HOEGEMEYER™ Agronomy Services

Herbicide Resistance Management

In recent years more and more farmers have become aware of weeds that have become resistance to popular herbicide programs. As agricultural production continues to intensify farmers have increased their use of herbicides to manage weeds. In addition, farmers are relying more on continuous use of herbicides with similar modes of action (MOA) or even the same herbicide.

Farmers have been selecting and developing weed resistance since the late 50's when the first weeds were identified resistant to 2,4-D and atrazine. The number of weeds resistant to herbicides has grown to over 250 species worldwide. The number of species resistant to a given herbicide family range from over 70 species resistant to the triazines (i.e.: atrazine) and ALS/AHAS (i.e.: Glean, Spirit, Pursuit) herbicides, to just a handful for glyphosates, and only a couple of weeds for the chloroacetamide (i.e.: Dual, Harness) herbicides.

With the exception of a few new herbicide derivatives, only the newest herbicide family, the HPPD mode of action group, has not yet had any weeds identified as resistant. The only herbicides presently labeled in this class are isoxaflutole and mesotrione (Callisto). There has been only two new herbicide MOA's in the past 15 years, including glufosinate in 1994 and the HPPD's since 2000. It is unlikely that there will be any new herbicide MOA's launched within the next 8-10 years. The lack of new MOA's will put increased pressure on farmers to better manage the products we have today to prevent further losses in weed control options.

Weed resistance is defined as the inherited ability of a weed to survive a rate of herbicide, which would usually give effective control. There are differences in opinions on exactly what "use rate" defines resistance. Most researchers follow the WSSA's guidelines that once a weed is no longer controlled at a rate 6 times greater than before, it is considered resistant. For example, if 1 lb per acre provided effective control of a given weed, then if a portion of that weed's population could no longer be controlled at 6 lbs per acre, then the non controlled weeds would be considered resistant to that herbicide MOA.

One of the common misconceptions is that weeds "mutate" to become resistant to herbicide treatments. Weeds actually do not mutate very easily but primarily rely on their diverse genetic codes to select for resistance to a specific herbicide family. There are two typical ways that weed resistance develops within a population.

The first is through a simple selection process. In some weed species there exist a small number of weeds that have the inherent ability to bypass a given herbicide's mode of action. If a farmer makes a treatment and kills all but these "resistant" weeds, they remain to produce seed or pollinate with others. If the farmer continues to use the same single herbicide program for consecutive years, eventually these escaped weeds will build up a larger and larger portion of the field population – or natural selection.
The second method of developing weed resistance is through cross breeding similar to what seed companies use to develop traits. This occurs when plants within a weed population have different levels of "tolerance" to an herbicide MOA. When farmers use low or reduced rates of the herbicide, these tolerant plants can survive (escape) and cross breed to potentially develop a stronger trait in the next generation. If this pattern continues, this cross breeding will develop a stronger trait of

resistance in each subsequent generation, ultimately developing a population of resistant weeds. This is how Shattercane developed resistance to reduced rates of the ALS herbicides.

It is important to note that not all weeds have the ability to develop resistance, and not every herbicide MOA will develop resistant weeds equally. Herbicides with very specific sites of activity, like the ALS/AHAS herbicides, tend to have a greater likelihood of resistance selection. The more specific the herbicide site of activity, the higher the probability that a weed can bypass that herbicide's mode of action. By contrast, herbicides with a very complex MOA such as the chloroacetamides (i.e. Dual) have only two species that have selected for resistance in over 25 years of use.

Farmers that are at the greatest risks for developing resistance are those that:

- Use the same herbicide MOA continuously and exclusively (alone)
- Continuously plant the same crop i.e.. Corn on corn
- Use herbicides that have very specific sites of activity
- Have high population of weeds that have shown the potential of developing resistant biotypes, such as kochia, waterhemp, pigweed, lambsquarter, etc.
- Use reduced or below label use rates targeting 80-90% control levels
- Multiple treatments of the same herbicide over and over again

The good news, it is not very difficult for farmers to develop a strong sustainable weed resistance strategy. Preventing resistance does not mean eliminating herbicides that can select for resistance – that would severely limit a farmer's product choices. By following these guidelines, farmers can successfully reduce their risk of developing resistance weeds, even when resistance is present in their local area.

- Use full label use rates of herbicides, even in a tank mix
- Treat weeds early within timing, smaller weeds result in fewer "escapes"
- Prevent weeds from flowering or going to seed
- Use tank mix treatments with multiple modes of action on tough weeds
- Rotate MOA's between sequential treatments to break up cycles
- Use cultural controls such as tillage or crop rotations to break up cycles

Weed resistance is a growing treat to American agriculture. As fewer new herbicides are developed, there is an increased need to manage the tools that we have. The increased adoption of GMO crops puts increased weed resistance pressures on a select group of herbicides, significantly reducing their long term input value.

By adopting the simple herbicide resistance strategies above, farmers can help prolong the use of these valuable tools. A good resistant strategy can incorporate several herbicide groups including GMO technology into a long term sustainable system. Use each herbicide where it provides the greatest value while using sequential or tank mixes to improve control. Incorporating a resistance strategy can lead to improved performance and value, otherwise "If you abuse it, you will lose it!"