KANSAS STATE UNIVERSITY

Department of Agronomy

Unraveling the Influence of Planting Date, Row Spacing, and Herbicide Programs on Weed Management in Soybean

Salina Raila, Hannah Buessing, Sarah Lancaster, Kraig Roozeboom, and Gregg Ibendahl

Introduction

- Weeds are one of the main problems in soybean (*Glycine max* (L.) Merr.) production (Datta et. al. 2017).
- Palmer amaranth (*Amaranthus palmeri*) and waterhemp (*Amaranthus tuberculatus*) are common and troublesome weeds in soybean (Van Wychen 2019).
- There is a trend of planting soybeans earlier (Ciampitti et. al. 2017), and there is a need to find appropriate weed management practices for early-planted soybeans.

Objective

- This study aimed to assess the impact of planting date, herbicide programs, and row spacing on light interception and Amaranthus spp. management in soybeans.

Methods

- Studies were conducted at two locations in 2023 (Table 1).
- Soybeans were planted using John Deere split-row vacuum planter with 38-cm and 76-cm row spacing.
- Treatments were arranged in a split-block design with planting date as main plot.
- Factorial combinations of row spacings and herbicide treatments were randomized within planting date (Table 2).
- Weed-free and non-treated controls were included.
- Subplots were 9-m by 3-m, replicated four times.
- Herbicides were applied using a CO_2-pressurized backpack sprayer equipped with an AIXR 11002 nozzle, calibrated to deliver 187 L ha^{-1}.

Table 1. Trial locations, soybean varieties, planting dates, and row spacing.

Location	Variety	Early Planting Date	Late Planting Date
Manhattan	GH4093 E3	4/14	5/22
Ottawa	GH4433 E3	4/24	5/24

Table 2. Herbicide rates and application timings evaluated.

Application Timing	Herbicide	Rates (g a.i. ha^{-1})
At planting (pre-emergent herbicide)	Sulfentrazone + Metribuzin (Authority MTZ)	126 + 189
	Flumioxazin + Metribuzin (Dimetric Charged)	394 + 88
Four weeks after planting (post-emergent herbicide)	2,4-D choline (Enlist One) + Glyphosate (RoundUp PowerMax 3)	1066 + 841
	2,4-D choline (Enlist One) + Glyphosate (RoundUp PowerMax 3) + S-metolachlor (Dual II Magnum)	1066 + 841 + 1598

Data collection and analysis

- Percent weed control was estimated visually 4 weeks after herbicide treatment (WAT).
- Weed biomass was collected at R7 soybean in 0.5 m^2 area.
- Analysis of variance was conducted with planting date, row spacing, and herbicide treatment as fixed effects.
- Canopy light interception was calculated as the difference between above and below-canopy light incidence as % of above-canopy incidence.
- Regression analyses were conducted with percent weed control or weed biomass as dependent variables and percent light interception as the independent variable.

Results

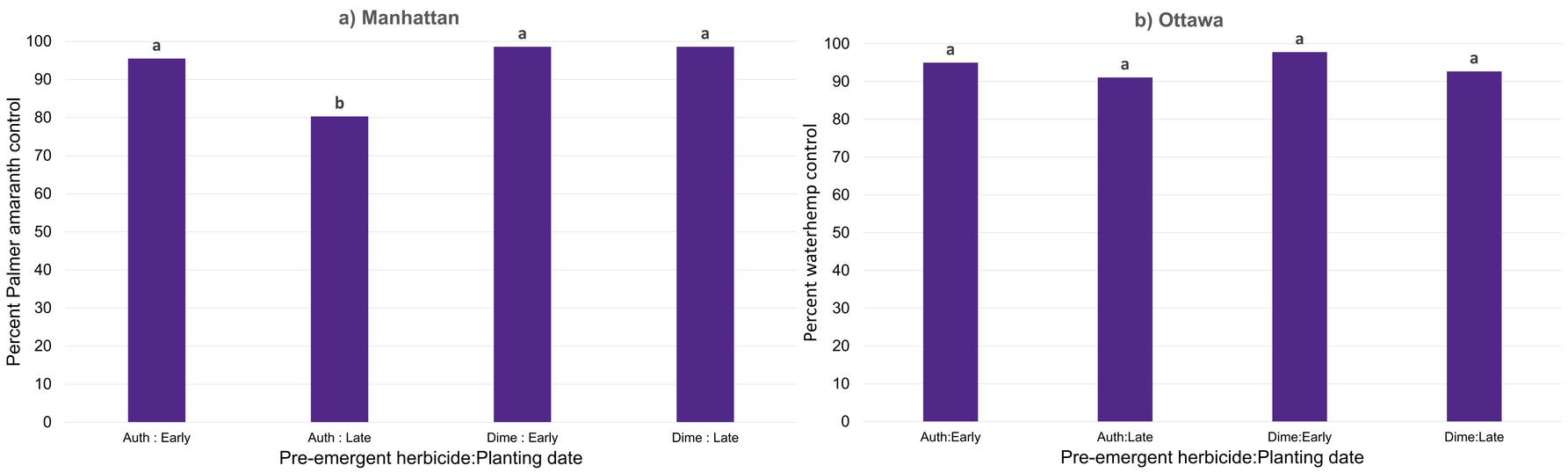

Figure 1. Percent control of a) Palmer amaranth at Manhattan and b) waterhemp at Ottawa four weeks after treatment. Auth, Authority MTZ; Dime, Dimetric Charged; Early, early-planted soybean; Late, late-planted beans. Letters represent differences according to the Tukey HSD test (α=0.05).

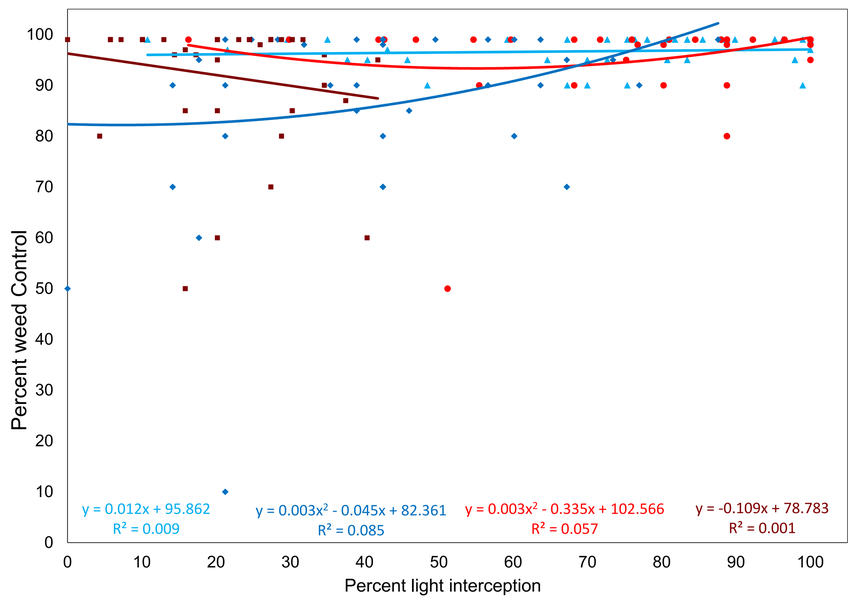

Figure 2: Regression of percent weed control and percent light interception in Manhattan (light blue triangle, early; dark blue diamond, late) and Ottawa (light red circle, early; dark red squares, late).

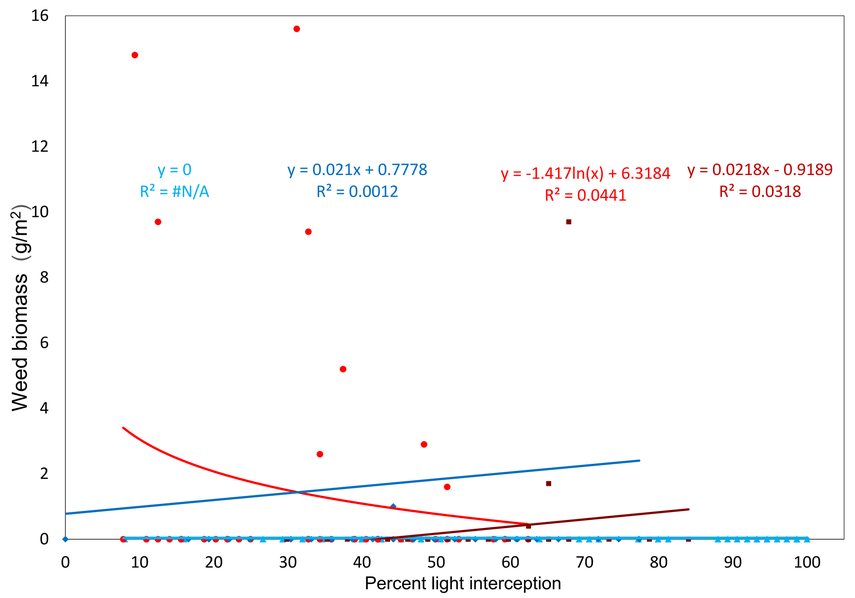

Figure 3: Regression between Weed Biomass (g/m2) and Percent light interception in Manhattan (light blue triangle, early; dark blue diamond, late) and Ottawa (light red circle, early; dark red squares, late).

Discussion

- Amaranthus spp. control was 90% or greater for all treatments except Palmer amaranth control by Authority MTZ in late-planted soybeans in Manhattan (Figure 1).
- Regression analysis resulted in a very low coefficient of determination for linear, polynomial, and logarithmic models, indicating a poor relationship of light interception with weed control and biomass.
- The best-fitting models to describe the response of weed control to percent light interception were linear for Palmer amaranth in early-planted soybeans in Manhattan, polynomial for late-planted soybeans in Manhattan, polynomial waterhemp control in early-planted soybeans in Ottawa, and linear for late-planted soybeans in Ottawa (Figure 2). Control increased as light interception increased for late planting in Manhattan and early planting in Ottawa.
- The best-fitting models to describe the relationship of weed biomass and percent light interception were polynomial for Palmer amaranth in late-planted soybeans in Manhattan, polynomial for waterhemp in early-planted soybeans in Ottawa, and logrithmic for late-planted soybeans in Ottawa (Figure 3). No Palmer amaranth biomass was present in early-planted soybeans in Manhattan. Waterhemp biomass in early-planted soybeans decreased as light interception increased.
- Data from Bell et al. (2015) also suggests that herbicide program has a greater effect on weed control than row-spacing; however, Hay et al. (2019) suggest that narrow row spacing may be more consistent than other nonchemical weed management practices..

Conclusion

- When applied with metribuzin, sulfentrazone or flumioxazin controlled waterhemp regardless of planting date and row spacing; however, Palmer amaranth control by metribuzin plus sulfentrazone was less consistent than metribuzin plus flumioxazin.
- When an effective residual herbicide program was used, light interception by the soybean canopy explained a low percentage of variability in percent weed control and weed biomass.
- Results suggest that effective weed control can be achieved in early-planted soybeans with either 38- or 76-cm rows and timely application of effective herbicides.

Literature Cited

- Datta et al., 2017. Crop protection, 95, 60-68.
- Van Wychen 2019. Weed Science Society of America.
- Ciampitti et. al., 2017. Extension Agronomy, eUpdate, Kansas State University Issue 626.
- Bell et al. 2015. Weed Technology. 29, 390-40.
- Hay et al. 2019. Weed Technology 33<710-719.

Acknowledgments

- My lab mates Alec Adam, Wade Burris, Leno Caldieraro, Landon Duff, and Igor Rezende Lima helped me with the data collection.
- Kansas Soybean Commission provided funding.

Future Work

- Estimate weed seed production of Palmer amaranth and waterhemp.
- Partial budget analysis.