

WHAT'S YOUR HERBICIDE'S RISK LEVEL?

The risk of developing resistance to an herbicide site of action is determined by how the herbicide is used by the applicator and 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. The use of multiple herbicide sites of action and incorporation of non-chemical weed control tactics are key to reducing the risk of herbicide resistance.



Always remember: Every herbicide site of action may develop resistant individuals when used as the sole weed-control tactic.

HIGH RISK

SITE OF ACTION GROUP (PRODUCT EXAMPLES BY TRADE NAME®)	NUMBER OF RESISTANT WEED SPECIES IN U.S.	MOST THREATENING WEED SPECIES	WHY HIGH RISK
1 ACCASE INHIBITORS (Assure® II and Select Max®)	15	Italian ryegrass, barnyardgrass, Johnsongrass, giant foxtail and junglerice	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 (Pursuit®, Classic® and FirstRate®)	51	Waterhemp, Palmer amaranth, horseweed (marestail), giant ragweed, common ragweed, common lambsquarters, Kochia, Italian ryegrass, barnyardgrass, Johnsongrass, giant foxtail and junglerice	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.
4 SYNTHETIC AUXINS (TIR1, AFB5 and unknown auxin receptors) (Enlist One®, XtendiMax® and Engenia®)	11	Waterhemp, Kochia, Palmer amaranth and barnyardgrass	Group 4 herbicides have been used in agricultural production since the 1940s, and only eight species had been confirmed resistant to the site of action prior to 2016. However, the introduction of soybeans resistant to 2,4-D and dicamba dramatically increased the use of these products, which raised the site of action to high-risk status. Initial confirmations of Palmer amaranth with resistance to Group 4 herbicides were identified in 2020 and 2021.
9 EPSPS INHIBITOR (Roundup®)	18	Waterhemp, Palmer amaranth, horseweed (marestail), giant ragweed, common ragweed, Kochia, Italian ryegrass, Johnsongrass, goosegrass, junglerice and barnyardgrass	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.
10 GLUTAMINE SYNTHETASE INHIBITOR (Liberty®)	3	Italian ryegrass, goosegrass, Palmer amaranth and waterhemp	Although only three species have been confirmed as resistant to Group 10 herbicides, the continued increase in use of Group 10 herbicides raises the risk of resistance to high. The introduction of Enlist E3® and XtendFlex® soybeans, in addition to LibertyLink soybeans, has contributed to this increased use of Group 10 herbicides. Palmer amaranth with resistance to Group 10 herbicides was identified in the Mid-South in 2021.
14 PPO INHIBITORS (Flexstar®, Cobra®, Valor® and Authority® brands)	6	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, which raises the risk to high.

MEDIUM RISK

SITE OF ACTION GROUP (PRODUCT EXAMPLES BY TRADE NAME®)	NUMBER OF RESISTANT WEED SPECIES IN U.S.	MOST THREATENING WEED SPECIES	WHY MEDIUM RISK
5 PHOTOSYSTEM II INHIBITORS (metribuzin and atrazine)	29	Waterhemp, Palmer amaranth, horseweed (marestail), common ragweed, common lambsquarters, Kochia, barnyardgrass, giant foxtail and junglerice	Group 5 resistance is widespread but 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.
15 LONG-CHAIN FATTY ACID INHIBITORS (Warrant®, Dual II Magnum®, Anthem® MAXX and Zidua®)	8	Italian ryegrass, Palmer amaranth, waterhemp and barnyardgrass	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. Recent identification of metabolism-based resistance raises the risk of Group 15 herbicides to medium.
27 HPPD INHIBITORS (Alite 27®, Impact® and Callisto®)	3	Waterhemp and Palmer amaranth	Group 27 herbicides were considered low risk because of their use in corn, often with other sites of action. The release of the HPPD inhibitor-resistant soybean will increase their overall use, which raises the risk to medium.

LOW RISK

SITE OF ACTION GROUP (PRODUCT EXAMPLES BY TRADE NAME®)	NUMBER OF RESISTANT WEED SPECIES IN U.S.	MOST THREATENING WEED SPECIES	WHY LOW RISK
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.
22 PHOTOSYSTEM I ELECTRON DIVERTER (Gramoxone®)	6	Horseweed (marestail) and Italian ryegrass	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., University of Kentucky, and Bill Johnson, Ph.D., 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. ©2024 United Soybean Board.