

MANAGING HERBICIDE-RESISTANT WEEDS

General Concepts

Modern agriculture, especially in the US, has increasingly relied on herbicides to control or manage weeds in crops. Repeated use of a particular herbicide will expose a target weed population to selection pressure that can result in biotypes that are resistant to the herbicide that would, under normal use conditions, effectively control that weed population.

US soybean growers are constantly dealing with herbicide-resistant (HR) weeds. In the recent past, growers had only to be concerned with glyphosate-resistant (GR) weeds. Now, however, they must contend with weeds that are resistant to herbicides from other groups as well. This is a major production problem and threatens the production of a profitable crop.

As of July 2021, there were 263 species of HR weeds in the world ([I. Heap, Intl. HR Weed Database](#)). Weeds have evolved resistance to 23 of the 26 known sites of action and to 167 different herbicides. Many of the more problematic weeds such as Palmer amaranth have evolved resistance to multiple herbicide sites of action.

As of Feb. 2019, number of HR weed species by crop was 61 and 48 for corn and soybean, respectively. There were 43 weed species resistant to glyphosate.

Click [here](#) for detailed and up-to-date statistics on HR weeds and [here](#) for Site-of-Action categories based on both the Herbicide Resistance Action Committee (HRAC) and Weed Science Society of America (WSSA)

classification systems.

The following is a summarization of best management practices (BMP's) for HR weeds that are presented in articles by the [HRAC](#) and the [WSSA](#) (see below "Risk of Resistance" summary table).

The most important practice in preventing and/or managing HR weeds is to use herbicides with different mechanisms or modes of action ([MOA](#)) prior to planting and throughout the growing season. Growers should check the group number on the herbicide label (see below) to ensure selection of the correct MOA to match targeted weeds. Frequent use of herbicides with the same MOA is the single most important factor in the development of HR weeds.

- Weed species present in individual fields should be documented each year so that MOA knowledge and level of weed control by individual herbicides can be coupled when making herbicide decisions.
- If resistant weed populations have emerged prior to soybean planting and/or emergence, tank-mix a burndown herbicide with another herbicide such as 2,4-D (MOA Group 4), Clarity (MOA Group 4), or Sharpen (MOA Group 14).
- In the Midsouth where HR Palmer amaranth is the major problem, plant in a seedbed that is free of this problem weed.
- Use tillage as a control measure on sites that are not highly susceptible to erosion or when needed as a last resort in a minimum tillage system. A [CAST](#) report concluded that HR weeds pose one of the most significant threats to soil conservation since the inception of the

USDA-NRCS because HR weeds have forced growers to include or intensify tillage in their cropping systems if they are to remain economically viable. Thus, using BMP's other than tillage for management of HR weeds should have a high priority to encourage the continuation of land stewardship.

- Use the full labeled rate of all herbicides that are applied.
- If and when GR weeds escape control with preemergence residual herbicides, use timely applications of postemergence herbicides that have an MOA different from that of glyphosate.
- Add a herbicide with in-crop residual activity in combination with postemergence contact herbicide applications in cases where multiple flushes of weeds are expected.
- Overlap residual herbicides from burndown to canopy-closure applications to ensure minimum escapes during the growing season.
- Use fall weed control measures such as residual herbicides to provide an edge going into the following growing season.
- Rotate herbicide MOA's in postemergence applications. Use tank-mixes to facilitate this activity. When tank-mixing herbicides with glyphosate to control GR weeds, it is important that the non-glyphosate herbicide is added at a rate that will control the targeted weed alone or in the absence of glyphosate. Otherwise, the GR weed will not be killed and will continue to live and reproduce.
- Each acre should get a minimum of two MOA's that are effective for control of targeted weeds. If GR weeds are present, growers should use two MOA's in addition to that of glyphosate.
- Rotate herbicides with different MOA's yearly. Simply rotating herbicides that have the same MOA will only delay the inevitable

occurrence of HR weeds.

- If there are no HR weeds in a field, it is still very important to rotate herbicides with different MOA's to prevent or delay the establishment of HR weeds. If weed species' resistance to glyphosate is not documented in a particular field or fields, then using glyphosate is a viable option when used in rotation with other herbicide(s) with a different MOA. In fact, glyphosate used in rotation is an excellent resistance management option if there is no documented GR.
- Crop rotation offers opportunity for herbicide MOA rotation to prevent or delay development of HR weeds. Crop rotation will determine the frequency and type of herbicide that is applied, and is a major factor in the selection of non-chemical weed control options. The principle of crop rotation as a resistance management tool is that different crops will allow rotation of herbicides that have different MOA's.

Herbicide MOA

Knowledge of the MOA categories described by the [HRAC](#) will aid in managing weeds that are resistant to herbicides that are now available. Using this additional management tool will reduce, if not prevent, the likelihood of selecting for HR weeds. In fact, in today's conservation production systems that rely mostly on herbicides for weed management, selecting and using herbicides with different MOA's is the primary tool for preventing and/or managing HR weeds.

The numerical classification system developed by the WSSA is available on herbicide labels. Near the top of the label, a box labeled "Group Herbicide" contains the number or numbers that indicate the MOA of the product's active



ingredient(s). Multiple numbers in the box indicate that the herbicide or herbicide premix has more than one MOA.

Examples are the labels for [Roundup WeatherMax](#) (Group 9)

GROUP	9	HERBICIDE
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and [Valor XLT](#) (Groups 2 and 14).

GROUP	2 + 14	HERBICIDE
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Selecting herbicides with different MOA's must be combined with choosing herbicides within those MOA Groups that are effective at controlling targeted weeds in individual fields. In other words, merely selecting herbicides

from a different MOA Group will do little to reduce selection pressure if those herbicides are not effective at controlling targeted weeds in a field.

Producers should understand that the discovery of new herbicide chemistries is rare, and that the existing herbicide reservoir is exhaustible. Thus, the indiscriminate use of a herbicide or herbicides will lead to the rapid evolution of HR weeds, and can result in the reduction of herbicide options to all producers.

[United Soybean Board Take Action Against Herbicide-Resistant Weeds](#)

This program is an industry-wide partnership to help producers manage HR weeds. Click through the various modules on this site to learn techniques to fight herbicide resistance.

Management option	Risk of Resistance		
	Low	Moderate	High
Herbicide mix or rotation	> 2 MOA's	2 MOA's	1 MOA
Weed control	Cultural*, mechanical, and chemical	Cultural and chemical	Chemical only
Using same MOA per season	Once	More than once	Many times
Cropping system	Full rotation	Limited rotation	No rotation
Resistance status to MOA	Unknown	Limited	Common
Weed infestation	Low	Moderate	High
Control in last 3 years	Good	Declining	Poor

From the [HRAC](#).

*Control can be by cultivation, stubble burning, competitive crops, stale seedbeds, etc. Checklist to be used per weed species.