# UTILIZING HERBICIDE *Site of Action* TO COMBAT WEED RESISTANCE TO HERBICIDES

Individual herbicides may be grouped or classified into families according to common characteristics. For example, herbicide families can be classified according to application timing (PPI, PRE, POST), chemical structure (imidazolinones, chloroacetamides, etc.), and mode of action (photosynthetic inhibitor, growth regulator, etc.). While there will likely always be exceptions to any classification scheme, classifying herbicides into families can provide useful frameworks for understanding general commonalities.

| SITE OF ACTION | CHEMICAL FAMILY |
|---|---|
| Inhibitors of acetolactate synthase (ALS) | Sulfonylurea |
| | Imidazolinone |
| | Triazolopyrimidine |

**Figure 1.** Inhibitors of acetolactate synthase (ALS) include the sulfonylurea, imidazolinone, and triazolopyrimidine chemical families.

An appreciation of how and where herbicides work in plants can be valuable for planning weed management strategies that reduce the potential to select for herbicide-resistant weed biotypes. Herbicide mode of action (MOA) may be defined several ways, but essentially describes how the herbicide inhibits plant growth. Herbicide site of action (SOA), however, defines the exact location within the plant where the herbicide binds.Several herbicide MOA classification schemes have been proposed, but unfortunately they often lack uniformity with respect to how the families are named and which herbicides are included within each family. MOA family names such as "growing point disintegrator" and "cell membrane disrupter" have been used, but do not provided much detailed information about how or where these herbicides work within the plant. While an understanding of herbicide MOA is beneficial, classification of herbicides by their site of action may provide a more reliable classification scheme to design strategies that delay the development of herbicide-resistant weed biotypes. For example, classifying herbicide MOA as "inhibition of amino acid biosynthesis" places Roundup and Pursuit in the same family, whereas classification by SOA places these two herbicides into distinctly different families.

The development of herbicide-resistant weed biotypes is the result of sufficient selection pressure imposed on the weed population by repeated use of herbicides with similar modes/sites of action. The frequency of herbicide-resistant weed biotypes continues to increase in Illinois, with nine confirmed herbicide-resistant species to date. Worldwide, the problem also has dramatically increased during the past decade. While arguments persist about which strategies are better able to reduce the selection pressure for herbicide-resistant weed biotypes, understanding where herbicides act within the plant remains the first step to successful management of this problem.

The Weed Science Society of America (WSSA) and the Herbicide Resistance Action Committee (HRAC) have developed classification schemes based on herbicide site of action. While there are some minor differences between the two schemes, they both convey essentially the same information. We have adapted the WSSA herbicide site of action classification scheme (described by Mallory-Smith and Retzinger, 2003, Weed Technology 17:605-619) into a color-coded system. The column "Site of Action" lists each herbicide site of action individually with a "primary" color. Herbicide chemical families with similar sites of action are listed in shades of the respective primary color. For example, the site of action "Inhibitors of acetolactate synthase (ALS)" appears in red (see Figure 1). Three chemical families (sulfonylurea, imidazolinone, and triazolopyrimidine) share this site of action and each of these three chemical families appears in a shade of red.

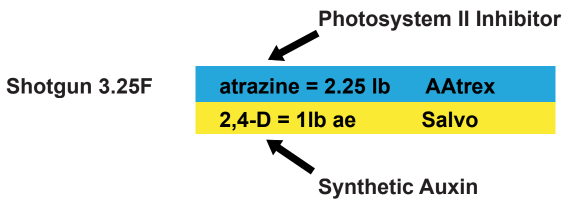


**Figure 2.** Herbicide premixes with distinctly different colors target more than one site of action.

Corn and soybean herbicide premixes (back cover) also are listed by site(s) of action, with identical (same site of action) or different (multiple sites of action) colors where appropriate. A herbicide premix example appears in Figure 2.

Rotation of herbicides with distinctly different colors, or using premixes with distinctly different colors, will help reduce the selection pressure to develop herbicide-resistant weed biotypes.

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