TIPS ON WATERHEMP MANAGEMENT IN SOYBEANS

Rodrigo Werle[1]

Introduction

Waterhemp has become one of the most troublesome weeds in row crop production in the Midwest. Though not as widespread like in southern neighboring states, glyphosate-resistant waterhemp populations have been confirmed in 25 Wisconsin counties; moreover resistance to ALS- and PPO-inhibiting herbicides in waterhemp have also been confirmed in the state (see Stoltenberg's paper in this proceedings for complete information). Reduced tillage, herbicide resistance, and less diversified herbicide programs and crop rotations are the main factors that have contributed to waterhemp establishment in row crop production systems (Nordby et al., 2007).

Waterhemp Biology

Understanding the key biological aspects of a weed species one is trying to manage is crucial for selection and timing of management practices. Waterhemp is a dioecious species, meaning that plants are either male or female. Cross-pollination combined with abundant pollen production by male plants and seeds by female plants greatly increase the genetic diversity of populations, making this species prone to adaptation of continuous selection pressure (e.g., use of glyphosate for weed control across growing seasons). Under ideal conditions and no competition for resources, waterhemp can produce up to a million seeds (Bradley, 2016). In 2013 and 2014, waterhemp plants were collected from commercial soybean fields in Wisconsin for estimation of seed production and retention (Schwartz et al., 2016). Waterhemp produced an average of 17,459 and 38,221 seeds per plant in 2013 and 2014, respectively. Moreover, researchers found that more than 98.5% of total waterhemp seeds produced in Wisconsin were retained to the plant at soybean maturity, indicating that seed dispersal occurs from harvest onwards. Waterhemp seeds are small and can only emerge from shallow depths. Another important aspect of waterhemp biology is seed viability in the soil seedbank. In a study conducted in Iowa, Buhler and Hartzler (2001) found 12% of the original seedbank still viable 4 years after seed burial. Waterhemp has a late and extended emergence window when compared to other troublesome weed species. In an Iowa study, waterhemp was found to emerge from May through July (Werle et al., 2014). Besides the extended emergence window, waterhemp is a C4 species with vigorous growth rate (it can

[1] Assistant Professor and Extension Cropping Systems Weed Scientist, Dept. of Agronomy, Univ. of Wisconsin-Madison, 1575 Linden Dr., Madison, WI 53706.

grow up to 1 ¼ inches per day during the growing season; Bradley, 2016). All combined, these biological attributes make waterhemp an "ideal" troublesome weed for current production systems.

Waterhemp Management

For proper waterhemp management, a holistic and integrated management approach should be adopted, and the minimization of seedbank replenishment a priority. Below I discuss cultural and chemical strategies to be considered for waterhemp control in soybeans.

Tillage. Since waterhemp seeds can only emerge from shallow depths, tillage can be an effective management strategy. In a multi-state study conducted by Farmer et al. (2017), deep tillage (moldboard plow in the fall followed by spring field cultivation) was shown to reduce waterhemp density in 73% when compared to no-till. Conventional (fall chisel plow in the fall followed by field cultivation in the spring) and minimum tillage (vertical tillage in the spring) reduced waterhemp density by 11% and 6% compared to no-till, respectively. The deep tillage system had the biggest impact on waterhemp density. However, deep tillage is not a recommended practice for sites prone to soil erosion.

Row Spacing. Because of faster canopy closure, narrow-row spacing has the potential to reduce the likelihood of weed resurgence in soybeans later in the season. In a Missouri study conducted by Schultz et al. (2015), narrow row spacing (15-inch or less) was shown to have greater waterhemp suppression when compared to 30-inch row spacing. Reducing row spacing would demand a change in equipment and is not recommended for areas prone to diseases favored by fast canopy closure such as white mold.

Cover Crops. Cover crops have increased in popularity across the Midwest as a soil conservation strategy. Weed suppression has been claimed as an attribute of such cultural practice. In a Missouri study conducted by Cornelius and Bradley (2017), cereal rye cover crop provided 68% reduction in winter annual weed density and 40% reduction in waterhemp emergence. Cover crops have the potential to suppress weeds but herbicides and/or additional management practices are necessary for complete weed control. Cover crops must be properly selected, established, and terminated in order to maximize their benefits while minimizing crop yield reduction. Cover crops add a level of complexity to cropping systems and operation costs.

Herbicide Programs. According to a multi-state study conducted by Farmer et al. (2017) and a Missouri study conducted by Schultz et al. (2015), the program containing a PRE followed by POST with additional residual herbicide (practice known as "layered residuals") provided adequate level of waterhemp control. Such strategy is recommended for weeds with extended emergence window such as waterhemp and Palmer amaranth when present at high density in the soil seedbank.

The POST application must occur when weeds are small (4-inches of less). In fields where glyphosate and PPO resistance are suspected/confirmed, the adoption of Liberty Link or RR2 Xtend technology provide farmers with the opportunity to spray an additional effective POST herbicide for waterhemp control (glufosinate or dicamba, respectively). The addition of a residual herbicide (e.g., Cinch, Dual II Magnum, Outlook, Warrant, etc.) during the POST application reduces the likelihood of additional weed emergence until canopy closure. Despite the benefits in terms of weed control, diversified herbicide programs with soil residual activity tend to cost more. For herbicide options, check the 2018 Pest Management in Wisconsin Field Crops (A3646). Always check and follow the label before purchasing and spraying a pesticide.

Integrated Weed Management. In their multi-state study evaluating tillage methods and herbicide programs, Farmer et al (2017) reported that deep tillage combined soil residual herbicides provided the highest level of control of pigweed species (waterhemp and Palmer amaranth). In a study evaluating row spacing and herbicide programs, Schultz et al. (2015) reported that narrow row spacing combined with soil residual herbicides provided the highest level of waterhemp control in Missouri. Across studies, treatments including chemical and non-chemical strategies provided better levels of waterhemp control when compared to sole strategies.

Herbicide Resistance Management. From a herbicide resistance management point of view, effective crop and herbicide rotations are key strategies for sustainable weed control. Introducing crops with different life-cycles (e.g., wheat, alfalfa) provides opportunity for direct weed suppression (i.e., established canopy reducing weed emergence and development of weeds common to soybeans). When using herbicides, mixtures of multiple effective SOA have been reported as the most effective way to prevent resistance evolution (Evans et al., 2016). Using distribution and frequency of glyphosate resistance in common waterhemp populations from more than 100 farms across Illinois, Evans et al. (2016) presented strong evidence that the likelihood and frequency of resistant individuals within a population are inversely correlated to the number of herbicide modes of action used per application per season at each farm. Roguing waterhemp escapes from a POST herbicide application and field edges is highly encouraged, particularly at the onset of infestation in a field, as a means to reduce seedbank replenishment with potential herbicide-resistant biotypes. The effective herbicide options for weed management in soybeans are limited. For sustainable weed management, holistic and integrated strategies beyond herbicides should be adopted.

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