HERBICIDE RESISTANCE

Herbicide resistance is the ability of a weed biotype to survive and reproduce after treatment with herbicides that would typically have been lethal. The development of herbicide resistance poses three serious problems:

1. It is very expensive and time consuming to test for and to develop alternative management plans
2. Develop management techniques to continue utilizing current herbicides and protect them against resistance development. Few new active ingredients are being discovered and developed into commercial products due to their high costs of development.
3. Development of herbicide resistance in a biotype limits weed management options and creates economic consequences.

Like all organisms, random genetic mutations occur within plant populations. These mutations are often at very low frequencies. For herbicide resistance, a single plant in several million may have a mutation to survive a herbicide treatment. Herbicide applications do no cause for the development of the genetic mutations; applications create selection pressure that favors the spread of resistant biotypes.

Cross resistance can occur within weed populations. For example, wild oats resistant to diclofop ACCase inhibitor may also be resistant to other ACCase inhibitors within the Group 2 family of herbicides. It is important to use another herbicide group with a different mode of action.

Factors that control development of resistant weeds;

1. Selection Pressure.
   - If highly effective and applied often, has long soil residual activity, and is the only practice utilized to control a weed species, high selection pressure is placed for resistant biotypes of a weed.
2. Weed biology.
   a. Genetic variability – some plant species have high genetic variability meaning that many different varieties or biotypes exist under the one species. Cross pollinating species like kochia have greater genetic variability that self-pollinating species. Weeds with higher genetic variability generally develop resistance quicker, since chances are there are more resistant biotypes within a population prior to spraying.
   b. Seed longevity – plant species that produce long-lived seed tend to develop resistance more slowly. This is because susceptible seeds from the seedbank germinate over many years adding variation to the population.
3. Genetics of resistance.
   - This is regarding the site of action of the herbicide on the plant. There are differences pertaining to the frequency mutations occur at different biological target sites within plants. Sites that have high frequency of mutation, tend to develop quickly, for example the site of action of ALS inhibitors can develop resistance with 3 or 4 years of continuous use since the target site is highly variable. In contrast, the target site of glyphosate do not mutate as often. Glyphosate resistance does not exist, but it took many years to develop.

To prevent and manage existing herbicide resistant biotypes requires an integrative approach.

1. **Monitor Results** - Scout for resistant biotypes following herbicide applications. If you suspect herbicide resistance, have the field tissue sampled and tested.
2. **Integrated Weed Control -** Minimize reliance on herbicides. Combine control tools such as mechanical, cultural, and biological with chemical. Monitor weeds and make applications based on actual weed populations and when the infestations exceed economic thresholds.
3. **Rotate crop types –** Crop rotations allow for a rotation of herbicide types. Don't plant uncompetitive crops two years in a row on a field.
4. **Tank Mix** herbicides with different modes of action. The tank mix can delay the development of resistant weeds it the components control the same weed with different modes of actions. The chemicals used should have activity against potentially herbicide resistant biotypes.
5. **Use herbicides with short residual activity**
6. **Herbicide Rotation –** Herbicides must be rotated. It is important not only to utilize different herbicides, but herbicides with different modes of action. Do not make more than two consecutive herbicide applications to a field using the same herbicide or a herbicide with the same mode of action.
7. **Utilize post-harvest weed control** - It reduces weed seed production, controls perennials and prevents worse infestations for the following year.
8. **Equipment Sanitation** - Clean equipment to prevent the spread of herbicide resistant weed seed.

SOURCE: Montana Herbicide Resistance Guide

For an up-to-date list of herbicide resistant weeds across the Provinces check out the Weed Science website.

http://www.weedscience.org/Summary/UniqueCountry.asp?lstCountryID=7&FmCountry=Go

TEMPERATURE AND HERBICIDES

Herbicides are most effective when applied to vigorously growing plants at 21-27°C. Weather conditions influence how plants metabolize herbicides and many labels advise against applying herbicides when plants are under stress. Applications to stressed plants can result in crop injury and/or decreased weed control.

To accommodate for either temperature extremes changes can be made to the tank mix and the sprayer settings to optimize weed control across different environmental conditions.

Under hot, dry conditions plants are trying to conserve water. In doing so, plants develop a waxy layer (cuticle) on the leaf surface to prevent evaporation of water from the leaves. This cuticle also serves as a barrier to herbicide absorption. Under extreme drought conditions, the leaves may roll up to minimize moisture loss making herbicide coverage and uptake difficult. Under these conditions, herbicide movement may also be slower within the plant. Consequently, applications under these conditions results in reduced weed control.

Reduced weed control under hot and dry conditions is more of a concern for systemic herbicides, such as 2,4-D, Puma and Roundup.

Application of systemic herbicides early in the morning when the plants have recovered from the heat of the previous day will result in better control than an application made later in the day. Adjuvants, where recommended, can also help improve weed control.

For the most part, contact herbicides (Buctril M for example) become more active as temperature increases. Although this may result in better weed control, crop injury can result. Caution needs to be taken as temperatures reach 29°C and above. It is important to remember that appropriate application timing is critical with contact herbicides. Optimal control is achieved when made to small weed seedlings. Under high temperatures, delaying spraying until it is cooler can result in the weeds growing beyond the best time for application. Lowering the herbicide rate can help reduce crop injury, even in temperatures above 31°C. The hour's immediately following application of contact herbicides is the most critical for crop injury. Injury can be minimized if applications are made in the evening after temperatures has decreased.