ROUNDUP READY PLUS.
WEED MANAGEMENT SOLUTIONS

Palmer Amaranth: A Weed to Watch

Palmer amaranth is spreading to fields in various regions of the United States and control of this weed is imperative to maintain productivity. It is important to correctly identify it from other Amaranthus species as it is aggressive, competitive, and has many characteristics common to plants that are prone to develop herbicide resistance. The earlier this weed is properly identified and controlled after an initial infestation, the easier it will be to manage to help minimize potential yield losses.

Figure 1. Palmer amaranth is dioecious with separate male (left) and female (right) plants.
Photo on right is courtesy of Dr. Dallas Peterson, Kansas State University, Agricultural Experiment Station and Cooperative Extension Service.

Why take Palmer Amaranth Seriously?

Palmer amaranth (*Amaranthus palmeri)*, also known as Palmer pigweed, and carelessweed, has several characteristics that make it a very successful weed[2]. To help put the threat of Palmer amaranth in perspective, its aggressive characteristics are often discussed relative to waterhemp and redroot pigweed.

Potential yield loss. Palmer amaranth is very competitive, capable of causing significant yield loss in various crops. Soybean yields were reduced by 78%, 56%, and 38% for Palmer amaranth, waterhemp, and redroot pigweed respectively, when 8 plants/m^2 started competing at crop emergence[3]. Corn yields have been shown to decrease 11 to 91% with 0.5 to 9 Palmer amaranth plants/m^2.

Prolific. A female Palmer amaranth plant has the ability to produce 500,000 to 1 million seeds[2]. Male plants can be equally as effective in pollen production. Additionally, Palmer amaranth has a higher germination rate than many other *Amaranthus* species[3]. Seeds are small, similar to the size of radish seeds or poppy seeds, which makes them fairly mobile. It doesn't take many surviving plants to provide seed for the following growing season. However, Palmer amaranth seeds are relatively short-lived in the soil, with about 80% mortality in 3 years[1].

Higher Photosynthetic and Growth Rate. Palmer amaranth has three to four times the photosynthetic rate of corn, cotton, and soybean[3]. A high photosynthetic rate contributes to its ability to grow rapidly. Research from Kansas State University in 1994 showed that for every 25 growing degree days (GDD), which is a typical GDD accumulation for a day in July, Palmer amaranth grew 2.1 inches, waterhemp grew 1.6 inches, and redroot pigweed grew 1.2 inches. Actual growth rates varied depending on environmental conditions and emergence dates, but Palmer amaranth consistently had more aggressive growth than waterhemp and redroot pigweed, in terms of height and leaf area[4].

Dioecious. Of the approximately 75 *Amaranthus* species, 10 are dioecious, meaning that there are separate male and female plants[3]. Waterhemp (common and tall) and Palmer amaranth are 3 of the 10 dioecious species (Figure 1). Having separate male and female plants increases the ability for cross pollination which can increase genetic diversity within a species. Also, the dioecious nature of Palmer amaranth has resulted in it having an even greater ability to readily hybridize with waterhemp and monoecious pigweeds such as redroot and smooth pigweeds.

Herbicide Resistance

Many of the characteristics that make Palmer amaranth a successful weed, also make the presence of herbicide-resistant biotypes fairly daunting. Glyphosate resistance may be spread by seed and/or pollen. Since Palmer amaranth is prolific with small seed that are spread easily, as well as being dioecious and capable of cross pollinating, herbicide resistance can be spread rapidly. Due to the rapid growth, rescue treatments are challenging, making early identification critical. Fields should be scouting in season and in the fall for Palmer amaranth to tailor weed management strategies for control.

Populations of Palmer amaranth have been identified as resistant to dinitroanilines (pendimethalin), ALS inhibitors (chlorimuron), photosystem II inhibitors (atrazine), and glycine (glyphosate) herbicides[6]. Populations exist in some areas of the United States that exhibit resistance to multiple modes of action. Some populations are resistant to both ALS and glycines, while others are resistant to both ALS and photosystem II inhibitors[6,8]. Glyphosate-resistant populations of Palmer amaranth have been identified in Georgia, North Carolina, Arkansas, Tennessee, New Mexico, Mississippi, Alabama, Missouri, Louisiana, Illinois, Ohio, Michigan, Virginia, Kansas, Arkansas, Delaware and South Carolina[6]. Glyphosate-resistant populations of waterhemp have been identified in Missouri, Illinois, Kansas, Minnesota, Ohio, Indiana, Iowa, Mississippi, North Dakota, South Dakota, Iowa, Oklahoma, Tennessee and Nebraska. Both field and greenhouse work continues to be done to help learn about herbicide resistance in Palmer amaranth.

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Management Options

1. Several tactics are needed to effectively manage Palmer amaranth. It is an aggressive weed and requires aggressive tactics.
2. Residual herbicides can help control the plants prior to emergence and multiple modes of action should be used in a herbicide program.
3. Tillage can help bury the small seeds that require sunlight to germinate; however, subsequent tillage can stimulate germination by bringing seeds back to the surface[1,8].
4. Hand weeding prior to seed set or complete removal of the Palmer amaranth from the field may be necessary if the weed has set seed.

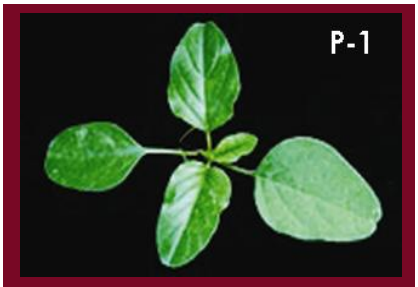

Figure 1. Palmer amaranth and waterhemp are difficult to distinguish, especially in the seedling stage, but key identifying characteristics can aid in identification[7]. Helpful, unique identification characteristics are highlighted.

Photos courtesy of Kansas State University Agricultural Experiment Station and Cooperative Extension Service[7].

Palmer amaranth	Characteristic	Waterhemp
None or rare (P-1 and P-2)	Pubescence (hair)	None or rare (W-1 and W-2)
Smooth (P-1)	Leaf surface	Smooth and waxy in appearance (W-1 and W-2)
Long or longer than leaf blade (P-2 and P-3)	Petiole length	Shorter than leaf blade (W-1 and W-2)
Yes	Dioecious	Yes
1 to 2 feet long, thick, and minimal branching (P-4)	Flowering structure	Open and near the top of plant and tips of branches. Color and length can vary greatly (W-3)
V-shaped variegation on leaf is common, but not always present (P-3)	Other Identifying Characteristics	Leaf shape is variable, but often longer and more slender (W-2)
Symmetrical leaf arrangement can result in a poinsettia appearance (P-3)	Other Identifying Characteristics	

Figures P-1 to P-4. Palmer amaranth from seedling stage through reproductive maturity.
Figure W-1 to W-3. Waterhemp from seedling stage through reproductive maturity.

Sources: [1] Sosnoskie, L.M., et. al. The biology and ecology of Palmer amaranth: implications for control. University of Georgia Extension. http://www.caes.uga.edu (verified 6/27/2013)
[2] Smith, P. March 26, 2011. The truth about pigweed. AgWeb. http://www.agweb.com (verified 6/27/2013)
[3] Steckel, L. 2007. The dioecious Amaranthus spp.: here to stay. Weed Technology vol 21:567-570.
[4] Horak, M.J. and T.M. Loughin. 2000. Growth analysis of four Amaranthus species. Weed Science vol 48:347-355.
[5] Hager, A. Nov. 11, 2005. Palmer amaranth: today's pigweed of concern. University of Illinois Extension. The Bulletin. Issue 24. Article 6. http://bulletin.ipm.illinois.edu (verified 5/8/2013)
[6] Heap, I. The International Survey of Herbicide Resistant Weeds. Online. Internet. http://www.weedscience.com (verified 6/27/2013).
[7] Horak, M.J., et. al. 1994. Pigweed identification: a pictoral guide to the common pigweeds of the great plains. Kansas State University, Agricultural Experiment Station and Cooperative Extension Service. S-80.
[8] Personal communication with Dr. Dallas Peterson, Kansas State University, Agricultural Experiment Station and Cooperative Extension Service. 5/13/2011.

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