

# MISSISSIPPI SOYBEAN PROMOTION BOARD

## MANAGING HERBICIDE-RESISTANT WEEDS

### Palmer Amaranth

Palmer amaranth (pigweed) is the bellwether or index weed for herbicide-resistance. Biotypes that are resistant to six Mechanisms/Modes/Sites of Action ([MOA](#)) [have been identified](#). Glyphosate-resistant (GR) Palmer amaranth is of particular concern, and is found throughout the southern soybean production region of the US.

GR Palmer amaranth has created a conundrum for producers. Using glyphosate for weed control in GR soybean has been and continues to be a preferred management tool, but the advent of GR weeds such as Palmer amaranth has reduced its utility. So even though glyphosate is still an effective herbicide for weed management in GR soybeans, its use must be tempered to either prevent or delay the selection for GR weeds resulting from its overuse.

This is a problem that must be managed if profitable soybean production is to continue. Control options depend on using

- Older non-glyphosate herbicides,
- Premixes of non-glyphosate herbicides,
- Premixes of non-glyphosate herbicides and glyphosate, and
- Liberty herbicide with Liberty Link soybean varieties.

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The following compilation of the best measures for control of GR pigweed in Roundup Ready, Liberty Link, and conventional soybean production systems is from the below sources.

[Mississippi State University](#) by Dr. Jason Bond (designated MSU in this article);

The [University of Georgia](#) by Dr. Eric Prostko (designated UGA in this article);

The [University of Arkansas](#) by Drs. Scott and Smith (designated UA in this article); and

[North Carolina State University](#) by Drs. Everman and York (designated NC in this article);

[Crop Management](#) by Drs. Ahmed and Holshouser (designated CM in this article).

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From the above sources and the below table, the following tenets apply to management systems for control of GR pigweed.

- **Rotate herbicide chemistry as much as possible.** Use the Group numbers shown in parenthesis in the below table to determine the [MOA](#) of the listed herbicides and premixes. Rotation of Roundup Ready, Liberty Link, and Conventional herbicide systems will delay the onset of HR weeds if not present, or will help manage populations of HR weeds that are present (MSU, NC, and UGA).
- **Rotate crops where possible.** Including corn in a crop rotation with soybeans is an advantage since [atrazine](#) (MOA Group 5)-based weed control programs, which are an effective tool for controlling pigweed, can be used (NC and UGA).
- A residual herbicide should be part of any weed management program for GR

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pigweed in all three systems—Roundup Ready, Liberty Link, and Conventional soybeans. This reduces the pressure on postemergence (POST)-only management (MSU, NC, & UGA).

- Herbicide combinations such as Authority XL, Authority MTZ, Boundary, Canopy, Envive, Prefix, and Valor XLT that contain at least two MOAs provide the most consistent and effective control of pigweed (MSPB).
- POST options in the below table—Flexstar, Flexstar GT, Prefix, Pursuit, Sequence, and Warrant—have residual activity on Palmer amaranth, and their use will enhance in-season control of pigweed (MSU, NC, & UA).
- Palmer amaranth should be treated POST when no taller than 4 in. Preferably, POST treatments should be applied when pigweed is 2-3 in. tall (MSU, NC, & UGA).
- POST applications of herbicide mixes that include glyphosate should be applied to weeds at the recommended time/size for the non-glyphosate herbicide in the mix since that is the component that will control the GR weed (NC).
- Contact POST herbicides such as Cobra, Flexstar, Flexstar GT, Liberty, and Prefix that are applied to kill pigweed should be applied using flat-fan or twin-jet nozzles and a spray volume of at least 15 gal./acre (MSU and NC).
- Management tenets for control of pigweed in Liberty Link soybeans are basically the same as those for Roundup Ready

soybeans with the following exceptions: Liberty herbicide is used instead of glyphosate (NC).

- Soybean yield (MSPB) and control of pigweed (MSPB & CM) resulting from use of recommended POST applications of Liberty alone on Liberty Link soybean varieties were as good as those resulting from the use of preemergence (PRE) residual herbicide applications followed by recommended POST applications of Liberty. See next item for resistance management caveat.
- **Do not overuse Liberty since this will increase selection pressure for resistance to this herbicide;** i.e., do not depend entirely on Liberty for weed control. Do not exceed two applications of Liberty per year, do not use reduced rates, and treat weeds when they are small. Apply residual herbicides preplant, PRE, or POST as part of the total weed management program with Liberty Link soybeans to prevent possible resistance development to the Liberty class of chemistry (MSPB & NC).
- There is no economic threshold for pigweed management; thus, near-zero tolerance is required each year. **Mechanical removal of pigweed escapes should be done immediately to prevent pollen and/or seed production (UA).**

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<b>Herbicide Programs to Manage Resistant Palmer Amaranth</b>	
<b>Preplant/PRE Herbicide (MOA Group)</b>	<b>POST Herbicide (MOA Group)</b>
<b>Roundup Ready System</b>	
Anthem (14 +15), Authority XL (2 + 14), Authority MTZ (5 + 14), Authority Elite (14 + 15), Authority Maxx (2 +14), Boundary (5 + 15), Canopy (2 + 5), Canopy EX (2), Envive (2 + 14), Fierce (14 + 15), Gangster (2 + 14), Optill (2 + 14), Prefix (14 + 15), Pummel (2 + 15), Sonic (2 + 14), Surveil (2 + 14), Torment (2 + 14), Valor (14), Valor XLT (2 + 14), Verdict (14 + 15), or Zidua (15).	Glyphosate (9) + Prefix (14 + 15), Flexstar (14), Reflex (14), Flexstar GT (9 + 14), Glyphosate (9) + Warrant (15), Sequence (9 + 15), or Torment (2 + 14).
<b>Liberty Link System</b>	
Anthem (14 + 15), Authority XL (2 + 14), Authority MTZ (5 + 14), Authority Elite (14 + 15), Authority Maxx (2 +14), Boundary (5 + 15), Canopy (5 + 2), Canopy EX (2), Envive (2 + 14), Fierce (14 + 15), Gangster (2 + 14), Optill (2 + 14), Prefix (14 + 15), Pummel (2 + 15), Sonic (2 + 14), Surveil (2 + 14), Torment (2 + 14), Valor (14), Valor XLT (2 + 14), Verdict (14 + 15), or Zidua (15).	Liberty (10), Liberty (10) + Dual (15), or Liberty (10) + Warrant (15).
<b>Conventional (Non-GR) System</b>	
Anthem (14 + 15), Authority XL (2 + 14), Authority MTZ (5 + 14), Authority Elite (14 + 15), Authority Maxx (2 +14), Boundary (5 + 15), Canopy (2 + 5), Canopy EX (2), Envive (2 + 14), Fierce (14 + 15), Gangster (2 + 14), Optill (2 + 14), Prowl (3), Pummel (2 + 15), Sharpen (14), Sonic (2 + 14), Surveil (2 + 14), Torment (2 + 14), Treflan (3), Valor (14), Valor XLT (2 + 14), Verdict (14 + 15), or Zidua (15).	Reflex (14), Flexstar (14), Ultra Blazer (14), Cobra (14), Prefix (14 + 15), or Torment (2 + 14).
<ul style="list-style-type: none"> <li>● All herbicides listed above control weeds other than pigweed. Therefore, they should be selected to manage other broadleaf and grass weed species that may be present in a particular field and that are listed as controlled by the chosen herbicide or mix.</li> <li>● Authority MTZ, Boundary, and Canopy contain Metribuzin. Check <a href="#">selected varieties to ensure tolerance to this herbicide</a>.</li> <li>● For estimated levels of weed control normally expected with above herbicides, see <a href="#">Ark.</a>, <a href="#">Miss.</a>, and <a href="#">Tenn.</a> Weed Control Guides.</li> </ul>	

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<b>Single Component Herbicides: Trade Name–Active Ingredient–MOA Group</b>
<a href="#">Blazer</a> –Acifluorfen–Group 14, <a href="#">Classic</a> –Chlorimuron Ethyl–Group 2, <a href="#">Cobra</a> –Lactofen–Group 14, <a href="#">Dual</a> –S-metolachlor–Group 15, <a href="#">Express</a> –Tribenuron methyl–Group 2, <a href="#">FirstRate</a> –Cloransulam-methyl–Group 2, <a href="#">Flexstar</a> –Fomesafen–Group 14, <a href="#">Glyphosate</a> –Group 9, <a href="#">Harmony</a> –Thifensulfuron-methyl–Group 2, <a href="#">Liberty</a> –Glufosinate–Group 10, <a href="#">Outlook</a> –dimethenamid-P, Group 15, <a href="#">Pursuit</a> –Imazethapyr–Group 2, <a href="#">Reflex</a> –Fomesafen–Group 14, <a href="#">Select</a> –Clethodim–Group 1, <a href="#">Sharpen</a> –Saflufenacil–Group 14, <a href="#">Valor</a> –Flumioxazin–Group 14, <a href="#">Warrant</a> –Acetochlor–Group 15, <a href="#">Zidua</a> –Pyroxasulfone–Group 15.
<b>Premix Herbicides: Trade Name–Components–MOA Group</b>
<a href="#">Anthem</a> –Cadet + Zidua–Group 14 + 15, <a href="#">Authority XL</a> –Classic + Authority (Sulfentrazone)–Group 2 + 14, <a href="#">Authority MTZ</a> –Metribuzin + Authority–Group 5 + 14, <a href="#">Authority Elite</a> –Authority + Dual–Group 14 + 15, <a href="#">Authority Maxx</a> –Authority + Classic–Group 2 + 14, <a href="#">Boundary</a> –Metribuzin + Dual–Group 5 + 15, <a href="#">Canopy</a> –Classic + Metribuzin–Group 2 + 5, <a href="#">Canopy EX</a> –Classic + Express–Group 2, <a href="#">Envive</a> –Classic + Express + Valor–Group 2 + 14, <a href="#">Fierce</a> –Valor + Zidua–Group 14 + 15, <a href="#">Flexstar GT</a> –Glyphosate + Reflex–Group 9 + 14, <a href="#">Gangster</a> –FirstRate + Valor–Group 2 + 14, <a href="#">Harmony Extra SG</a> –Harmony + Express–Group 2, <a href="#">Optill</a> –Pursuit + Sharpen–Group 2 + 14, <a href="#">Prefix</a> –Reflex + Dual–Group 14 + 15, <a href="#">Pummel</a> –Pursuit + Dual–Group 2 + 15, <a href="#">Sequence</a> –Glyphosate + Dual–Group 9 + 15, <a href="#">Sonic</a> –FirstRate + Authority–Group 2 + 14, <a href="#">Surveil</a> –FirstRate + Valor–Group 2 + 14, <a href="#">Synchrony XP</a> –Classic + Harmony–Group 2, <a href="#">Torment</a> –Pursuit + Reflex–Group 2 + 14, <a href="#">Valor XLT</a> –Classic + Valor–Group 2 + 14, <a href="#">Verdict</a> –Sharpen + Outlook–Group 14 + 15.

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