

WHAT'S YOUR HERBICIDE'S RISK LEVEL?

The risk of weeds developing resistance to a herbicide site of action is determined both by how the herbicide is used by the applicator and also by the frequency of resistance mutations in weeds. The more a site of action is relied on, the greater the risk of resistance, regardless of the frequency of resistance.



Always remember that every herbicide site of action has a risk of allowing the development of resistant individuals when it's used as the sole weed-control tactic.

HIGH-RISK

SITE OF ACTION GROUP <small>(PRODUCT EXAMPLES BY TRADE NAME®)</small>	NUMBER OF RESISTANT WEED SPECIES IN U.S.	MOST THREATENED WEED SPECIES	WHY HIGH-RISK
1 ACCASE INHIBITORS <small>(Assure®II and Select Max)</small>	15	Italian ryegrass, barnyardgrass, Johnsongrass and giant foxtail	Group-1 herbicides are high-risk due to a higher frequency of resistance mutations, which include both target site and metabolic resistance.
2 ALS INHIBITORS <small>(Pursuit®, Classic® and FirstRate®)</small>	49	Waterhemp, Palmer amaranth, horseweed (marestail), giant ragweed, common ragweed, common lambsquarters, kochia, Italian ryegrass, barnyardgrass, Johnsongrass and giant foxtail	Group-2 herbicides are high-risk due to a high frequency of resistance mutations that occur in wild populations (both target site and metabolic). Heavy reliance on the Group-2 herbicides since their introduction in the 1980s has led to the highest number of resistance cases in the U.S. of any site of action.
9 EPSPS INHIBITOR <small>(Roundup®)</small>	17	Waterhemp, Palmer amaranth, horseweed (marestail), giant ragweed, common ragweed, kochia, Italian ryegrass and Johnsongrass	Since their introduction in 1974, 17 species of weeds have evolved resistance to Group-9 herbicides. The majority of resistance events have occurred since the introduction of Roundup Ready® crops, which greatly increased glyphosate use.
14 PPO INHIBITORS <small>(Flexstar®, Cobra®, Authority® and Valor®)</small>	4	Waterhemp, Palmer amaranth and common ragweed	Despite a low number of resistant species, heavy reliance on Group-14 herbicides in soybeans makes the group high-risk. Group-14 herbicides are often included as pre-emergent herbicides and heavily relied on as postemergent applications for glyphosate- and ALS-resistant weeds.
27 HPPD INHIBITORS <small>(Balance®, Impact® and Callisto®)</small>	2	Waterhemp and Palmer amaranth	Group-27 herbicides were considered low-risk because of their use in corn, often with other sites of action. But the impending release of the HPPD inhibitor-resistant soybean in the late 2010s will increase their overall use, which will raise the risk to high.

MEDIUM-RISK

SITE OF ACTION GROUP (PRODUCT EXAMPLES BY TRADE NAME®)	NUMBER OF RESISTANT WEED SPECIES IN U.S.	WHY MEDIUM-RISK	
		MOST THREATENED WEED SPECIES	
4 SYNTHETIC AUXINS (TIR1 Auxin Receptors) (2,4-D and Clarity®)	8	Waterhemp, kochia, Palmer amaranth and barnyardgrass	Group-4 herbicides have been used in agricultural production since the 1940s, and only eight species have been confirmed resistant to the site of action. However, the introduction of soybeans resistant to 2,4-D and dicamba will dramatically increase the use of these products, which raises the site of action to medium-risk status.
5 PHOTOSYSTEM II INHIBITORS (AAtrex® and Sencor®)	26	Waterhemp, Palmer amaranth, horseweed (marestail), common ragweed, common lambsquarters, kochia, barnyardgrass and giant foxtail	Group-5 resistance is widespread and can sometimes make the resistant weeds less competitive than the wild type. Also, Group-5 herbicides are often applied with other sites of action, reducing the risk of resistance.
10 GLUTAMINE SYNTHETASE INHIBITOR (Liberty®)	1	Italian ryegrass, goosegrass, Palmer amaranth, waterhemp	Although only one species has been confirmed as resistant to Group-10 herbicides, the continued increase in use of Group-10 herbicides, with the growth of acres planted to LibertyLink® soybeans, has raised the risk of resistance to medium.

LOW-RISK

SITE OF ACTION GROUP (PRODUCT EXAMPLES BY TRADE NAME®)	NUMBER OF RESISTANT WEED SPECIES IN U.S.	WHY LOW-RISK	
		MOST THREATENED WEED SPECIES	
3 MICROTUBULE INHIBITORS (Prowl® and Treflan®)	6	Waterhemp, Palmer amaranth, kochia and barnyardgrass	Group-3 herbicides have pre-emergent activity only and are often used in combination with other sites of action or followed by postemergent applications with alternate sites of action. Their inclusion in a site-of-action rotation and lack of reliance as sole sites of action for weed control make this group low-risk.
15 LONG-CHAIN FATTY ACID INHIBITORS (Degree Xtra®, Dual II Magnum® and Zidua®)	1	Italian ryegrass, Palmer amaranth, waterhemp	Group-15 herbicides have pre-emergent activity only and are often used in combination with other sites of action or followed by postemergent applications with alternate sites of action. Their inclusion in a site-of-action rotation and lack of reliance as sole sites of action for weed control make this group low-risk.
22 PHOTOSYSTEM I ELECTRON DIVERTER (Gramoxone®)	5	Horseweed (marestail)	Group-22 herbicides are used in burndown applications prior to soybean planting and are often combined with other sites of action, such as Groups 4 and 5.

For more information and links to additional resources, visit www.IWillTakeAction.com.

Technical editing provided by Travis Legleiter, Ph.D., and Bill Johnson, Ph.D., both of Purdue University. The United Soybean Board and Take Action partners neither recommend nor discourage the implementation of any advice contained herein, and are not liable for the use or misuse of the information provided. ©2017 United Soybean Board.