

Spray Water Quality: An Overlooked Factor in Herbicide Performance

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Introduction

- Over 95% of spray solution volume typically consists of water, making its composition a critical factor in herbicide effectiveness.
- Cations such as calcium, magnesium, and iron can bind with certain herbicides leading to reduced activity (Mirzaei et al. 2022).
- Alkaline or acidic water conditions can accelerate herbicide degradation or affect formulation stability.
- Simple field tests and use of conditioners or buffering agents can give insight into how to manage water quality and protect herbicide efficacy.

Research Hypothesis

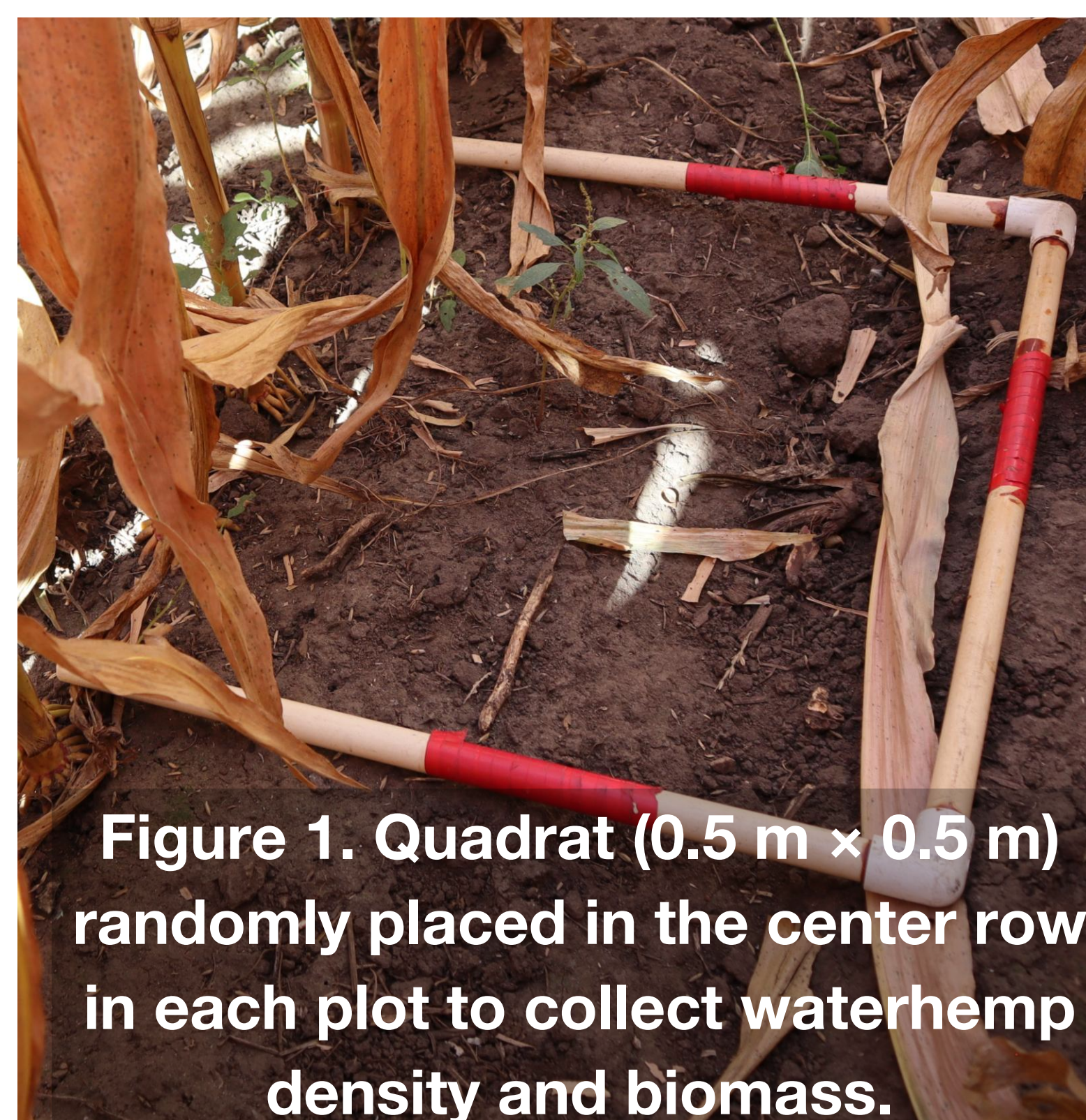
Adjusting spray water with a pH-lowering water conditioner will improve herbicide performance and result in greater waterhemp control compared with herbicide applications made without spray water conditioning.

Materials and Methods

- Field experiments were conducted in 2025 in Rochester, MN.
- Experiments were laid out in a RCBD and the treatments were replicated four times (Table 1):
 - Each treatment included a tank-mix of Atrazine and Acuron GT (full or half rate)
 - pH treatment with or without Alpha Shot (lowers & buffers pH)
 - Mix timing treatment 6 days ahead (simulating rain delay) or at time of herbicide application
- Waterhemp control, density, and biomass collected (Figure 1):
 - 24 days after treatment (DAT)
 - 112 DAT (right before harvest)
- Data were subjected to ANOVA using *glmmTMB* package in R. Pairwise comparisons were made using Fisher's LSD at $\alpha = 0.05$.

Table 1. Details of the treatments.

pH Adjuster	Mix Timing	Acuron GT Rate
No	6 days ahead	Full Rate
No	6 days ahead	Half Rate
No	At application	Full Rate
No	At application	Half Rate
Yes	6 days ahead	Full Rate
Yes	6 days ahead	Half Rate
Yes	At application	Full Rate
Yes	At application	Half Rate



Results and Discussion

Table 2. ANOVA P-values for factors on waterhemp control, density, and biomass.

Factors	WH Control 24 DAT	WH Control 112 DAT	WH Density 112 DAT	WH Biomass 112 DAT
pH Adjuster	0.007**	>0.001**	0.005**	0.045*
Mixing Timing	0.735	0.785	0.614	0.584
Acuron GT Rate	0.115	0.062	0.059	0.074

* $0.01 \leq p \leq 0.05$ ** $p < 0.01$

There were no significant interactions between factors.

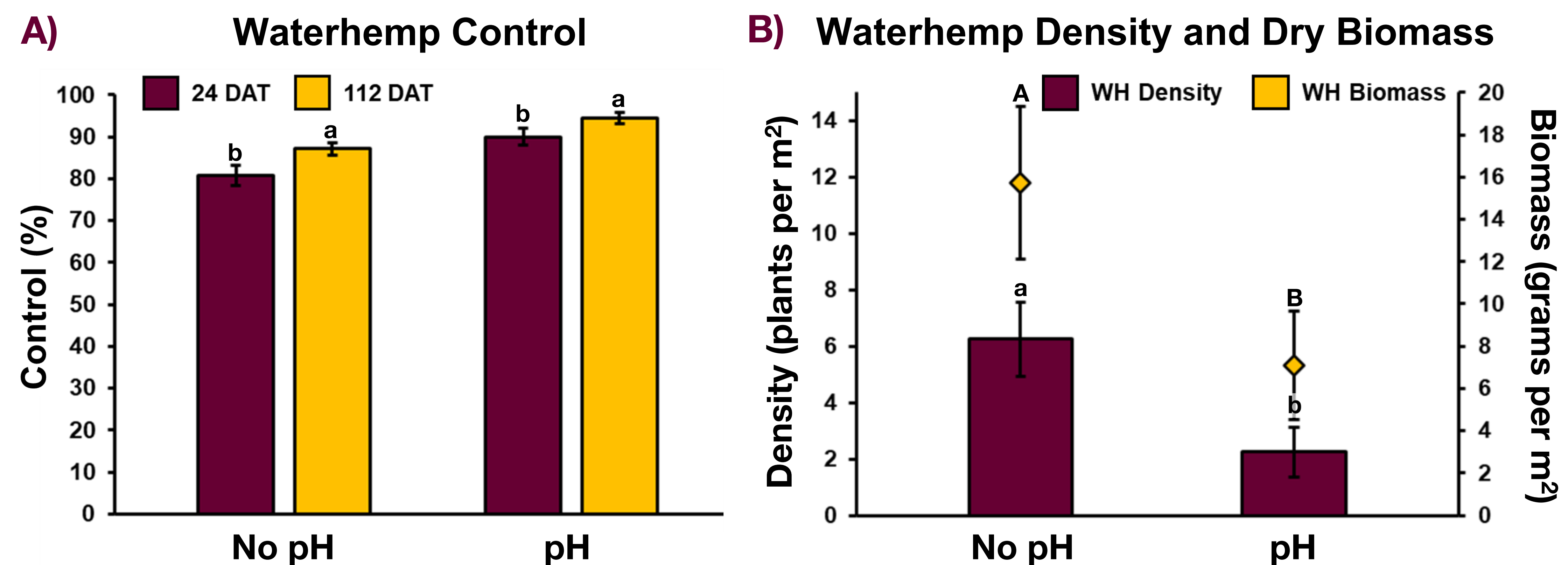


Figure 2. Effects of including a pH-adjusting adjuvant on A) waterhemp control and B) waterhemp density and dry biomass.

- The addition of Alpha Shot + AMS reduced pH of water solution from 7.5 to 5.8.
- Acuron GT rate and timing of pH-adjuster mixing did not affect waterhemp control, density, or biomass. However, the inclusion of the pH-adjuster did impact these variables (Table 2).
- Inclusion of the pH-adjusting adjuvant improved waterhemp control by 10% at 24 DAT and 7% at 112 DAT (Figure 2A).
- Waterhemp density decreased by 64%, and biomass was reduced by 55% when the pH adjuster was included (Figure 2B).
- Uptake through the leaf cuticle is greater for weak acid herbicides in acidic water compared to alkaline (Devkota and Johnson 2020; Matocha et al. 2006).
- Overall, adjusting alkaline spray water with a pH-lowering adjuvant significantly enhanced mid- and late-season waterhemp management, supporting the research hypothesis.

Literature Cited

- Devkota P and Johnson WG (2020) Efficacy of dicamba and glyphosate as influenced by carrier water pH and hardness. *Weed Technol.* 34: 101–106.
- Matocha et al. (2006) Spray carrier pH effect on absorption and translocation of trifloxysulfuron in Palmer amaranth (*Amaranthus palmeri*) and Texasweed. *Weed Sci.* 54: 969–973.
- Mirzaei et al. (2022) Effects and mitigation of poor water quality on herbicide performance: A review. *Weed Res.* 63(3): 139–152.