Quantifying Success: Cereal Rye Cover Crop versus Giant Ragweed

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Introduction

- Giant ragweed (*Ambrosia trifida*), an early-emerging and competitive species, is ranked as one of the most troublesome weeds in soybean cropping systems the US Midwest.
- In Wisconsin, giant ragweed exhibits a prolonged emergence period within the season, contrasting with patterns observed in other regions of the U.S. Midwest (Striegel et al., 2021; Davis et al., 2013; Kaur, 2016).
- Farmers across the US Upper Midwest are adopting cereal rye (*Secale cereale* L.) cover crop (CC) thus research is warranted to better understand the impact of such practice on giant ragweed development, ecology, and management.

Objectives

- Quantify the amount of cereal rye cover crop needed to suppress giant ragweed emergence and growth.

Hypothesis

- The increase in cover crop biomass will reduce giant ragweed density and growth.

Materials and Methods

- A cereal rye biomass dose-response field experiment was conducted in 2022 and 2023 at the Rock County Farm near Janesville, WI, in fields naturally infested with giant ragweed. For both years, the experiment was established on May 30 and data collected on July 11(42 days after establishment).
- The cereal rye was drilled in the fall before each experimental season at the University of Wisconsin-Madison Arlington Agricultural Research Station at 67.2 kg.ha^{-1}.
- When the cereal rye reached anthesis in the spring, it was clipped at soil level and oven-dried until constant mass at 60Cº.
- The study followed a complete randomized block design, utilizing 0.9m x 2.1m plots with eight cereal rye biomass rates (0, 0.6, 1.2, 2.5, 4.9, 7.4, 9.9, and 12.4 Mg.ha^{-1}) evenly distributed within each plot, and secured with wired metal fences to prevent wind dispersal, all replicated four times (Figure 1).
- At 42 days after establishment, data collection involved measuring giant ragweed density and biomass in two 0.25m^2 squares within each plot, as well as determining plant height (cm) from five random plants in each plot.

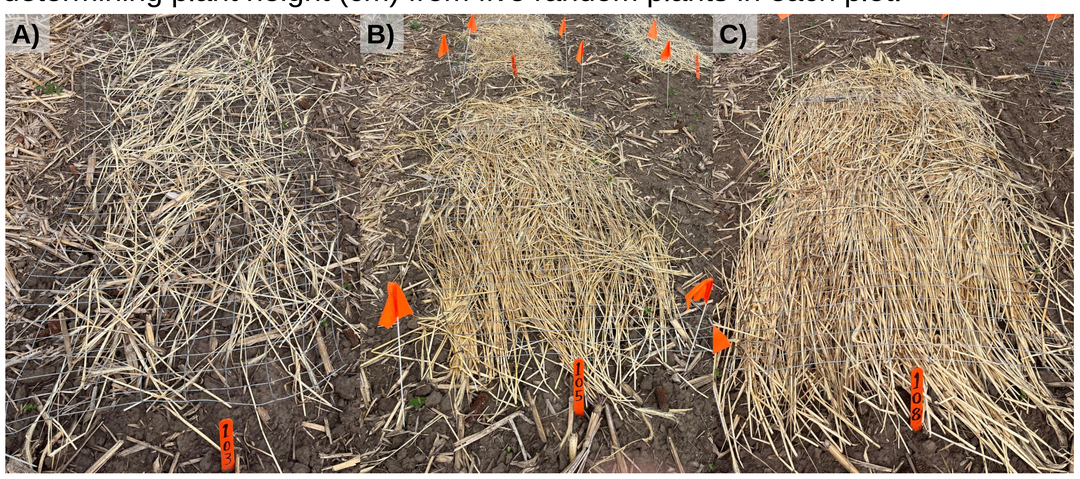

Figure 1: Overview of plots with cereal rye cover crop biomass corresponding to: **A)**1.2 Mg.ha^{-1} **B)** 4.9 Mg.ha^{-1} **C)**12.4 Mg.ha^{-1}.

Statistical analyses

- Data from weed biomass (g.m^{-2}), weed density (plants.m^{-2}) and weed height (cm) were subject to non-linear regression analysis. The 'drc' package in R version 4.3.1 was used to determine the amount of cereal rye required to estimate 50% reduction in weed density and height, using the three-parameter Weibull model function (Ritz et al. 2015).
- Based on ANOVA and model assessments, there was no basis for separating giant ragweed biomass data by years, while for weed density data was separated to account for the year-to-year variation.

Results

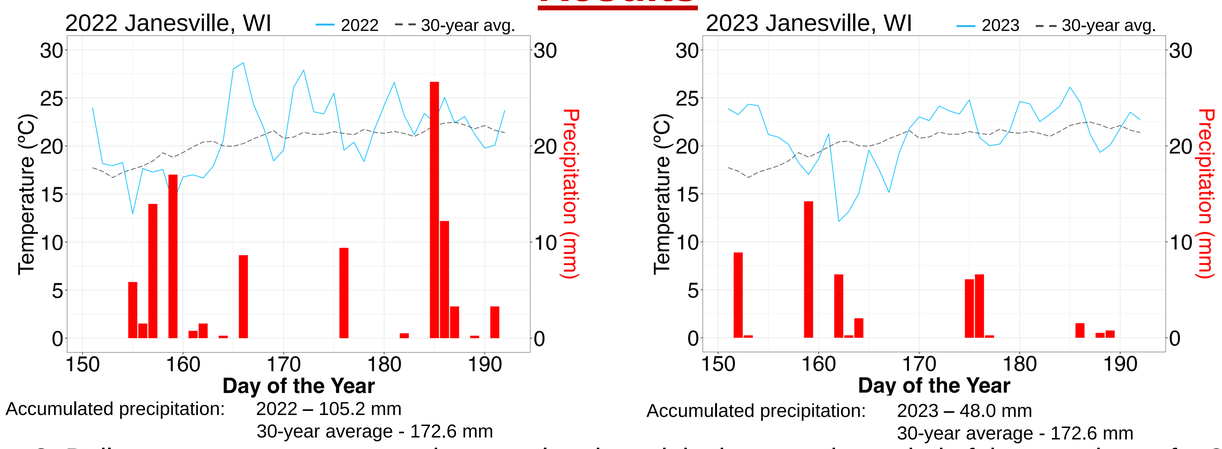

Figure 2: Daily average temperature and accumulated precipitation over the period of the experiment for 2022, 2023, and 30-year average in Janesville, WI. Daily precipitation over the period of the experiment for 2022 and 2023. The experiment was established on day of the year 150 and data collected on 192.

Dose-response study

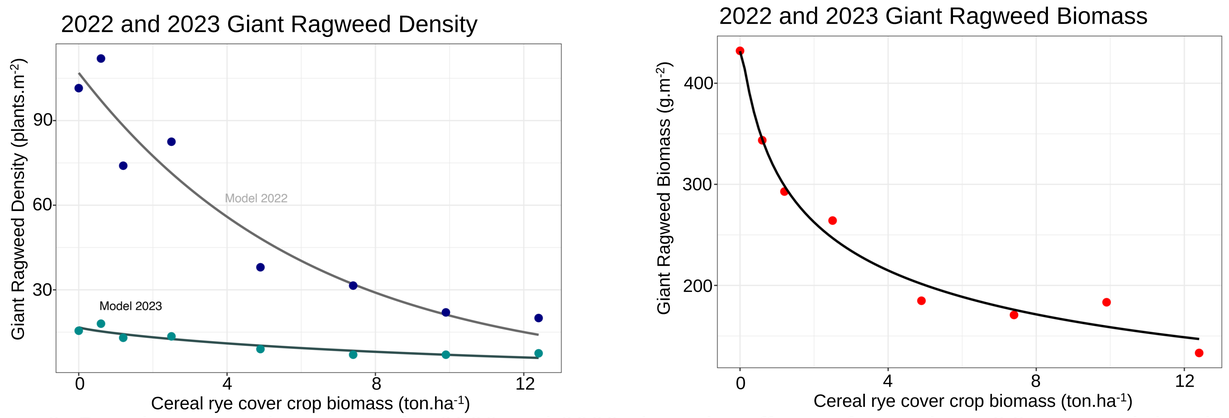

Figure 3: Density regression curves for 2022 and 2023 show the effects of cereal rye CC on weed density. Biomass regression curve for 2022 and 2023 show the effects of cereal rye CC on weed biomass.

Table 1: Effective Dose (ED50) in Mg.ha^{-1} of cereal rye CC estimated to achieve 50% reduction in the response variable

	Year	Mg.ha^{-1}	Standard error
Giant Ragweed Biomass (g.m-²)	2022/23	**3.93**	1.13
Giant Ragweed Density (plants.m-²)	2022	**4.27**	0.73
Giant Ragweed Density (plants.m-²)	2023	**7.46**	3.41

Discussions

- In 2023, with 48 millimeters of precipitation over the 42 days, less than half of the 105.2 millimeters in 2022, giant ragweed density was highly impacted.
- Effective dose (ED50) values serve as a practical guide for growers and consultants, helping them determine the optimal biomass required to effectively suppress giant ragweed.

Conclusion

- The increasing amounts of CC biomass reduced both giant ragweed density and biomass, with approximately 4 Mg.ha^{-1} leading to a 50% reduction in giant ragweed biomass.

Future Directions

- Additional research is focusing on identifying the ideal soybean planting time and growth stage for terminating cover crops, emphasizing the balance between effective weed suppression and minimizing competition with the cash crop within the planting green system.

Acknowledgments

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