

Palmer Amaranth Management in Soybeans



Palmer Amaranth Distribution and Biology

- Native to the southwestern United States, Palmer amaranth (aka Palmer pigweed) has become a devastating weed problem in the South and has recently spread to the upper Midwest.
- Many fields in the eastern Soybean Belt where Palmer amaranth has been found received an application of manure from dairy cows that were fed cotton byproducts as a feed supplement.
- Palmer amaranth is the most competitive and aggressive pigweed species. Season-long competition by Palmer amaranth at 2.5 plants per foot of row can reduce soybean yield by as much as 79 percent.
- Palmer amaranth emerges later than many summer-annual weeds and continues to emerge throughout the growing season. This extended emergence pattern makes it difficult for preemergence and nonresidual postemergence herbicides to control later-emerging plants.
- The high relative growth rate of Palmer amaranth makes control with postemergence herbicides difficult. In the southern United States, Palmer amaranth has been documented to grow as much as 2.5 inches per day. In Michigan, Palmer amaranth grows 4 inches in less than five days during the time of postemergence-herbicide applications.
- Prolific seed production has perpetuated the establishment and spread of Palmer amaranth. A single female Palmer amaranth can produce approximately 600,000 seeds per plant.
- Compared with many other summer-annual weeds, Palmer amaranth seed is relatively short-lived in the soil. Research has shown that only 2 percent of Palmer amaranth seed remains viable in the soil seedbank after six years. However, the sheer number of seeds produced by one female plant makes the eradication of Palmer amaranth difficult once it is established.

Genetic Diversity and Herbicide Resistance in Palmer Amaranth

- Palmer amaranth is dioecious, meaning its male and

female flowers grow on separate plants. This increases the genetic diversity of this species and facilitates the spread of herbicide resistance and other adaptive traits that improve the survival of Palmer amaranth in agronomic systems.

- Since the late 1980s, Palmer amaranth has evolved resistance to five different herbicide sites of action.

Group #	Group 2	Group 3	Group 5	Group 9	Group 27
Site of Action	ALS Inhibitors	Microtubule Inhibitors	Photosystem II Inhibitors	EPSP Synthase Inhibitors	HPPD Inhibitors
Product Examples	Classic®, Pursuit®	Treflan®	atrazine, metribuzin	glyphosate	Callisto®, Laudis®

- Several populations across the United States exhibit resistance to multiple herbicides. For example, many Palmer amaranth populations exhibit resistance to both ALS-inhibiting herbicides (Group 2) and glyphosate (Group 9), and a more recently identified Palmer amaranth population has shown resistance to herbicides from three different sites of action: ALS- (Group 2), Photosystem II- (Group 5) and HPPD-inhibiting (Group 27) herbicides. As the selection pressure from other herbicides increases, multiple resistant populations will evolve.

Management of Herbicide-Resistant Palmer Amaranth in Soybeans

Palmer amaranth with resistance to one or more herbicides is one of the most difficult weeds to manage in soybeans. If you have herbicide-resistant Palmer amaranth in your soybean fields, it is important to follow the steps below for best management. Additionally, cultural practices such as earlier planting, narrow row spacing and optimum planting populations can increase the soybean plant's ability to compete with this weed and will also improve the consistency of the herbicide programs listed below.

1. **Consider planting LibertyLink® soybeans.** Controlling herbicide-resistant Palmer amaranth in Roundup Ready® soybeans has been a challenge. That's because of the limited postemergence-herbicide options available, label restrictions and lack of consistency observed with postemergence herbicides. However, LibertyLink soybeans offer more flexibility in use rates and the number of applications of Liberty (Group 10) that can be made.

2. **Start clean!** Make sure that all herbicide-resistant Palmer amaranth plants are controlled with tillage or an effective burndown herbicide – i.e., Gramoxone® (Group 22) or Liberty (Group 10), prior to planting.
3. **Effective soil-applied (preemergence) herbicides are essential.** Apply the full rate (according to label guidelines for soil type and organic matter content) of an effective soil-residual herbicide, prior to or soon after soybean planting. In many cases, Valor® (Group 14) and Fierce® (Groups 14 & 15) have been the most consistent control options. Valor XLT, Envive®, and Gangster® (Groups 14 & 2) are also Valor (flumioxazin)-based products that have provided good control. Premixes that contain the Group 14 herbicide Spartan (sulfentrazone), Authority® MTZ (Groups 14 & 5), Authority First/XL/MAXX/Assist, and Sonic® (Groups 14 & 2) can also be used. However, rates of these herbicides need to be equivalent to 8 fl. oz./A. of Spartan® (0.25 lb. a.e./A. of sulfentrazone). Adding metribuzin (Group 5) to one of these Group 14 herbicides or herbicide premixtures (where allowed) can provide additional residual control of Palmer amaranth as well as another site of action to the mix. Remember, higher rates of the Group 14 herbicides also increase the likelihood for soybean injury. Group 15 herbicides have provided fair to good initial control of glyphosate/multiple-resistant Palmer amaranth; however, these herbicides may be best utilized as tank mixtures with the postemergence herbicide application.
4. **Timely postemergence herbicide applications.** Proper timing is everything! Postemergence herbicides must be applied before Palmer amaranth is 3 inches tall. In Roundup Ready (RR) soybeans, a Group 14 (Flexstar®, Cobra® or Ultra Blazer®) herbicide should be used. Flexstar has been the most consistent of these herbicides for Palmer amaranth control. In LibertyLink soybeans, use a minimum rate of 29 fl. oz./A. of Liberty. Spray coverage is essential with any of these herbicides, so a minimum of 15 gal./A. of spray solution should be used. Once Palmer amaranth plants exceed 3 inches tall, control with any of these postemergence herbicides is substantially reduced.
5. **Residual product tank-mixtures with postemergence herbicides.** A residual Group 15 herbicide (i.e., Dual® II Magnum®, Warrant™, Outlook® or Zidua®) should be tank-mixed with the postemergence herbicide application. It is essential for the postemergence herbicide – Flexstar,

Cobra, Ultra Blazer or Liberty (LibertyLink soybeans only) – to have effective control of herbicide-resistant Palmer amaranth since the residual herbicides will not control Palmer amaranth that has already emerged. Prefix is one product where the postemergence herbicide Flexstar is premixed with the residual herbicide Dual Magnum.

6. **Additional postemergence herbicide applications if needed.** A follow-up application of an additional postemergence herbicide may be needed. Again, proper timing is everything. Make these applications when Palmer amaranth is 3 inches tall or less. In RR soybeans, if Flexstar was used in the first postemergence application, Cobra or Ultra Blazer is the only herbicide option remaining. If Palmer amaranth is larger than 3 inches, you will have to use 12.5 fl. oz./A. of Cobra. The use of a methylated seed oil (MSO) as the adjuvant with these mixes may also improve control. In LibertyLink soybeans, Liberty should be applied at rates ranging from 29 to 36 fl. oz./A., depending on weed height.

While following these strategies may not be 100 percent effective, they can substantially reduce herbicide-resistant Palmer amaranth populations. Additional cultural control measures, such as hand-weeding, should be implemented to eliminate any remaining herbicide-resistant Palmer amaranth plants from the field. It is also important to manage Palmer amaranth around field edges and ditch banks. Remember, one female plant can produce upward of 600,000 seeds per plant. It is important to reduce seed production from this weed to stop its further spread. If you think that you have this weed or other glyphosate-resistant weeds in any of your fields, make sure these are the last fields that you harvest. This will reduce the transportation of resistant weed seed to your other fields.

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

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