Amaranthus species
A current and emerging threat in Wyoming

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Figure 1. Palmer amaranth is a future threat to Wyoming agriculture. Credit: Shawn Askew

Introduction

The genus *Amaranthus* comprises more than 70 summer annual weed species commonly referred to as pigweeds. Many are native to Central and North America, and they have a history of association with agricultural cultivation. In Wyoming, the most common *Amaranthus* species are redroot pigweed (*Amaranthus retroflexus*) and prostrate pigweed (*Amaranthus blitoides*). Amaranthus species occur in cultivated lands, gardens, and disturbed soils.

Palmer amaranth (*Amaranthus Palmeri*) is perhaps the most aggressive pigweed species and has been found in Colorado, South Dakota, and western Nebraska. Although not currently known to exist in Wyoming, this species is rapidly expanding northwesterly and threatens to establish within Wyoming's borders. This species has evolved resistance to many herbicides, so preventing its introduction and establishment is highly critical.

Impacts

Palmer amaranth is a major agronomic weed in most major crops, capable of significantly reducing crop yields when left unmanaged. This plant can grow 3 inches per day in ideal conditions. Palmer amaranth can outcompete even the most aggressive crops. Management is often difficult because Palmer amaranth emerges throughout the growing season, often escaping control measures. Palmer populations can develop resistance to herbicides when not managed appropriately. In the U.S., populations resistant to a single mode of action have been reported in several states and a few with multiple resistance, that is the ability to withstand herbicides from different modes of action.

Current distribution

Palmer amaranth is native to the Southwest United States and became a major agronomic weed in the Southeast. However, palmer has recently been documented in four of the seven states surrounding Wyoming.

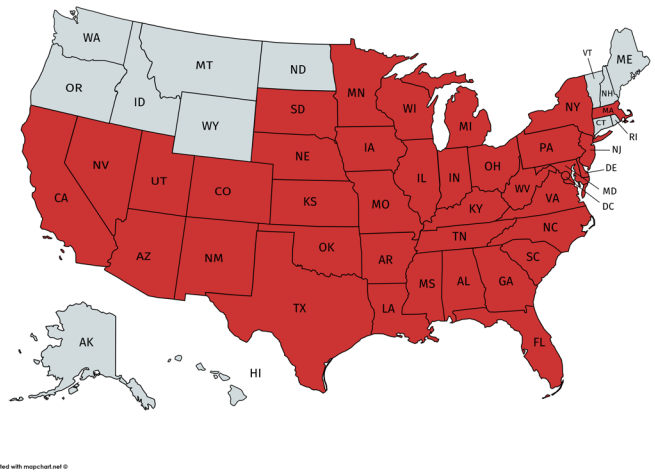

Figure 2. Current distribution of palmer amaranth across the United States.

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Potential dispersal in Wyoming

Palmer amaranth has the potential to establish anywhere in Wyoming. Assuming that tough growing conditions in Wyoming will limit the range of expansion to other areas of the state is not safe, considering its capacity to adapt to different environments that has allowed this species to rapidly spread across the U.S.

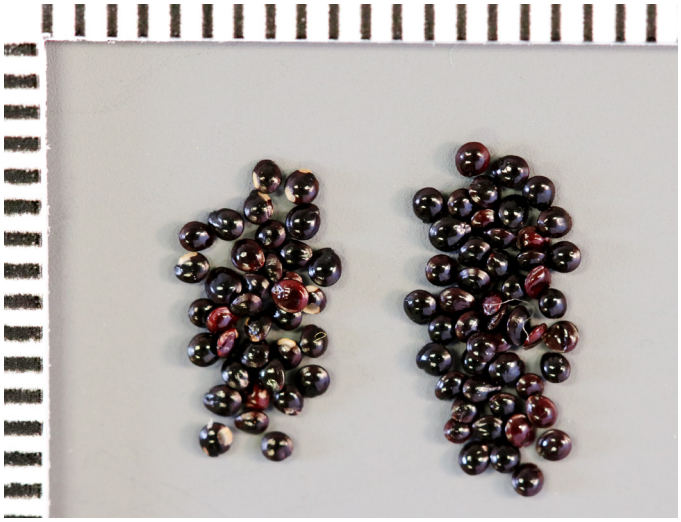

Figure 3: Both palmer amaranth (left) and redroot pigweed (right) are incredibly small seeded. 1mm scale interval. Credit: Andrew Kniss

Palmer has small, inconspicuous seeds that can easily adhere to equipment or act as a contaminant in transported grain. Special considerations should be given to potential vectors of seed dispersal.

- *Manure transport*. Manure is one of the primary pathways Palmer spreads. Cattle feed contaminated with Palmer seed can pass undamaged through the gut of cattle due to the hard seed coat and germinate within the manure. Knowing where manure is sourced is an important step to stopping its spread potential.

- *Movement of agricultural equipment*. Pigweed seeds, in general, are less than 1 mm in length. They can easily attach to dirty equipment and be mistaken for dust. Special emphasis is required when cleaning equipment to avoid transportation.

- *Contaminated feed*. Palmer amaranth spread is possible when using contaminated cottonseed meal feed or hay. Because of its small size, Palmer amaranth seed is potentially difficult to remove from other seed.

- *Restoration seed*. The use of contaminated seed mixes for restoration projects (like conservation reserve program [CRP] and pollinator habitat improvement) has been confirmed as a source of new Palmer amaranth introductions in other states. For this reason, seed produced in states were Palmer amaranth is widespread may be offered at a lower price.

Plant Identification

Pigweed identification can be very difficult because many species look similar during the vegetative stage. Identification can be further complicated as some *Amaranthus* species may hybridize. Nevertheless, there are features that can help identify Palmer from other endemic pigweeds in the state (redroot pigweed and prostrate pigweed).

Palmer Amaranth description. Upon germination, Palmer amaranth has long, linear cotyledons. Adult plants are extremely vigorous and can grow up to 6 feet tall. The stems and leaves are glabrous (smooth and without hairs). The leaves are diamond- to lance-shaped and have long leaf stalks (petioles). The petiole length is a key identifying feature of Palmer amaranth. Palmer can be distinguished from other pigweeds because its petioles are longer than the leaves; other pigweeds have longer leaves than petioles. Leaves may also have a white or red V-shaped pattern; however, similar markings are quite common on many pigweeds, including redroot, and so should not be used as a positive identification. Plants often have a symmetrical leaf arrangement (poinsettia-like). The inflorescence (flowering and reproductive part of the plant) is distinctly long and can reach over 1-foot tall. Plants are dioecious – they are either male or female. Female plants can have very sharp inflorescences while male plants tend to be softer.

Figure 4: Palmer amaranth seedlings are small due to the small seed and the cotyledons are very long and narrow. Credit: Shawn Askew

Figure 5: Palmer amaranth leaf arrangement is "poinsettia-like" to optimally expose leaves to sunlight. Credit: Shawn Askew

Characteristic	Palmer amaranth	Redroot pigweed	Prostrate pigweed
Leaf shape	Diamond or lance-shaped	Broad, lanceolate to obovate.	Ovate to spatulate w/ notched tip
Leaf length	2–4 inches	2–4 inches	½–1inch
Leaf marks	"V" shaped white watermark, sometimes	Veins prominent, "V" shaped or blotchy white or red watermark, sometimes	Occasional white blotchy watermark
Petiole length	Equal to or greater than leaf length	Shorter than leaf length	Less than leaf length
Hair characteristics	No hairs	Pubescent stems	Smooth, no hairs
Flowering structure	Long (6 to 18 inches long) and prickly	Short (up to 8 inches long, usually shorter), stout, prickly	No obvious seed heads, flowers in small clusters in leaf axils, shorter than the petiole

Figure 6: The inflorescence of palmer amaranth, whether male or female is very long.

Figure 7: Prostrate pigweed has much smaller leaves that most often have a significant notch at the tip. Credit: Virginia Tech Weed Guide

Figure 8: Palmer amaranth may have white watermarks on the leaves. This is not as common on other Amaranthus species but should not be used for identification. Credit: Shawn Askew

Figure 9: Redroot pigweed usually displays a bumpier surface and prominent veins.

Figure 10: Palmer amaranth (two right) petioles are as long or longer than the leaf length. Redroot pigweed (left) petioles are shorter than its leaves.

Figure 12: Redroot pigweed (left) has much more compressed flowers than palmer amaranth (right). Credit: Shawn Askew

Figure 11: Palmer amaranth has smooth shiny stems. Credit: Shawn Askew

Factors Favoring Palmer Amaranth, Spread and Predominance

- *Plant growth and development*. The widespread distribution of this species can be explained in part by its competitive ability. Studies comparing growth rates among *Amaranthus* species show Palmer amaranth had the fastest growth rate. In addition, Palmer amaranth seeds germinate faster than most other *Amaranthus* species.

- *Plant genetics*. Palmer amaranth is a dioecious plant, meaning male or female flower parts are on separate plants. Pollen movement between male and female plants is required to produce seed. Pollen exchange among individual plants increases genetic diversity, and traits that favor survival can rapidly spread in a population. Not only can this trait make Palmer more competitive in general, but is likely in part to blame for the rapid increase in herbicide resistance nationally.

- *Herbicide resistance*. Palmer amaranth can be resistant to ALS inhibitors, triazines, HPPD inhibitors, dinitroanalines, PPO inhibitors, and ESPS inhibitors (glyphosate) herbicides. Further populations with multiple resistance, which is to two or more modes of actions, have been reported in the Midwest.

- *Production practices*. The current trend toward reduced tillage or no-till systems favor establishment of small-seeded weeds like the *Amaranthus* species because their shallow emergence depths benefit. Weed management programs based mainly on postemergence herbicides with little or no use of soil applied residual herbicides have limited usefulness against this already-resistant species.

Control

Identifying Palmer amaranth before establishment and spread is the most effective control method. Because any potential Palmer amaranth infestation within Wyoming is likely limited, hand pulling may be a control option; however, proper identification of the prevailing *Amaranthus* species in a field will enhance development of effective control tactics. The combined use of soil applied and post-emergence herbicides will allow for herbicides with different modes of actions and help decrease the variability in weed control. Cultural practices that lead to optimal plant spacing and crop canopy development must be implemented to enhance crop competition. Cultivation after post-emergence herbicide application, whenever possible, can also help eliminate surviving plants and reduce the risk of developing an herbicide-resistant population in a field.

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