

# WEED RESISTANCE TO HERBICIDES

In Arkansas and surrounding states, the following examples of weed resistance to herbicides have been documented: horseweed, Palmer amaranth, common ragweed, giant ragweed, annual ryegrass and johnsongrass resistance to glyphosate; barnyardgrass resistance to propanil, quinclorac and clomazone; cocklebur and pigweed resistance to Scepter and Classic; ryegrass resistance to Hoelon and Osprey; and johnsongrass resistance to Select and Fusilade.

## Things That Promote Resistance

- 1) Overdependence on single herbicides.
- 2) Relying on a single mode of action year after year.
- 3) Sequential applications of the same herbicides within a year.
- 4) Applying sub-lethal rates of herbicides.

In order to manage herbicide-resistant weeds and to prevent the widespread development of resistance, the University of Arkansas recommends the following strategies:

## General Resistance Management Strategies

- 1) Rotate crops.
- 2) Use tillage, cultivation and other cultural practices in rotation, when possible.
- 3) Rotate herbicides using different modes of action.
- 4) Use tank-mixtures at effective rates, with different modes of action.
- 5) Avoid using sequential applications of the same single herbicide over and over again.
- 6) Control weeds on fallow ground or set aside land to prevent spreading (glyphosate-resistant horseweed is a good example).
- 7) **If you suspect resistance after a herbicide application: Attempt to eradicate escapes with alternative herbicides or cultural methods. Do not let them go to seed! Collect seed samples from suspect plants and take them to your county Extension agent who will have them tested at the University of Arkansas or can let you know if resistant populations are known to exist.**

## Some Examples of Herbicides Having Same Mode of Action and Weeds That Are Resistant to Them in Arkansas

MOA	Herbicides	Weeds Resistant to This Group in Arkansas
9	<b>EPSPS inhibitor</b> Roundup	horseweed, Palmer pigweed, common ragweed, giant ragweed, annual ryegrass and johnsongrass
1	<b>Postemergence grass herbicide (ACCase inhibitor)</b> Hoelon, Axial, Select, Fusilade, Clincher, Ricestar HT, Assure II, Poast	annual ryegrass
2	<b>ALS inhibitor herbicide</b> Newpath, Classic, Staple, FirstRate, Scepter, Synchrony XP, FirstShot, Harmony, Oust, Regiment, Permit, Finesse	annual ryegrass, pigweed, common cocklebur, red rice, barnyardgrass, annual nutsedge, smallflower, umbrella sedge and yellow nutsedge
7	<b>Photosynthesis inhibitors (amides)</b> Propanil (Superwham, Stam, others)	barnyardgrass
13	<b>Pigment inhibitors</b> Command	barnyardgrass
4	<b>Synthetic auxins</b> Facet	barnyardgrass
3	<b>DNA herbicides</b> Prowl H <sub>2</sub> O, Treflan, Sonolan, Barricade, Pendimax, Trilin	goosegrass

## Other herbicides with the same mode of action (resistance not documented in Arkansas):

MOA	Herbicides
15	<b>Acetamide herbicides</b> Dual, Lasso, Degree, Outlook, Parrlay
5,6,7	<b>Photosynthesis inhibitors</b> Atrazine, metribuzin, Meturon, Lorox, Karmex, Cotoran
14	<b>PPO inhibitors</b> Valor, Flexstar, Ultra Blazer
10	<b>Glutamine synthetase inhibitor</b> glufosinate

## Specific Weed Control Strategies:

- 1) **Glyphosate-resistant horseweed in soybean and cotton.**
  - a. Most horseweed in Arkansas is now resistant to glyphosate. In soybeans, begin with a burndown application of 8 oz/A of Clarity tank-mixed with glyphosate or start clean with tillage. If burning down with Clarity, allow at least 14 days after 1.0 inches of rainfall prior to planting. Include a residual component such as Valor or a Valor-containing pre-mix for extended horseweed control.
  - b. In cotton, apply glyphosate plus Clarity at least 21 days prior to planting + 1 inch of rainfall. Valor can be added for extended residual control.
  - c. Glufosinate may be a partially effective burndown treatment for glyphosate-resistant horseweed if the Clarity timing is missed. In soybean, 1.0 oz/A of Python can be added for burndown and residual control.
  - d. Tank-mix glyphosate with FirstRate herbicide POST in soybean.
  - e. Rotate to Liberty Link varieties and use glufosinate POST.
- 2) **Glyphosate-resistant Palmer amaranth in soybean and cotton.**
  - a. In soybean, start clean with tillage or a burndown program. Use a residual treatment of either Prefix, Dual, Valor or Valor-containing pre-mix (Valor XLT, Gangster, Envive, etc.). Use Flexstar or Ultra Blazer at a full rate early-POST to 3- to 4-inch pigweeds. Rotate to Liberty Link Soybean and use glufosinate in combination with a residual treatment listed above.

- b. In cotton, start clean with a good burndown program or tillage. It is necessary to prevent pigweeds from emerging in cotton as postemergence options in conventional and Roundup Ready cotton are not effective. Apply Prowl or Treflan PPI. Apply Direx, Caparol or Cotoran PRE to delay the emergence of pigweed. Metolachlor-containing products can be applied POST up to the fifth leaf with glyphosate. Follow this with a lay-by application of Valor. Consider rotating to corn, use atrazine or Liberty Link cotton, and use glufosinate POST.
- 3) **PPO (Group 14)-resistant Palmer amaranth in soybean and cotton.**
- a. In soybean, consider a rotation to Liberty Link technology. Start clean with tillage or a burndown program that includes Gramoxone (paraquat). Use a residual PRE or preplant treatment that includes herbicides with multiple modes of action. Boundary, Canopy + Dual Magnum or other herbicide combinations of metribuzin and Dual Magnum or Zidua are highly recommended. In Liberty Link Soybean, include Prefix, Dual Magnum or Zidua with the early post applications of Liberty.
- b. In cotton, plant a cultivar that is tolerant to Liberty herbicide. Apply Gramoxone (paraquat) plus Cotoran or Diuron at planting. Early post applications of Liberty should include a residual herbicide such as Dual Magnum for pigweed control. Layby applications should include MSMA plus Anthem Flex, Zidua or Fierce.
- 4) **Glyphosate-resistant giant ragweed in soybean.**
- a. Use tillage to control ragweed prior to planting. Giant ragweed usually only germinates one time per year and can be controlled with a timely tillage. Use 2,4-D in a burndown program, at least 14 days prior to planting + 1 inch rainfall.
- b. Use a full rate of Flexstar or FirstRate postemergence prior to 6-inch giant ragweed.
- 5) **Glyphosate-resistant johnsongrass in soybean and cotton.**
- a. Apply a full rate of Select or other graminicide instead of glyphosate to 8-inch-tall johnsongrass. Multiple applications may be needed.
- b. In Liberty Link soybeans, use two applications of glufosinate plus a half rate of a graminicide.
- 6) **Hoelon-resistant ryegrass in wheat.**
- a. Most wheat-producing counties in Arkansas have had at least one confirmed field of Hoelon-resistant ryegrass. A preemergence treatment of Finesse or very early POST treatment of Finesse Grass and Broadleaf will provide effective control of Hoelon-resistant ryegrass. A rainfall is needed to activate the residual component of these treatments. Utilize Osprey or PowerFlex POST for control of Hoelon-resistant ryegrass. Prowl H<sub>2</sub>O or Axiom are good residual options if you are planning on a follow-up POST treatment.
- 7) **ALS-resistant weeds (Group 2).**
- a. ALS-resistant pigweed and cocklebur once infested soybean fields from years of Scepter and Classic use. However, since the introduction of Roundup Ready soybeans, the occurrence of these has been significantly reduced. See glyphosate-resistant Palmer amaranth above.
- b. Since the introduction of Clearfield rice, outcrossing of weedy rice with the CL varieties has occurred. This has resulted in the occurrence of CL-tolerant red rice or outcrossed ALS-resistant biotypes of red rice. Rotation to Roundup Ready soybeans or conventional soybeans with a red rice program of Dual followed by a graminicide (Select) is recommended for these fields. In addition, the heavy reliance on Newpath herbicide for barnyardgrass control has sparked concerns over more grass species becoming resistant to Newpath and other ALS chemistry. The University of Arkansas Cooperative Extension Service recommends the use of Command, propanil or other non-ALS barnyardgrass herbicides in combination with Newpath for resistance management.
- 8) **Propanil-resistant barnyardgrass in rice.**
- a. Most rice-producing counties have tested positive for at least one field of propanil-resistant barnyardgrass. Alternate propanil with other barnyardgrass control options in rice such as Ricestar HT, Facet or Regiment. Begin with a preemergence application of Command. Tank-mix residual herbicides, such as Bolero, Prowl H<sub>2</sub>O, Command and Facet, with propanil.
- 9) **Command-resistant barnyardgrass in rice.**
- a. Two populations of Command-resistant barnyardgrass have been identified in Arkansas as of the fall of 2008.
- b. Follow up any “misses” from a Command PRE application with Ricestar HT or Facet and do not allow these plants to get too big or go to seed. Often Command can antagonize glyphosate (Roundup), causing control failures in burndown applications. Do not allow these plants to get too big prior to a follow-up in-season application in rice.
- 10) **Facet-resistant barnyardgrass in rice.**
- a. A growing number of rice fields have tested positive for Facet-resistant or a combination of Facet + propanil-resistant barnyardgrass.
- b. Alternative programs should be used. Clearfield rice with Newpath herbicide, Command PRE and Ricestar HT or Clincher POST.
- 11) **ALS-resistant barnyardgrass in rice (Group 2).**
- a. Use Command PRE in Clearfield rice.
- b. Grasp and Regiment are also ALS herbicides.
- 12) **DNA-resistant goosegrass.**
- a. Documented occurrence of this pest has been reduced since the introduction of Roundup Ready crops.
- 13) **ALS-resistant sedges, annual sedge, smallflower, umbrella sedge and yellow nutsedge (Group 2).**
- a. Bolero delayed PRE followed by propanil + Basagran.
- b. Strada, Permit, Permit Plus, Halo Max, Gambit, Grasp, League, Regiment, Newpath and Beyond are ALS herbicides.
- 14) **Glyphosate-resistant ryegrass.**
- Populations of ryegrass have been identified in Arkansas that are resistant to glyphosate. Treatment options include fall applications of herbicides, such as Dual, for preemergence control of ryegrass along with POST applications in the fall or early spring of paraquat or Select. See the burndown section for more information.