tr>
<tr>
<td>Pyroxasulfone</td>
<td>Zidua</td>
<td>15</td>
<td>1/2&quot;</td>
<td>Corn, Soybean</td>
<td>V4** V6</td>
</tr>
<tr>
<td>Mesotrione</td>
<td>Callisto</td>
<td>27</td>
<td>1/4&quot;</td>
<td>Corn</td>
<td>V8</td>
</tr>
</tbody>
</table>

*Warrant = 30"  
**V8 anticipated

---

### Weed control 60 DAP

#### Warrant (2.5 qts/A)

![Weed control chart](chart.png)

- Control (%): 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100
- Time Points: 14 DBP, PRE, PRE fb EPOST, PRE fb LPOST, PRE fb EPOST fb LPOST
- Herbicide Types: Waterhemp, Velvetleaf, Grass Foxtail

- Jhala et al. 2015
Common waterhemp control
4, 8, & 16 WAP

Is 95% control enough?
Palmer amaranth example

Seed rain year 1

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>350,000 seeds acre × 20%</td>
<td>70,000 viable seeds acre</td>
</tr>
</tbody>
</table>

Plants emerged year 2

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>70,000 seeds × 40%</td>
<td>28,000 plants acre</td>
</tr>
</tbody>
</table>

Plants escaped year 2

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>28,000 plants × 95%</td>
<td>1,400 plants acre</td>
</tr>
</tbody>
</table>

Resistant plants year 2

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1,400 plants × 84%</td>
<td>1,176 plants acre</td>
</tr>
</tbody>
</table>

Seed rain from resistant plants year 2

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1,176 plants × 487 seeds plant</td>
<td>572,712 seeds acre</td>
</tr>
</tbody>
</table>
Is 95% control enough?
Marestail example

<table>
<thead>
<tr>
<th>Step</th>
<th>Calculation Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed rain year 1</td>
<td>74,800 ( \text{seeds/acre} \times 30% = 22,500 \frac{\text{viable seeds}}{\text{acre}} )</td>
</tr>
<tr>
<td>Plants emerged year 2</td>
<td>22,500 ( \text{seeds} \times 80% = 18,000 \frac{\text{plants}}{\text{acre}} )</td>
</tr>
<tr>
<td>Plants escaped year 2</td>
<td>18,000 ( \text{plants} \times 95% = 900 \frac{\text{plants}}{\text{acre}} )</td>
</tr>
<tr>
<td>Resistant plants year 2</td>
<td>900 ( \text{plants} \times 50% = 450 \frac{\text{plants}}{\text{acre}} )</td>
</tr>
<tr>
<td>Seed rain from resistant plants year 2</td>
<td>450 ( \text{plants} \times 900 \frac{\text{seeds}}{\text{plant}} = 405,000 \frac{\text{seeds}}{\text{acre}} )</td>
</tr>
</tbody>
</table>

Marestail control in Enlist soybean

- Control or injury (%)

- Control on Enlist + RUPM fb with Perpetuo:
  - Enlist + RUPM
  - Enlist + RUPM + Fierce EZ fb
  - Enlist + RUPM + Authority MTZ fb
  - Enlist + RUPM + Anthem Maxx
  - Enlist + RUPM + Perpetuo

- Control on Enlist + RUPM fb without Perpetuo:
  - Enlist + RUPM fb
  - Enlist + RUPM + Fierce EZ fb
  - Enlist + RUPM + Authority MTZ fb
  - Enlist + RUPM + Anthem Maxx
  - Enlist + RUPM + Perpetuo

- 5 WAP