



Sustainable Management of Waterhemp in Established Alfalfa for Dairy Systems

Mark Renz, University of Wisconsin-Madison; Roger Becker, University of Minnesota; Erin Burns, Michigan State University; John Wallace, Penn State University

PROBLEM/SITUATION

- While waterhemp has been documented to severely impact annual crops, no information is available on the impact in established alfalfa systems. Reports indicate waterhemp is present in alfalfa, but no knowledge of its impact to productivity exist. Waterhemp is highly competitive but the fast growth of established alfalfa and frequent harvests may limit the impact of these species.
- We sought to understand the impact of waterhemp in established alfalfa and if control can be achieved with residual herbicides. As timing of application is critical to success we determined emergence patterns of waterhemp in established alfalfa to improve our understanding of when to apply these products to maximize success. Additionally, we sought to understand the level of seed production of these weeds and if management through the use of residual herbicides would eliminate weed seed production.

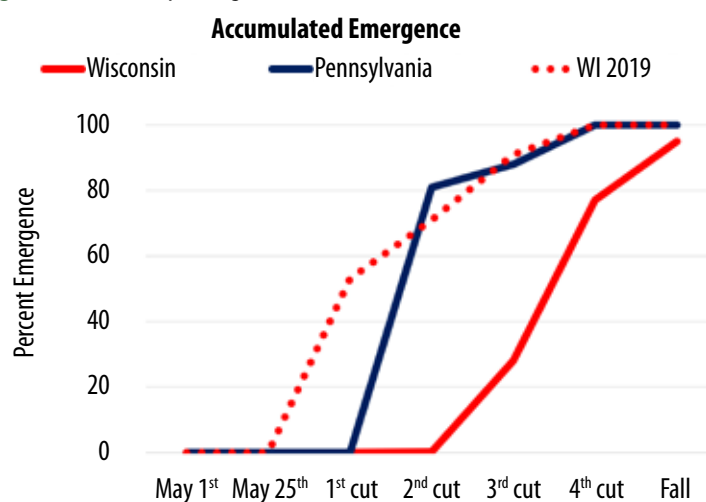
METHODS/APPROACH

- We established field experiments in 2019 in MN, MI, PA and WI. Due to lack of establishment of target species in multiple locations (MN, MI, PA) we repeated experiments in 2021 (MN, PA, WI).
- Treatments were established at each site and herbicides (acetochlor, flumioxazin, or pendimethalin) were applied at maximum labeled rates just after (within 7 days) either the first or second harvest of 2019.
- Alfalfa stem density was estimated in the spring prior to applying the treatments and weed control, alfalfa injury and resulting forage yield were estimated just prior to harvests 2, 3, and 4. Forage quality was estimated at one site but the lack of waterhemp biomass prevented additional analyses.

RESULTS

- Waterhemp presence: Five fields were researched over two years that had high historic populations of waterhemp during the establishment year. Among these fields only two (40%) had any waterhemp present the year after establishment. This suggests that alfalfa is very competitive and, once established, prevents waterhemp establishment. Waterhemp density may be associated with alfalfa stand health, as the highest densities were seen in fields below the acceptable threshold for established alfalfa stands.
- **Waterhemp emergence** (Figure 1). While waterhemp was only found at three of the five fields, emergence patterns suggest that high levels of emergence occur near the first harvest **IF** soil moisture is adequate to stimulate germination. When extended dry periods occur after this timeframe a significant delay in alfalfa emergence was observed (Wisconsin 2021).

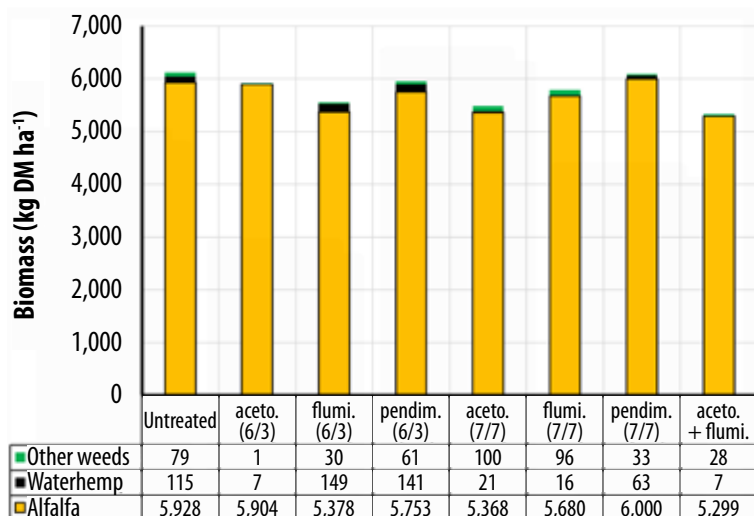
Figure 1. Waterhemp emergence in established alfalfa.



- Waterhemp mortality was high at all locations with 92 and 73% mortality of all emerged plants. This suggests that the competitive nature of alfalfa in combination with frequent harvests prevents competition with this crop.

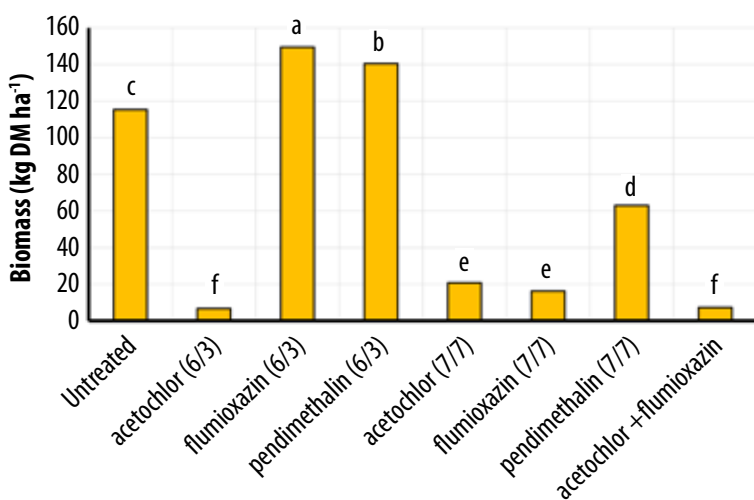
- Waterhemp had no impact on forage yield or quality (Figure 2). Not treated areas had similar yield and forage quality as treated areas that removed waterhemp.

Figure 2. Combined yield (alfalfa, waterhemp, other weeds) (2nd, 3rd, 4th harvest).



- Acetochlor and flumioxazin were best at controlling waterhemp when applied after the 1st or 2nd cut (Figure 3). Injury from flumioxazin to alfalfa 33% was observed, while acetochlor displayed no injury. Due to the high mortality of waterhemp plants between the first and second harvest, we recommend applying acetochlor to maximize late season control and limit seed production.

Figure 3. Total season waterhemp biomass (2nd, 3rd, 4th harvest).



- While waterhemp survival was low, surviving individuals flowered and produce a small amount of seed (72 m⁻²). This seed production, while significant, is much less than documented in annual cropping systems (1 plant can produce thousands of seed). While seed production was reduced by herbicide treatments in Wisconsin it was not eliminated. In Pennsylvania, no seed was produced at the site. We hypothesize that this was due to waterhemp plants flowering at the time of the 4th harvest (9/6/21). After harvest plants did not resprout, suggesting that a later season harvest at that phenological stage may prevent production of viable seed. Further exploration of this observation is warranted.

CONCLUSIONS

- Results across five field research trials across three states support the notion that waterhemp has no impact to established alfalfa productivity or quality.
- Presence of competitive alfalfa stands (>45 stems ft⁻²) is likely a key factor in preventing the establishment of significant amounts of waterhemp. Even when below this threshold, while large waterhemp populations can establish, mortality was high due to the competitiveness of the alfalfa and frequent harvest schedule.
- Emergence of waterhemp in established alfalfa, while variable, begins near the first harvest if adequate soil moisture is present to promote germination.
- Applications of herbicides can reduce but not eliminate populations. Acetochlor gave the highest control with no injury to alfalfa. We suggest acetochlor be applied after the 2nd harvest, as it reduced seed population to minimal amounts in two studies.