

Herbicide-Resistant Weeds and Their Management

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to prevent resistance, do not use herbicides from the
same group two years in a row.**

Herbicide resistance is the inherited ability of a plant to survive a herbicide to which the wild-type was susceptible. Resistant plants occur naturally within a population and differ slightly in genetic makeup but remain reproductively compatible with the wild-type.

Herbicide-resistant plants are present in a population in extremely small numbers. The repeated use of one herbicide allows these few plants to survive and reproduce. The number of resistant plants then increases in the population until the herbicide no longer effectively controls the weed.

Resistant plants likely will persist in infested fields for many years, even in the absence of any additional selection with the herbicide. There is no evidence that herbicides cause the genetic mutations that lead to herbicide resistance.

Resistant plants may be resistant to other herbicides (imidazolinones as well as sulfonylureas, for example) that kill plants in the same way (same site of action, or same group). This is called *cross-resistance*.

Weeds can also be resistant to herbicides with different sites of action (aryloxyphenoxy propanoates as well as sulfonylureas, for example). In Australia a biotype of annual ryegrass is resistant to at least five different herbicide groups. This is called *multiple resistance*.

Herbicide resistance is not the natural tolerance that some species have to a herbicide. For example, wheat is

tolerant to Hoelon because it can rapidly deactivate it. Wild oat can only slowly deactivate Hoelon, so the herbicide can be used selectively to remove wild oat from wheat.

The first identified herbicide-resistant weed, spreading dayflower (*Commelina diffusa*), which is resistant to 2,4-D, was identified in 1957 in a sugarcane field in Hawaii. Since then, more than 200 weeds resistant to one or more herbicides have been identified worldwide. Current information on the status of herbicide-resistant weeds can be found at <http://WeedScience.com>

Herbicide-resistant weeds are now common in the Pacific Northwest:

- Kochia, prickly lettuce, and Russian thistle resistant to sulfonylurea herbicides (Glean, Amber, Ally, and other group 2 inhibitors)
- Wild oat and Italian ryegrass resistant to Hoelon and other group 1 (ACCase) inhibitors
- Powell amaranth resistant to triazines and other group 5 inhibitors
- Yellow starthistle resistant to Tordon and other group 4 inhibitors
- Wild oat resistant to Fargo and Avenge

The appearance of herbicide-resistant weeds is strongly linked to repeated use of the same herbicide or herbicides with the same site of action in a monoculture cropping system (for example,

This publication contains the

Herbicide Rotation

Reference Poster

wheat after wheat) or in noncrop areas (railway or road rights-of-way, etc.). To manage herbicides to delay and prevent the appearance of herbicide-resistant weeds, you must know in which chemical family a herbicide belongs *and* which herbicides have the same site of action.

The table inside lists herbicides by group number and site of action, chemical family, common name, and trade name and gives examples of resistant weeds. The table is color coded so that different herbicide families that have the same site of action are the same color and group number.

When planning a herbicide program to prevent resistance, do not use herbicides from the same color or group two years in a row.

Tank-mixing herbicides as a resistance management strategy is not a recommended practice. If herbicides in the tank mixture control different weed species and have different soil residual characteristics, resistant weed biotypes will continue to be selected.

For example if a long-residual (Glean) and a short-residual (2,4-D) herbicide are tank-mixed, both herbicides may control emerged broadleaf weeds. However, Glean will continue to control weeds throughout the growing season and could continue to select for resistant plants. Tank-mix only when a herbicide combination is required to control the weed spectrum or will result in reduced herbicide use rates. Tank-mixing for other reasons is not economically or ecologically sound.

Management practices can be used to prevent or delay the appearance of herbicide-resistant weeds. The following list of practices can be used along with the information on herbicide families provided in the table to deal with herbicide resistance.

Preventing herbicide-resistant weeds

Herbicide rotation—Avoid year-after-year use of herbicides that have the same site of action. At one time this meant not using herbicides from the same chemical family, but this is no longer the case. For example, two chemically different groups of herbicides, the sulfonylureas and imidazolinones, have the same site of action. For another example, Hoelon and Poast belong to different chemical families but kill susceptible grasses in the same way.

Short-residual herbicides—Using herbicides that do not persist in soil for long time periods and are not applied repeatedly within a growing season reduces the selection of herbicide-resistant weeds. However,

repeated applications within a growing season of a herbicide with no soil activity (e.g., Gramoxone) has resulted in weeds resistant to the herbicide.

Crop rotation—Because different crops may require different herbicides, rotating crops can increase herbicide rotation. But with the large number of sulfonylurea and imidazolinone herbicides available for use in many different crops, crop rotation alone may not be enough to avoid weed resistance to herbicides. This also is true for other herbicides with the same site of action.

Cultivation—In row crops, cultivation can be an effective tool for eliminating weed escapes that may represent the resistant population. Fallow tillage will control herbicide-resistant and herbicide-susceptible weeds equally as long as the seedlings of the two biotypes emerge at the same time. Do not use the same site-of-action herbicide in fallow as was used to control weeds in the crop.

Accurate record keeping—To have an effective herbicide rotation or tank-mix system to prevent resistance, you must know which herbicides have been used in the past, at what rate, and how often.

Clean seed—Plant certified seed to prevent the introduction of herbicide-resistant weed seeds.

Integrated weed management—This concept is important for all weed control, not just management of herbicide-resistant weeds. Integrated weed management uses all the tools available to control weeds, including cultural, mechanical, and chemical methods. An integrated approach to weed management, whether it is in crop or noncrop land, is an important environmental and economic consideration.

Dealing with herbicide-resistant weeds

Monitor fields for weed escapes—Weed escapes are not necessarily resistant, but they may be. A resistance problem may not be visible until 30 percent or more of the weeds are no longer controlled. Check to see if the escapes are only one species or a mixture of species. If there is a mixture, the problem is more likely related to environment or application. If only one species was not controlled, the problem is more apt to be resistance, especially if the species was controlled by the herbicide in the past and if the same herbicide has been used repeatedly in the field.

Keep weeds from spreading—Prevent known resistant weeds from flowering and producing seed. After using machinery in fields or areas with known

or suspected infestations of herbicide-resistant weeds, thoroughly clean the equipment to reduce the spread of resistant weeds from one field or area to another. Always plant clean seed.

Change crops and tillage systems—Crop rotation and altered tillage practices can affect the weed populations. Alternating spring and winter crops means that the field will be tilled at different times each year. During one of the field preparation operations, resistant as well as susceptible weeds will be killed.

Change herbicide program—If weed resistance occurs, herbicides with other sites of action and other weed management practices must be used.

Recognizing herbicide-resistant weeds

Irregular patches of a single weed species in the field are an indicator of herbicide resistance, especially when

1. There are no other apparent application problems.
2. Other weed species are controlled adequately.
3. There are no or minimal herbicide symptoms on the single weed species not controlled.

4. There has been a previous failure to control the same species in the same field with the same herbicide or a herbicide with the same site of action.
5. Records show repeated use of one herbicide or herbicides with the same site of action.

What to do if you suspect herbicide resistance

- Do not respray the field with the same herbicide.
- Report your suspicion to university research or extension personnel or to the extension educator in your county.
- Collect plants or seed that can be used to confirm resistance has developed.

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