Factors affecting pyroxasulfone behavior in soil

Several products (Anthem, Fierce and Zidua) containing pyroxasulfone have been labeled for use in corn, and recently Fierce and Zidua received registration for soybean. Pyroxasulfone is a Group 15 herbicide with similar uses and activity as other products in this group (Dual, Harness, Outlook, etc.). This article discusses characteristics that differentiate pyroxasulfone from other Group 15 products.

Although pyroxasulfone is from a different chemical family than other Group 15 herbicides, its behavior in soils and plants is similar to older herbicides with this site of action. The major difference between pyroxasulfone and other Group 15 herbicides is a higher specific activity, therefore allowing lower use rates. The maximum labeled rate of pyroxasulfone is 3.0 oz a.i./A, whereas dimethenamid-P (Outlook) and s-metolachlor (Dual II Magnum) are labeled up to 16.0 and 26 oz a.i./A on soybean, respectively. All of the Group 15 herbicides have good activity on most small-seeded annual grasses and broadleaves.

Preemergence herbicides must be present at a toxic concentration within the soil profile where weed seeds germinate (0-1” for most weeds) to provide effective control. Rainfall serves two functions with preemergence herbicides: 1) move the herbicide to the proper depth of the soil profile, and 2) dissolve the herbicide so it is available for absorption by plants. The chemical properties that have the biggest influence on these factors are adsorption to soil colloids and persistence. Pyroxasulfone has a much lower water solubility than other Group 15 herbicides, yet in Colorado State University research it was more mobile than s-metolachlor (Table 1).

The reason for the greater mobility of pyroxasulfone in spite of low water solubility is that it has a lower sorption coefficient (Kd) than metolachlor, and this determines a herbicides mobility in soil more than water solubility. The higher a Kd, the more tightly the herbicide is bound to soil colloids (organic matter and clay). Binding to soil colloids reduces both leaching and availability of the herbicide to plants. Water solubility is less important than the Kd due to the low use rates of herbicides. When there is sufficient water for plants to grow, there is enough water for most herbicides to dissolve completely, regardless of their solubility.

Pyroxasulfone was more persistent than metolachlor in this research. While a long half-life is a benefit in extending weed control later into the season, other factors also determine residual activity. Length of weed control is determined by the rate applied, amount of binding to colloids, and the half-life.

A reasonable question is whether the differences in the Kd among the Group 15 herbicides will influence their performance in the field. A low Kd reduces the amount of rainfall needed to move the herbicide into the profile and may allow better performance during dry conditions. Conversely, a herbicide with a high Kd can be expected to perform better in years with above average rainfall since less herbicide will be leached out of the surface profile than a herbicide that binds less tightly to soils. However, the differences in Kd are small enough that under most conditions differences in performance will not be due to the availability of the herbicide within the soil profile. Rather, differences in the rates of herbicide applied, or differences in the specific conditions found between the fields where the products were used probably will be responsible for most differences observed in performance of the different Group 15 products.

Prepared by Bob Hartzler
March 15, 2013

Table 1. Properties of three Group 15 herbicides.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>H2O solubility</th>
<th>Kd</th>
<th>Half-life (days)</th>
<th>Mobility (% below 7.5 cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>dimethenamid-P</td>
<td>1450 mg L⁻¹</td>
<td>2.28</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>pyroxasulfone</td>
<td>3 mg L⁻¹</td>
<td>1.72</td>
<td>34</td>
<td>13</td>
</tr>
<tr>
<td>s-metolachlor</td>
<td>530 mg L⁻¹</td>
<td>4.01</td>
<td>22</td>
<td>6</td>
</tr>
</tbody>
</table>

²The Kd represents the average value tested on 25 soils.
³Half-life and mobility are means of two years data in an irrigated environment. The mobility data represents the percentage of herbicide that moved from the surface 7.5 cm of the soil into the 7.5 to 30 cm zone of the soil profile.