Field pennycress (Thlaspi arvense) Response to Simulated Carryover of Group 15 Herbicides in the Greenhouse

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Introduction

- Field pennycress, also known as stinkweed, is a winter annual, and is being cultivated as an oilseed cover crop to be grown after corn and before soybean.
- Herbicides used in commercial agriculture for control of grass and broadleaf weeds pose a danger to field pennycress production, and there is a lack of data on herbicide carryover for pennycress stand establishment.
- Dose response studies may be used to simulate herbicide degradation in the soil, and identify herbicide levels that will not negatively impact a cover crop (Heaton & Bernards 2016).

Hypothesis and Objective

Hypothesis: Field pennycress stand will be reduced by Group 15 herbicide carryover.

Objective: To determine field pennycress sensitivity to Group 15 herbicide carryover using simulated half-life doses in the greenhouse.

Methods

- Dose response experiments were conducted in the Spring and repeated in the Fall of 2020 in Western Illinois University’s Agronomy Farm’s Greenhouse.
- The greenhouse was set to a 15:9 h day:night with a temperature of 25±5 C.
- An Ipava silt loam soil was modified at 4 parts soil, 1 part perlite, and 1 part sand to improve drainage. Approximately 15 seeds of pennycress variety ‘ARV1’ were planted in 10x10 cm pot and watered immediately prior to herbicide application.
- Herbicide treatments (Table 1) were sprayed using a single-tip chamber sprayer with nozzle 8002EVs at an application volume of 180 L ha⁻¹.
- The experiment was arranged as a randomized complete block design with six replications.
- Stand counts and visual estimations of chlorosis and necrosis were made 21 days (~3 weeks) after initial spray application was made.
- Data was analyzed using proc glimmix in SAS 9.4. Data from the Spring and Fall applications were combined and a linear regression model was fit to the data.

Results

Figure 1 (above and right). Pennycress stand 3 weeks after planting as affected by seven herbicide active ingredients and five simulated half-life doses.

Table 1. Herbicide active ingredients, half-life, and the rates used in the dose-response study.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Half-life (days)</th>
<th>Rate 1 (g a.i/ha)</th>
<th>Rate 2 (g a.i/ha)</th>
<th>Rate 3 (g a.i/ha)</th>
<th>Rate 4 (g a.i/ha)</th>
<th>Rate 5 (g a.i/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-metolachlor</td>
<td>2.5 to 289</td>
<td>447</td>
<td>224</td>
<td>111</td>
<td>55.7</td>
<td>27.8</td>
</tr>
<tr>
<td>acetochlor</td>
<td>30 to 20</td>
<td>550</td>
<td>276</td>
<td>137</td>
<td>68.7</td>
<td>34.3</td>
</tr>
<tr>
<td>pyroxasulfone</td>
<td>36 to 26</td>
<td>25.7</td>
<td>14.8</td>
<td>7.4</td>
<td>3.7</td>
<td>1.85</td>
</tr>
<tr>
<td>dimethenamid</td>
<td>7 to 42</td>
<td>236</td>
<td>118</td>
<td>59</td>
<td>29.6</td>
<td>14.8</td>
</tr>
<tr>
<td>clopyralid</td>
<td>12 to 70</td>
<td>33.3</td>
<td>16.6</td>
<td>8.3</td>
<td>4.15</td>
<td>2.07</td>
</tr>
<tr>
<td>dicamba</td>
<td>&lt;14</td>
<td>70</td>
<td>35</td>
<td>17.5</td>
<td>8.7</td>
<td>4.37</td>
</tr>
<tr>
<td>2,4-D</td>
<td>6.2</td>
<td>66.6</td>
<td>33.3</td>
<td>16.6</td>
<td>8.3</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2. Field pennycress growing in the greenhouse on 10 Nov 2020.

Figure 3. Pots in the spray chamber prior to application.

Discussion

- We accept the hypothesis because field pennycress stand increased as Group 15 herbicide dose decreased.
- The average stand count in the untreated check was 11 plants pot⁻¹.
- Based on a typical application time of Group 15 herbicides (no later than early June in corn) and pennycress planting (after September 1), herbicide concentrations will likely be 1/8th to 1/32nd of the applied dose (3 to 5 half-life periods).
- Pyroxasulfone most negatively affected pennycress stand among the Group 15 herbicides, and 2,4-D among the Group 4 herbicides. Clopyralid and dicamba had no effect on pennycress stand at doses equal to what would be expected after 3 half-life periods.
- Future research should include dose-response studies with multiple active ingredient corn herbicides.

Works cited


Acknowledgements

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