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Genetic analysis of weediness in waterhemp. It is difficult to explain the spread of weedy waterhemp based on crop production practices alone. Sauer (1957) suggested the increased weediness of waterhemp was due to the movement of the western biotype across the Mississippi River, resulting in hybrids between the western and eastern species. Sauer stated the waterhemp hybrids were better adapted to agricultural fields.

Several scientists have used genetic analysis to identify changes that might have facilitated waterhemp's movement from natural settings into crop fields. Trucco et al. (2009) evaluated hybridization between waterhemp and smooth pigweed, and determined that transfer of genetic material from smooth pigweed to waterhemp occurred much more easily than transfer of material from waterhemp to smooth pigweed. The authors speculated that waterhemp may have acquired traits from a different *Amaranthus* species, and that the new traits facilitated expansion of waterhemp's range from riparian habitat to agricultural fields.

Waselkov and Olsen (2014) evaluated the genetics of waterhemp populations across its range, looking for evidence of hybridization between the two biotypes as Sauer had proposed. Their data supported Sauer's observation that the western population had moved eastward; however, they found no evidence that the weedy biotypes present in crop fields are hybrids of the eastern and western biotypes (Sauer 1957). While evidence of hybridization between the two biotypes was found, mixing of genes between the two biotypes wasn't linked to weediness. They concluded that the spread of weedy waterhemp is due primarily to the eastward movement of the western biotype that is better adapted to agricultural fields.

A recent paper evaluated the spread of glyphosate-resistant waterhemp in the US and Canada (Kreiner et al. 2019). Their genetic analysis supports the presence of the two regional biotypes and the eastward movement of the western biotype that has weedy tendencies. In addition, they reported multiple origins of glyphosate-resistant populations in Ontario. One population originated from transport of the US-based western biotype into Ontario, likely through movement of contaminated equipment or animal-based seed dispersal. A different glyphosate-resistant waterhemp population was identified that evolved independently, evolving within the local, eastern biotype of waterhemp.

Summary

Changes in crop production and migration of the western biotype with weedy tendencies have contributed to the problems posed by waterhemp, but it seems some other, still unknown, factor must be involved based on how weedy waterhemp has spread across the region. Sauer (1957) reported the western biotype was found as far east as Indiana in the 1950s, but waterhemp wasn't considered an agricultural problem in Indiana until the late 1990s. While a delay between introduction of an exotic invasive plant and the time the plant becomes a problem is common, is this likely for a native species? Perhaps a variant of the western biotype originated in the area of MO/IL where waterhemp first posed serious problems, and this agriculturally adapted biotype began to spread across the region in the 1990s. The combination of prolific seed production, prolonged emergence, persistent seed, and propensity for herbicide resistance creates a formidable foe. While all the causes of waterhemp's rise to success are not fully understood, it is clear waterhemp is ideally suited to the production system that dominates the Cornbelt.

Waterhemp Identification

Mark Renz, UW Madison Associate Professor and Extension Specialist

Tall/Common Waterhemp

Annual broadleaf that germinates April – August. Commonly found in agronomic and horticultural crops as well as highly disturbed areas.

- Leaves: Lance or spearhead shaped, 3-6 in long that alternate on the stem. Petiole is shorter than the length of the leaf blade.
- Stem: Typically, 4-5 ft tall, but can grow> 10 ft. Lacks hair on the stem.
- Flowers: Many small green flowers form an inflorescence in July-September. While the terminal inflorescence can be > 1 ft long, many wiry lateral branches occur throughout the inflorescence. Male and female flowers found on separate plants, and can on occasion turn pink – red as they mature.
- Similar Plants: This plant is often confused with other common pigweeds, especially palmer and spiny amaranth as they also have no hairs on stems. Palmer amaranth can be differentiated by the petiole as it is longer than its leaf blade unlike Waterhemp. Spiny amaranth has distinct spines below leaves. For more information including a video see visit the report-a-pigweed link below.
- Herbicide Resistance: In Wisconsin resistance to glyphosate has been confirmed in 16 counties and resistance to glyphosate and PPO-inhibitors in one county. It is also believed that many populations are also resistant to ALS herbicides but few have been tested. In nearby states much higher levels of resistance to these and other modes of actions of herbicides have been detected. Currently nearby states have Waterhemp populations resistant to five different herbicide modes of action.