



# Herbicide Resistance

Bayer Solutions

## // THE PROBLEM

### Why is Herbicide Resistance Important to Vegetation Managers?

As reported cases of herbicide resistance continue to increase in agriculture it is important for vegetation managers to understand how resistance develops and the practices used to avoid resistance because once resistance forms it is difficult to reverse. With the limited number of herbicides available to vegetation managers it is crucial to preserve the effectiveness of these vital tools.

#### How does herbicide resistance evolve?

Herbicide resistance is the inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide that would normally be lethal to the wild plant. Resistance happens with the repeated use of the same herbicide, or herbicides with similar site of action on a weed population.

**Herbicide resistance is sometimes hard to identify and in fact 90% of weed control failures are due to factors other than resistance\* including:**

- Application issues – (calibration, skip, etc.)
- Weather conditions – (temperature, rainfall, etc.)
- Weed factors – (size, new germination, stress)
- Shadowing of smaller weeds (poor coverage)
- Soil factors (moisture, organic matter, debris)

If herbicide resistance is suspected, confirmation using an approved scientific method should be obtained. Contact your local Ministry of Agriculture department for testing options.

\* Weed Science Society of America Survey

## // WHAT TO LOOK FOR

### Signs of Herbicide Resistance

- Failure to control weeds normally controlled with same herbicide and rate.
- Adjacent weeds are controlled.
- A spreading patch of a particular species (all other species controlled)
- Surviving plants mixed with controlled plants of the same or different species.

### Example of herbicide resistant weeds

#### Broadleaves

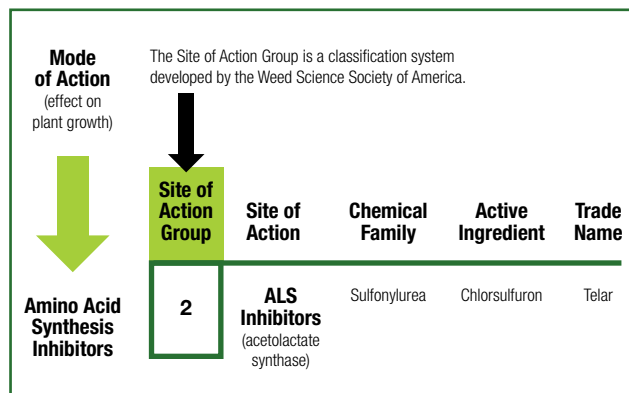
- Kochia
- Pigweeds
- Mareestail
- Russian thistle
- Prickly lettuce
- Lambsquarters

#### Grasses

- Annual ryegrass
- Barnyard grass
- Crabgrass
- Foxtail
- Goosegrass
- Johnsongrass

### Know Your Herbicide Group Code

It is important to understand which site of action group you are using. Below is an example for one product.



### Herbicide Resistance by Sites of Action

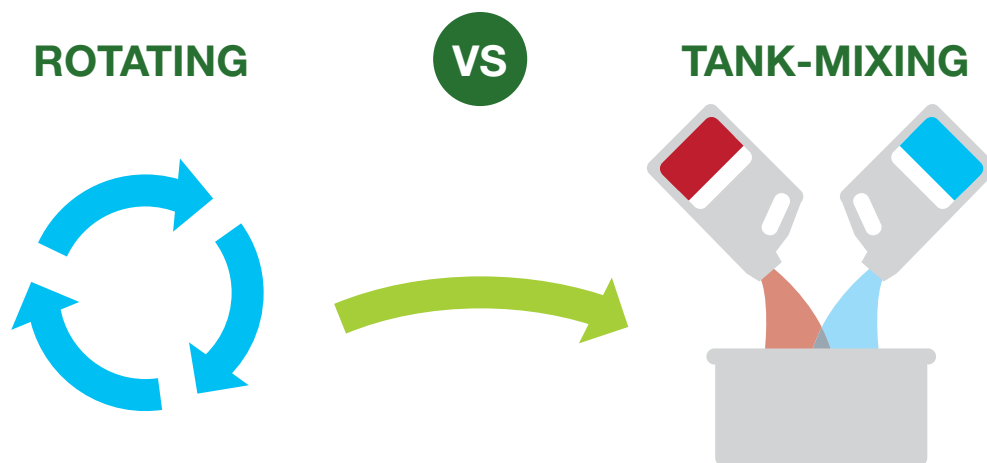
Herbicide resistance has been confirmed with nearly all sites of action so it is important to understand how these sites of action and their associated group numbers can affect vegetation management strategies. The chart below illustrates the number of weeds that are resistant to different commonly used active ingredients.

Group Number	Site of Action	Active Ingredient Examples	# Resistant Weed Species
2	Acetolactate Synthase Inhibitor (ALS)	Metsulfuron	160
5	Photosystem II Inhibitors (PSII)	Bromacil	102
9	Enolpyruvyl Shikimate-3-Phosphate Synthase Inhibitor (EPSP)	Glyphosate	41
4	Synthetic Auxin	2, 4-D	37
29	Cellulose Biosynthesis Inhibitor	Indaziflam	0

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How to Prevent Herbicide Resistance



## Rotation

Herbicide rotations between different sites of action and sequences (also called cycling) reduces selective pressure on individual target sites by employing herbicides with different sites of action in successive growing seasons or within the same season

## Tank Mixing

Exposes weeds to multiple sites of action simultaneously

**Experts have conducted extensive research and the results have challenged the conventional wisdom of rotation. The research has shown that tank mixing two different sites of action at the time of application is more effective at reducing the likelihood of resistance occurring.**

Research has shown that using two effective sites of action simultaneously on a key weed can sustain the viability of both herbicides or sites of action 83 times longer than using a rotation in-season or between seasons.

Source: Managing the evolution of herbicide resistance. 2015. Pest Management Science. Jeffery A Evans, Patrick J. Tranel, Aaron G Hager, Brian Schutte, Chexi Wi, Laura A Chatham and Adam S Davis.

For maximum benefit, herbicide mixtures must not only have different sites of action, but also have similar efficacy and persistence, allowing them to act simultaneously on the same weed group.

## Best Management Practices to Prevent Herbicide Resistance

- Know your sites and your weeds
  - Understand which weeds are most difficult to control and prone to herbicide resistance
- Always tank mix at least two effective herbicides with different sites of action
- Apply herbicides at labelled rates with the correct timing and application method – do not cut rates
- Use a pre-emergent herbicide
  - Control weeds early in their growth cycle when they are most susceptible
- Eliminate all escaped weeds
  - Escaped weeds are the primary driver of herbicide resistance

**For additional information on herbicide resistance please visit the Canadian Weed Science Society [www.weedscience.ca](http://www.weedscience.ca) or the Weed Science Society of America [www.wssa.net](http://www.wssa.net).**



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