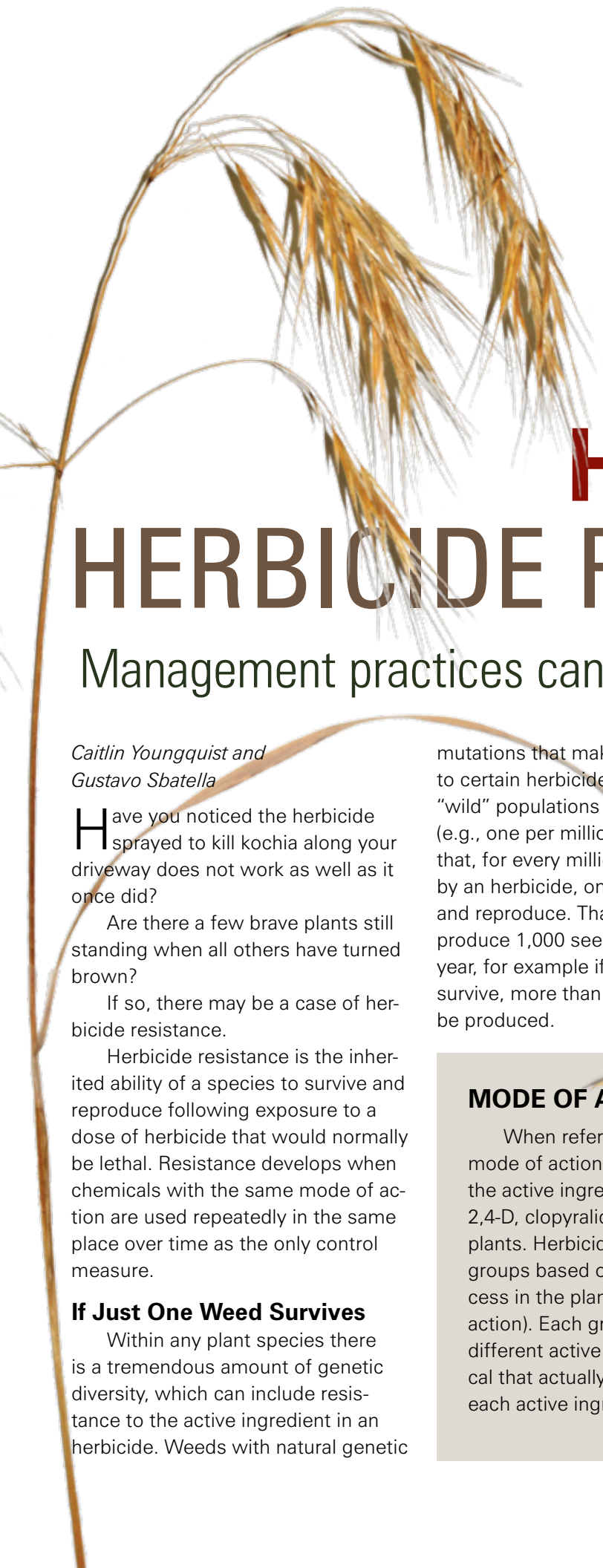


HELP HALT HERBICIDE RESISTANCE

Management practices can nip pesky weeds in the bud

Caitlin Youngquist and Gustavo Sbatella

Have you noticed the herbicide sprayed to kill kochia along your driveway does not work as well as it once did?

Are there a few brave plants still standing when all others have turned brown?

If so, there may be a case of herbicide resistance.

Herbicide resistance is the inherited ability of a species to survive and reproduce following exposure to a dose of herbicide that would normally be lethal. Resistance develops when chemicals with the same mode of action are used repeatedly in the same place over time as the only control measure.

If Just One Weed Survives

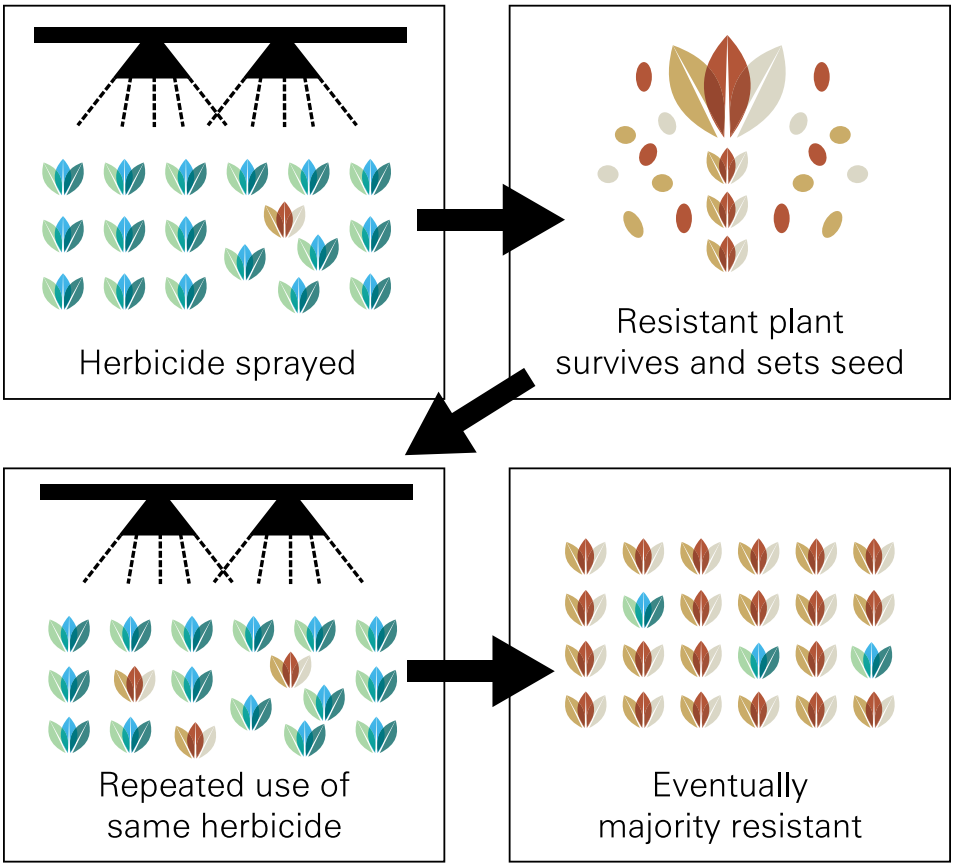
Within any plant species there is a tremendous amount of genetic diversity, which can include resistance to the active ingredient in an herbicide. Weeds with natural genetic mutations that make them resistant to certain herbicides typically exist in "wild" populations at very low rates (e.g., one per million). This means that, for every million weeds killed by an herbicide, one might survive and reproduce. That one plant might produce 1,000 seeds, and the next year, for example if only 4 percent survive, more than 40,000 seeds will be produced.

Meanwhile, the "susceptible" population is being killed using the same herbicide, giving a competitive advantage to plants that have inherited the resistance trait. If some other form of control like mowing, tillage, grazing, or an herbicide with a different mode of action, is not incorporated, resistance to a specific herbicide within this weed population is being selected (Figure 1 page 26). Seeds and pollen from this

MODE OF ACTION

When referring to herbicides, the mode of action is the way in which the active ingredient (e.g., glyphosate, 2,4-D, clopyralid, etc.) kills the target plants. Herbicides can be divided into groups based on the biological process in the plant they disrupt (mode of action). Each group may include many different active ingredients (the chemical that actually kills the plant), and for each active ingredient, there may be multiple product names. For example, there are over 20 different active ingredients that act as ALS inhibitors but only one that acts as a 5-enolpyruvyl-shikimate-3-phosphate (EPSP) inhibitor. While the chemicals in both of these categories all work to inhibit amino acid synthesis in the plant, they target different enzymes. This means that ALS inhibitors have a different mode of action than EPSP inhibitors.

Figure 1. How does selection for herbicide resistance occur?



Adapted from University of Minnesota Extension

ACTIVE INGREDIENT

The active ingredient in an herbicide product is the chemical that kills the target plant. For example, the active ingredient in Roundup and Ranger is glyphosate, and the active ingredient in Stinger and Spur is clopyralid. Some products contain more than one active ingredient, which may or may not have the same mode of action. The active ingredient(s) in the product is always listed on the label of a registered product.

new resistant population can now spread the infestation to new areas.

There is no evidence herbicides cause genetic mutations in the plants, but instead give a competitive edge to the plants that already carry the genetic mutation making them resistant.

Wyoming has only three confirmed cases of herbicide resistance. In 1984, University of Wyoming scientists confirmed the presence of atrazine-resistant kochia. In 1996, metsulfuron-resistant kochia was confirmed, and in 2014, glyphosate-resistant kochia was confirmed. Careful management can limit the further development and spread of herbicide resistant weeds in Wyoming.

Herbicide resistant weeds are also a problem on public lands. In some areas, cheatgrass has developed resistance to the ALS class of herbicides due to the use of these herbicides in small grain production (wheat and barley). This class of herbicides includes Plateau, a popular herbicide for cheatgrass control programs. As a result, another tool has been eliminated in some areas from the weed control toolbox, and infestations are harder to control.

Best Management Practices to Reduce Resistance

First and foremost, correctly identify the weed species you want to control. An effective weed control program requires correct identification. Your local University of Wyoming Extension or weed and pest control office can help with weed and insect identification. Scout pastures, yards, and gardens regularly for new weed species. A weed control strategy will be more effective and less costly if the problem is caught early.

Next, develop an integrated weed management strategy that includes non-chemical control methods like mowing, hand pulling, tillage, or grazing. When developing a plan, a thorough assessment is helpful. Where is it? How many are there? Are there any desirable plants still hiding among the weeds?

The next step is to research specific control tactics based on the time of year and level of infestation. Identify the action threshold for the weed in question. Complete eradication is not possible in many cases, nor should it be the goal.

If chemical control is part of your strategy, consider:

1. Using herbicides only when necessary to maintain weed populations at acceptable levels. Herbicides should not be the only tool in the toolbox, i.e., don't spray the whole field just because one or two weeds are seen.

2. Rotating herbicides with different modes of action. Do not make more than two consecutive applications with the same mode of action (twice in one year, or one application two years in a row) unless other weed control methods are also being used.
3. Applying two herbicides with different modes of action at the same time can be effective. These can be mixed in the spray tank or pre-packaged. Application rates may need to be adjusted when combining products, and, in some cases, the effectiveness of the herbicides will change. Read the label carefully to avoid issues with combining different products.
4. Always applying an herbicide according to the label. Applying lower rates than specified on the label may promote resistance by stressing but not killing the target species. Applying at rates higher than specified on the label is illegal.
5. Scouting for weeds 7 to 14 days after herbicide application and properly identify any surviving weed species. Initially, the number of surviving individuals may be low and distributed in small patches. Resistant plants are typically surrounded by dead or dying plants. Resistant plants may initially show herbicide injury symptoms but recover after a few days or weeks.

If herbicide resistance is suspected, first make sure there were no other factors affecting herbicide efficacy. Is the weed species listed as "controlled" on the herbicide label? Is the sprayer properly calibrated and application rate correct? Is the plant the right size for optimum control and is it the right time of year? Did wind or other factors cause the spray to drift? Did dust reduce the effectiveness of the application?

If resistance is still suspected, contact your local UW Extension office, and they can work to confirm resistance and help take appropriate action. Wyoming offices and contact information is at www.uwyo.edu/uwe/county.

ACTION THRESHOLD

The action threshold is the population density at which some action must be taken and is typically expressed in weeds or pests per area. Below this threshold no action is taken, but the weed or pest is carefully monitored. Once the weed or pest reaches the action threshold, it is time to implement an integrated management strategy. In some cases the action threshold will be zero (e.g., poisonous plants in the pasture), but other times it may be much higher (e.g., dandelions in the yard).

First case of herbicide-resistant weeds reported in 1950s

Herbicide resistant weed species are the result of using one or more herbicides with the same mode of action every year, or multiple times within the same growing season, to kill a specific species without integrating other control methods.

A homeowner or farmer using a single herbicide to kill weeds along a driveway without alternating or combining with another herbicide, and not using any non-chemical methods like mowing or pulling, is contributing to the rapid development of herbicide resistant weeds.

The first documentation of herbicide resistant weeds occurred in the 1950s. There are now over 180 different species of weeds worldwide resistant to at least one class of herbicides. To get a new product on the market, an agro-chemical company may need to screen more than 100,000 new chemicals and spend $250 million. Cellulose inhibitors in the 1990s was the most recent new herbicide class discovery to hit the market.

Caitlin Youngquist *is a University of Wyoming Extension educator serving northern Wyoming specializing in agriculture and horticulture, and* **Gustavo Sbatella** *is the irrigated crop and weed specialist based at the Powell Research and Extension Center. Youngquist can be reached at cyoungqu@uwyo.edu or (307) 347-3431, and Sbatella can be reached at (307) 754-2223 or at gustavo@uwyo.edu.*