# PALMER AMARANTH: ANOTHER PIGWEED SPECIES TO CONSIDER

Aaron Hager [1/]

***Background***

*Amaranthus* species are among the most troublesome weed species in agronomic production systems because of their innate ability to cause crop yield loss and their propensity to develop resistance to various herbicide site-of-action families. Several *Amaranthus* species are regarded as weedy pests across the Great Plains region, including the monoecious (male and female flowers on the same plant) species redroot pigweed (*A. retroflexus*), smooth pigweed (*A. hybridus*), Powell amaranth (*A. powellii*), tumble pigweed (*A. albus*), prostrate pigweed (*A. blitoides*), and spiny amaranth (*A. spinosus*), and the dioecious (separate male and female plants) species common waterhemp (*A. rudis*) and Palmer amaranth (*A. palmeri*). Among these species, smooth pigweed, redroot pigweed, Powell amaranth, Palmer amaranth, and the waterhemps are most common in Illinois corn and soybean fields. Historically, Palmer amaranth's range was limited in Illinois but the species appears to be expanding its range in the state.

Palmer amaranth is perhaps the most "aggressive" *Amaranthus* species with respect to growth rate and competitive ability. The growth rate and competitive ability of this species exceed that of other *Amaranthus* species. Horak and Loughin (2000) conducted a two-year field experiment to compare several growth parameters of Palmer amaranth, waterhemp, and redroot pigweed. Their research demonstrated that Palmer amaranth had the highest values for plant volume, dry weight, and leaf area of all species, as well as the largest rate of height increase. Klingaman and Oliver (1994) reported soybean seed yield was reduced between 17 and 68 percent from Palmer amaranth interference at densities between 0.33 and 10 plants per meter of crop row. Yield losses in corn from Palmer amaranth interference also have been reported (Massinga et al., 2001).

***Resistance to herbicides***

Biotypes of Palmer amaranth from across the United States have developed resistance to herbicides from0 various herbicide families, including dinitroanilines, triazines, glyphosate, and HPPD-, PPO- and ALS inhibitors.

***Identification of Palmer amaranth***

Accurate identification of weedy *Amaranthus* species during early vegetative stages can difficult because many exhibit similar morphological characteristics (i.e., they look very much alike). Additional difficulty in *Amaranthus* species identification arises due to hybridization between certain dioecious and monoecious species. During the 1990s, waterhemp provided an excellent example of how difficult it can be to differentiate among the various *Amaranthus* species, especially when plants are small. The following descriptions are provided to aid the reader in the identification of Palmer amaranth. Refer to Table 1 for a generalized summary of identification characteristics for several *Amaranthus* species.

While many people tend to identify weeds based on "how the plant looks", more accurate identification can be achieved by examining parts of the flowers. Historically, taxonomic separation of *Amaranthus* species has been based on differences in floral characteristics, but new methods utilizing molecular biology techniques also are being employed. Instead of delving into molecular biology, the following discussion will be restricted to separating the *Amaranthus* species based on floral characteristics. Definitions of the terms that will be used in the discussion, beginning with the outer parts of a flower and working inward to the seed, follow.

*Inflorescence* - flowers collectively. While many people associate the term flower with the colorful plants growing around the home, this term herein refers to the reproductive structures of the plant. Male flowers produce pollen, while female flowers produce seed.

*Bract* - a modified leaf associated with flowers. A bract differs from foliage leaves in shape, color, size, texture, or some other feature.

*Tepal* - leaf-like scales that encircle the outer flower parts. Some people refer to these structures as *sepals* when describing *Amaranthus* species flowers. If the inflorescence of a mature pigweed plant is brushed against the palm of the hand, the tan-colored structures that fall into the hand are tepals.

*Utricle* - a membranous bladder-like sac enclosing an ovary or fruit (seed). The utricle is contained with the tepals, and the seed is enclosed by the utricle.

*Seed* - small, hard, black, and often glossy. Seeds give rise to the next generation of plants.

***Identification of immature Palmer amaranth plants***

The cotyledon leaves of Palmer amaranth are relatively long compared with other *Amaranthus* species (Figure 1). Similar to the other weedy *Amaranthus* species in Illinois, the true leaves (those produced after the cotyledon leaves) of Palmer amaranth have a small notch in the tip (Figure 2).

Figure 1.  Cotyledons of Palmer amaranth.

Figure 2.  Notch in leaf tip of Palmer amaranth.

The stems and leaves have no to very few hairs, which causes these plant parts to feel smooth to the touch.  Leaves are alternate on the stem and are generally lance-shaped or egg-shaped and frequently with prominent white veins on the underside.  As plants become older, they often assume a poinsettia-like appearance and occasionally have a V-shaped chevron on the leaves (Figure 3).  Leaves are attached to the stem by petioles; petioles at the base of the stem usually are as long or longer than the leaf blade.

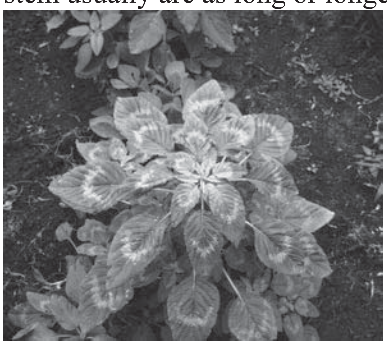

Figure 3.  White chevron on the leaves of Palmer amaranth.

***Identification of mature Palmer amaranth plants***

Palmer amaranth plants are either male or female; male plants produce pollen while female plants produce seed.  The terminal inflorescence of male and female plants (Figure 4) is generally unbranched and very long.  Female Palmer amaranth plants have a long terminal inflorescence (10 to 24 inches) with flowers containing 5 spatulate-shaped tepals.

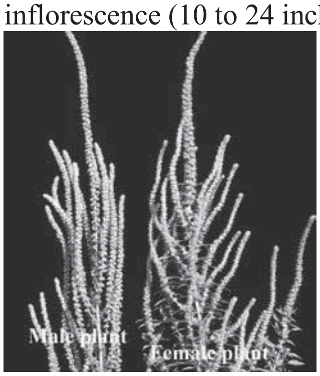


Figure 4.  Male and female inflorescences of Palmer amaranth.

The tepals are about twice the length of the seed, and the seed capsule (utricle) breaks into 2 regular sections when fractured. Grabbing the inflorescence of a mature female Palmer amaranth plant with a bare hand is **not** recommended as the bracts are very stiff and sharp. The terminal inflorescence of male Palmer amaranth plants is much softer to the touch. Palmer amaranth is an aggressively growing plant that often reaches 6 to 8 feet in height (Figure 5).

Figure 5. Mature Palmer amaranth plants.

***Management considerations***

The ability of Palmer amaranth to aggressively compete with crop plants warrants careful attention to its integrated management in corn and soybean. The occurrence of herbicide-resistant biotypes of Palmer amaranth increases the difficulty in managing this species due to the loss of several previously effective herbicide options. Thus, weed control practitioners should not rely exclusively on this herbicide family to manage Palmer amaranth.

There are some several soil-applied and post-emergence herbicide programs that can provide good control of Palmer amaranth, but each type of application timing has some basic considerations that can influence the degree of success achieved. The most consistent management programs for corn and soybean involve an integrated approach that utilizes soil-applied herbicides, post-emergence herbicides, and mechanical cultivation.

***Considerations with soil-applied programs***

Numerous soil-applied herbicides possess good activity on Palmer amaranth and other small-seeded species. Time of application can have a significant impact on the successfulness of soil-applied herbicides for Palmer amaranth control. A common practice in no-till systems is to apply the herbicide several weeks prior to planting in order to receive sufficient precipitation to incorporate the herbicide. Keep in mind, however, that the earlier a herbicide is applied, the earlier within the growing season that the level of weed control begins to decline. Palmer amaranth, similar to waterhemp, is capable of emerging later into the growing season than many other summer annual weed species. Application of soil-residual herbicides closer to the time of corn or soybean planting may enhance Palmer amaranth control later into the growing season compared with applications made several weeks prior to planting.

Herbicide families that demonstrate control or suppression of Palmer amaranth include the triazines (atrazine, simizine, metribuzin), dinitroanilines (trifluralin, pendimethalin), chloroacetamides (metolachlor, acetochlor, dimethenamid, alachlor), and protox inhibitors (flumioxazin, sulfentrazone).

***Considerations with post-emergence herbicides***
There are several postemergence herbicides that are very effective on Palmer amaranth. The factors governing the effectiveness of postemergence herbicides are critically important when dealing with Palmer amaranth. Herbicide application rate and timing, spray additives and volumes all influence how well postemergence herbicides perform.

Often, producers like to wait as long as possible to apply postemergence herbicides, especially those herbicides that lack significant soil residual activity. Because Palmer amaranth can germinate and emerge over an extended period of time, there typically exists a wide range of plant sizes by the time postemergence herbicides are applied. This can present problems with spray interception by smaller plants under the protective canopy of larger plants. Adjustments in spray volume and pressure can help to overcome some of the problem with coverage. Spray volumes of 15 to 20 gallons per acre with application pressures of 40 to 60 pounds per square inch generally provide a very uniform coverage of the target vegetation.

Postemergence herbicides that demonstrate control or suppression of Palmer amaranth include growth regulators (dicamba, 2,4-D), diphenylethers (acifluorfen, lactofen, fomesafen), glufosinate, and glyphosate.

Literature Cited
Horak, M.J., and T.M. Loughin. 2000. Growth analysis of four *Amaranthus* species. Weed Sci. 48:347-355.

Klingaman, T.E., and L.R. Oliver. 1994. Palmer amaranth (*Amaranthus palmeri*) interference in soybeans (*Glycine max*). Weed Sci. 42:523-527.

Massinga, R.A., R.S. Currie, M.J. Horak, and J. Boyer Jr. 2001. Interference of Palmer amaranth in corn. Weed Sci. 49:202-208.

Table 1. Identification characteristics of several *Amaranthus* species common to Illinois.

| Species | Hairs | Leaves | Flowers | Flowering Structures |
|---|---|---|---|---|
| Redroot | Small, fine | Rounded | Monoecious | Highly branched, compact |
| Smooth | Small, fine | Rounded | Monoecious | Highly branched, less compact than redroot |
| Powell amaranth | Small, fine | Tapered and slightly pinched at end | Monoecious | Branched, but less than redroot or smooth, 4 to 8 inches long |
| Spiny amaranth | None | "V" chevron, spines at nodes | Monoecious | Male flowers at top, female flowers in axils |
| Tumble | Small, fine | Egg-shaped, wavy edges, olive green color | Monoecious | No distinct flowering structure, flowers at nodes |
| Prostrate | Few to none | Spatulate | Monoecious | No distinct flowering structure, flowers at nodes |
| Palmer amaranth | Few to none | Poinsettia-like, "V" chevron | Dioecious | Non-branched, 1 to 2 feet long |
| Waterhemp | None | Lanceolate | Dioecious | At top of plant and tips of branches |