AGRICULTURAL

MU Guide

PUBLISHED BY UNIVERSITY EXTENSION, UNIVERSITY OF MISSOURI-COLUMBIA

Waterhemp Management in Missouri

William G. Johnson, Commercial Agriculture Program
Andrew Kendig, Commercial Agriculture Program
Donald E. Null, University of Missouri Extension, Grant City

The pigweed, or Amaranthus, family of weeds is one of the most common groups of weeds in field crops across the Midwest. These weeds can cause significant crop yield losses, interfere with harvest, and some species have shown an ability to develop resistance or tolerance to herbicides. There are eleven documented species of pigweed present in Missouri. Redroot, smooth, common waterhemp, tall waterhemp, spiny amaranth, Palmer amaranth, tumble pigweed and prostrate pigweed are most common in crop fields and noncrop areas. Some of the pigweed species may cross-pollinate and hybridize to produce plants that exhibit characteristics of both parents. All pigweed species produce large numbers of seeds. Redroot pigweed can produce more than 100,000 seeds per plant. These adaptive characteristics allow pigweeds to reproduce and adapt to changing environments and cultural practices.

In northern and central Missouri, waterhemp has become the predominant species of pigweed. This follows an increasing incidence of failure of chemical weed control for pigweed species throughout the state. In most cases the herbicides involved are designed to inhibit the acetolactate synthase (ALS) enzyme in the weeds; fields are typically treated for several consecutive years with these ALS-inhibiting herbicides. This herbicide family includes products such as Accent, Beacon, Classic, Concert, Pinnacle, Pursuit, Scepter and Synchrony and other prepackaged mixtures containing any of the same active ingredients. The species that has most often developed tolerance for such herbicides and has escaped treatment is either *Amaranthus rudis* (common waterhemp) or *Amaranthus tuberculatus* (tall waterhemp). Interestingly, in southeastern Missouri, the pigweed population is still largely mixed. However, much like waterhemp, Palmer amaranth (*Amaranthus palmeri*) is becoming increasingly tolerant of most broadleaf herbicides, and herbicide resistance has been confirmed in a few locations outside Missouri. If this trend continues, herbicide-resistant Palmer amaranth may become as prevalent throughout the southern United States as resistant waterhemp is in Missouri.

Herbicide-resistant waterhemp may be on the increase in Missouri

ALS-resistant waterhemp is suspected in Missouri, Iowa, Illinois, Minnesota and Kansas. The current herbicide lineup was and still is effective in controlling redroot and smooth pigweed and most biotypes of common and tall waterhemp. However, research at the University of Missouri has shown that the dinitroaniline, imidazolinone and sulfonylurea herbicides are 5–30 percent less effective in controlling common and tall waterhemp than in controlling smooth and redroot pigweed. In addition, repeated use of herbicides such as Accent, Beacon, and Pursuit (on imidazolinone-tolerant [IT] or imidazolinone-resistant [IR] corn) in field corn and Classic, Concert, Pinnacle, Pursuit, Scepter and Synchrony in soybeans has provided an environment that allows ALS-resistant waterhemp biotypes to survive. Use of ALS inhibitors in all crops in a rotation is called ALS stacking. This practice is becoming more common throughout the Midwest and middle southern states because of the broad range of weeds controlled by this class of herbicide chemistry.

Current research at the University of Missouri includes a long-term study designed to induce ALS resistance in a field where it had not been suspected. The study is being conducted in a conventional-till, corn-soybean rotation where ALS-inhibiting herbicides are used on both corn and soybeans. In the third year of the study, we began to suspect that a resistant waterhemp biotype was infesting one of the plots. During the fourth year, we noticed even more of a resistance problem. Seeds were collected from the escapes and grown in a greenhouse. The plants were

sprayed with five times normal rates of several ALS-inhibiting herbicides and survived many of these treatments. This confirmed the presence of a biotype resistant to ALS inhibitors after four years of continuous use of these types of herbicides.

How do I identify waterhemp?

The first and most important step in any weed control program is to correctly identify the weed. Kansas State University has published an excellent pigweed identification key available through the KSU Cooperative Extension Service Distribution Service, 16 Umberger Hall, Kansas State University, Manhattan, KS 66506-3406. Briefly, **redroot and smooth pigweed** are erect plants with **short, fine hairs on the stem and leaves giving the surfaces a rough texture**. The leaves are somewhat rounded. These species are sometimes called rough pigweed. **Common and tall waterhemp** are erect plants **without hairs on the stem and leaves**. The plants will often have a glossy appearance. The leaves are generally long and narrow. It is difficult to distinguish common from tall waterhemp until the plants have flowered. Although botanists distinguish between common and tall waterhemp, there is no difference in their outward appearance or in their response to herbicides.

How do I control waterhemp?

Currently there are several techniques for managing waterhemp. Although crop rotation is an excellent tool for managing weed, insect and disease pests, simple rotation does not necessarily decrease selection pressure for ALS-resistant weeds, especially if ALS-inhibiting herbicieds are used on both corn and soybeans. The key to managing this problem will be to use programs that control the weed by a different means. One technique is cultivation where possible. In addition, soil-applied herbicides such as atrazine, Dual, Frontier, Lasso (for corn and grain sorghum), Prowl and Surpass/Harness in corn and Dual, Frontier, Lasso, Lorox, Prowl, Sencor, Sonalan and Treflan in soybeans have shown excellent activity on waterhemp if there is enough rainfall for activation. Consult Tables 1, 2 and 3 for the relative effectiveness of several herbicides on waterhemp.

Several premixes containing the above-listed herbicides for corn, grain sorghum and soybeans offer a grower convenience and two different modes of action against waterhemp. These premixes are listed below. With all soil-applied herbicides, expect 30 to 45 days of weed control from the time of application. If the crop canopy has not closed at this time, sunlight reaching the soil surface may cause more weeds to germinate, and postemergence herbicides will be needed. Scout fields after 4 to 6 weeks to determine if postemergence herbicides are necessary.

The purpose of this publication is to provide a guideline for selecting herbicides to control waterhemp. It is not our intent to exclude ALS-inhibiting herbicides in our recommendations. These herbicides are effective and economical on a broad range of weed species in Missouri. However, an additional mode of action is needed in our arsenal against waterhemp. The pigweed response tables for corn, grain sorghum and soybeans are also included in this publication to provide additional information about the weed control spectrum of each herbicide.

No single herbicide program will meet the specific needs of every grower. To determine a program that fits a particular field, use MU publication MP 575, *Weed Control Guide for Missouri Field Crops*, to determine the target weeds in each crop. Use that publication to develop a list of potential herbicides for your crop. Then refer to Table 2 in MU publication G 4907, *Herbicide Resistance in Weeds*, to determine the mode of action for the herbicides on your list. Select herbicides that control waterhemp by some means other than inhibiting the ALS enzyme, or select a herbicide that has two modes of action, one of which is active against waterhemp. An example of a herbicide with two modes of action in soybeans is Canopy, which contains metribuzin (Sencor or Lexone) and chlorimuron (Classic). Metribuzin is a photosynthetic inhibitor and chlorimuron is an ALS inhibitor. If you have a serious problem with ALS-resistant waterhemp, avoid ALS-inhibiting herbicides altogether. Instead use soil-applied herbicides such as those listed below and follow up with postemergence treatments. Each of the soil-applied premix combinations listed below contain herbicides that control waterhemp with two modes of action. Atrazine and Sencor/Lexone are photosynthetic inhibitors. Dual, Frontier, Harness/Surpass and Lasso are growth inhibitors. Treflan/TRI-4 is a mitotic inhibitor.

ALS-inhibiting herbicides can still be used for other weeds. For example, use Accent and Beacon to control johnsongrass and shattercane in field corn, but target waterhemp with a soil-applied program, cultivation, or non-ALS-inhibiting postemergence herbicides.

Field corn

A typical weed-control program for field corn might include one of the soil-applied herbicides mentioned above, cultivation or postemergence herbicides.

Soil-applied herbicides such as Bicep, Bullet, Guardsman, Harness Extra, Lariat and Surpass 100 contain a chloroacetamide herbicide (Dual, Frontier, Harness/Surpass, Lasso) and atrazine. These premix-

es provide two modes of action against waterhemp. For information about proper applicationrates based on soil type, consult MU publication MP 575, the herbicide label or your dealer.

For postemergence control of waterhemp in fields that also need grass control measures, Accent or Poast (on Poast-tolerant corn) can be tankmixed with several herbicides that are not ALS inhibitors but will control waterhemp. See the respective herbicide labels for a list of labeled tank mixes. If your weed spectrum is such that an ALS inhibitor is not needed, then do not apply it, this will prevent additional selection pressure for weeds resistant to ALS inhibitors. If postemergence herbicides are needed, then atrazine, Banvel/Clarity, Buctril + atrazine, Laddok, Marksman, Tough and 2,4-D can provide good control of waterhemp in field corn.

Grain sorghum

A typical weed-control program in grain sorghum might include one of the soil-applied herbicides, cultivation and postemergence herbicides. The soil-applied herbicides Bicep and Lariat contain a chloroacetamide (Dual, Lasso) and atrazine, which will provide two modes of action against waterhemp. Consult MU publication MP 575, the herbicide label or your dealer for proper application rates based on soil type. You can control waterhemp without using ALS inhibitors through postemergence applications of atrazine and oil, Banvel, Laddok, or Buctril + atrazine; over-the-top application of 2,4-D; or post-directed application of Lorox or Gramoxone.

Soybeans

In soybeans a typical weed-control program might include a soil-applied herbicide such as Dual, Frontier, Lasso, Lorox, Prowl, Sencor, Sonalan and Treflan; cultivation; or a postemergence herbicide. Soil-applied herbicides such as Freedom (Lasso + Treflan), Salute (Treflan + Sencor/Lexone), and Turbo (Dual + Metribuzin) provide two modes of action against waterhemp. Many of these herbicides can also be tank mixed to provide broad-spectrum weed control. Typical tank mixes combine a “grass” herbicide, such as Dual, Frontier, Lasso, Prowl, Sonalan or Treflan, with a “broadleaf” herbicide, such as Lorox or Sencor/Lexone. Consult MU publication MP 575, the herbicide label or your dealer for proper application rates based on soil type.

If using Pursuit postemergence or one of the postemergence grass herbicides, refer to MU publication MP 575 and the manufacturer’s label for a list of labeled tank mix or sequential partners.

Blazer/Status, Cobra and Reflex/Flexstar are diphenyl ether herbicides and offer excellent waterhemp control. Premixed products such as Galaxy, Storm and Stellar contain one of the above diphenyl ether herbicides and can be used postemergence over-the-top in soybeans to provide broad-spectrum weed control. Many growers will tank mix a postemergence grass product with one of the above broadleaf products. Consult MU publication MP 575 for a more detailed discussion of labeled tank mixes, application timings and additives. It is important to remember that reduced grass control is probable when tank mixing postemergence grass and broadleaf herbicides, unless the rates are increased for the grass-control herbicide. Goal + 2,4-DB, Gramoxone, and Lorox + 2,4-DB can be used post-directed in soybeans to provide control of waterhemp.

With the addition of Roundup-Ready soybeans to our weed-control options in 1996, we have an additional mode of action against waterhemp. If you are growing Roundup-Ready soybeans, you may want to use a soil-applied herbicide, cultivate and apply Roundup.

In either drilled or wide-row Roundup-Ready soybeans, be prepared to make two postemergence applications of Roundup to the field, especially if canopy closure is slow and if cultivation and soil-applied herbicides are not used.

Conclusions

In a field with a serious waterhemp infestation, use a sequential herbicide approach. Sequential approaches use soil-applied herbicides followed by postemergence herbicides and cultivation in conventional tillage systems. Soil-applied herbicides typically provide 30 to 45 days of control. As the herbicide breaks down in the soil, more weeds will emerge if environmental conditions are favorable for germination and growth. As this flush of weeds begins to emerge, scout to determine the weeds present and apply postemergence herbicides or cultivate if necessary.

Use the full labeled rate with soil-applied herbicides on reduced-till fields since the residue will intercept a portion of the herbicide. **It is also important to remember that the best postemergence annual weed control with all herbicides will be obtained when the weeds are less than 6 inches tall at application. Scout your fields early and often to identify the weeds present.**

The waterhemp problem is not out of our control. However, we need to apply the lessons learned from our previous herbicide mismanagements to keep our current products available and efficacious for our production systems.

Table 1. Field corn: Pigweed and waterhemp response to herbicides.

Herbicide	Redroot and smooth pigweed	Common and tall waterhemp
Preplant incorporated		
Sutan +/Genate +	8	–
Preplant incorporated or preemergence		
Atrazine	10	10
Bladex	6	5
Dual	9	9
Frontier	9	9
Harness/Surpass	10	9
Lasso/Microtech	9	9
Princep	10	–
Preemergence		
Prowl	9	7
Ramrod	7	6
Postemergence		
Accent	8	7
Atrazine + oil	10	10
Banvel/Clarity	9	8
Beacon	8	7
Basagran	4	3
Bladex 80W or 90 DF	7	6
Buctril	7	6
Buctril + atrazine	9	8
Laddok	9	8
Marksman (Banvel + atrazine)	9	8
Pursuit (Pursuit-tolerant corn only)	9	7
Sencor	–	–
Tough	9	8
2,4-D	9	8

Table 2. Soybeans: Pigweed and waterhemp response to herbicides.

Herbicide	Redroot and smooth pigweed	Common and tall waterhemp
Preplant incorporated		
Prowl	10	8
Sonalan	10	9
Treflan/trifluralin/others	10	9
Vernam	10	–
Preplant incorporated or preemergence		
Canopy	10	10
Command	5	4
Dual	9	9
Frontier	9	9
Lasso/Microtech	9	9
Pursuit	-	7
Scepter	10	7
Sencor/Lexone	9	9
Preemergence		
Gemini	10	10
Lorox/Linex	9	8
Lorox Plus	10	10
Prowl (PRE)	9	
Postemergence overtop		
Basagran	4	3
Blazer	10	9
Classic	8	7
Cobra	10	9
Pinnacle	9	8
Pursuit	9	7
Reflex/Flexstar	10	9
Scepter	9	7
Storm	9	9
Postemergence directed		
Goal + 2,4-DB	9	9
Gramoxone Extra	9	9
Lorox + 2,4-DB	9	9
2,4-DB	2	1

Table 3. Grain sorghum: Pigweed and waterhemp response to herbicides.

Herbicide	Redroot and smooth pigweed	Common and tall waterhemp
Preplant incorporated		
Atrazine	10	10
Dual	9	9
Lasso	9	9
Preemergence		
Ramrod	7	6
Postplant incorporated		
Treflan	8	7
Prowl	8	7
Postemergence		
Atrazine + oil	10	10
Banvel	9	8
Basagran	4	3
Laddok (Basagran + atrazine)	9	8
Buctril	7	6
Buctril + atrazine	9	8
2,4-D	9	8
Post-directed		
Lorox	9	–
Gramoxone	9	–

Table notes

Weed control:

8 to 10 = Good 6 to 7 = Fair*
Less than 6 = Poor – = No data available

*A weed control rating of 6 to 7 indicates partial control or suppression.

Use these tables as guides for comparing the relative effectiveness of herbicides on pigweeds. Herbicides may perform better or worse than indicated due to extreme weather conditions or other factors. If you are obtaining satisfactory results under your conditions, changing products as a result of information in this table is not necessarily recommended.

University Extension
UNIVERSITY OF MISSOURI
COLUMBIA

■ Issued in furtherance of Cooperative Extension Work Acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. Ronald J. Turner, Director, Cooperative Extension, University of Missouri and Lincoln University, Columbia, MO 65211. ■ University Extension does not discriminate on the basis of race, color, national origin, sex, religion, age, disability or status as a Vietnam era veteran in employment or programs. ■ If you have special needs as addressed by the Americans with Disabilities Act and need this publication in an alternative format, write ADA Officer, Extension and Agricultural Information, 1-98 Agriculture Building, Columbia, MO 65211, or call (573) 882-8237. Reasonable efforts will be made to accommodate your special needs.