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Optimizing no-till soybean planted into a cereal rye cover crop

Mark Kendall, Spyros Mourtzinis, John Gaska, Adam Roth, and Shawn Conley
Dept. of Plant and Agroecosystem Sciences
University of Wisconsin, Madison

In a bean pod

- **Nitrogen application increased cereal rye biomass but did not affect soybean seed yield**
- **Delaying cereal rye termination two weeks after soybean planting reduced seed yield**
- **Plant longer maturity group varieties (>2.0) if terminating cereal rye close to soybean planting**
- **The seed and soil applied biologicals/stimulants we tested did not increase soybean seed yield when planting green**

Introduction

Acreage of soybean planted into a cereal rye cover crop has continued to increase citing benefits including reduced soil erosion and weed pressure in addition to monetary programs available to producers implementing cover crops. This proposed research's goal is to take a holistic view of soybean planted into a cereal rye cover crop by testing the effects of various treatments on soybean seed yield and cover crop biomass.

Objectives: (1) Quantify the effect of cereal rye termination timing and nitrogen rate on soybean seed yield and cereal rye biomass accumulation, (2) evaluate the effect of cereal rye termination timing and soybean maturity group on soybean seed yield, and (3) measure the effect of seed and soil-applied biologicals and/or stimulants on soybean seed yield when planted green into living cereal rye.

Trial #1

The objective of this research is to evaluate multiple cereal rye termination timings and nitrogen rates on no-till soybean seed yield and cereal rye biomass accumulation in a corn-soybean rotation.

Three experiments were conducted in southern Wisconsin to evaluate the effects of three different cereal rye termination timings with glyphosate and five different nitrogen rates on soybean seed yield and cereal rye biomass accumulation. The previous crop for two experiments was corn harvested as grain and were located at Arlington and Mineral Point. The third experiment followed corn harvested as silage and was located at Arlington. Cereal rye termination treatments for the corn silage experiment were two weeks prior to soybean planting (PP), at planting (ATP), and two weeks after planting (POST), and the treatments for the corn grain experiments were no rye, ATP, and POST (Table 1).

Funding for this project was provided by the Wisconsin Soybean Marketing Board.

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Location	Previous crop	Cereal rye planting date	Cereal rye termination date	Nitrogen rate (lbs./ac)	Nitrogen application date	Soybean planting date
Arlington (ARL)	Corn silage	9-30-23	4-15-24 (PP) 5-13-24 (ATP) 5-29-24 (POST)	0 25 50 75 100	4-10-24	5-12-24
Arlington (ARL)	Corn grain	10-23-23	No rye 5-13-24 (ATP) 5-29-24 (POST)	0 25 50 75 100	4-10-24	5-12-24
Mineral Point (MP)	Corn grain	10-24-23	No rye 5-13-24 (ATP) 5-29-24 (POST)	0 25 50 75 100	4-15-24	5-13-24

Table 1. List of locations, planting information, and treatments.

Figure 2. Cereal rye cover crop on May 7, 2024.

Results & Discussion

In the corn silage-soybean rotation, the interaction of termination treatments and nitrogen rates increased cereal rye biomass (figure 3). There was not an interaction in the corn grain-soybean rotation; however, main effects of nitrogen rates (figure 4) and termination treatments (figure 6) increased cereal rye biomass. Combining management practices such as delayed cereal rye termination with low rates of nitrogen (25 lb./ac) appears to be a promising strategy to produce greater cereal rye biomass to reduce erosion and suppress weeds.

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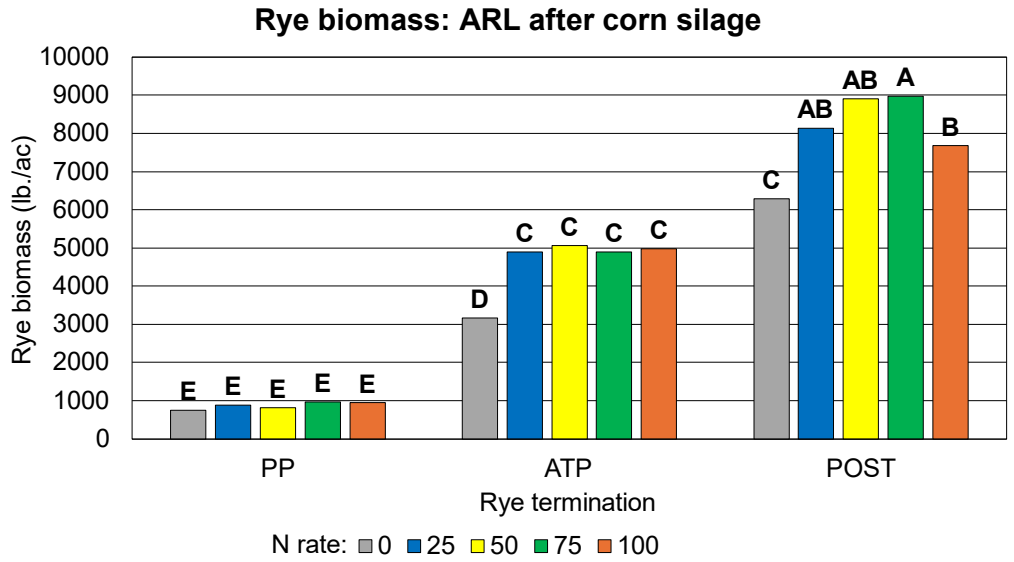

Figure 3. Interaction of termination treatments and N rates on cereal rye biomass at Arlington following corn silage. Bars with the same letter yield were not significantly different at alpha=0.05.

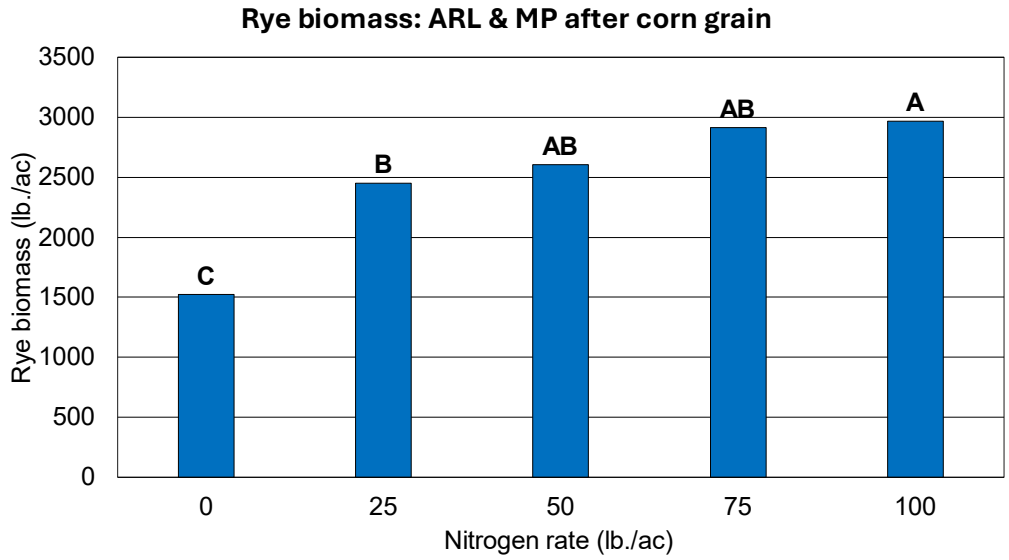

Figure 4. Cereal rye biomass (pooled across termination treatments) comparison among N rates at Arlington and Mineral Point combined following corn grain. Bars with the same letter yield were not significantly different at alpha=0.05.

Nitrogen fertilizer did not affect soybean seed yield in any experiment. In the corn silage-soybean rotation, soybean seed yield was reduced when cereal termination occurred ATP (~5 bu./ac) or POST (~12 bu./ac) compared to PP termination (Figure 5). In the corn grain-soybean rotation, no rye and ATP termination produced the same soybean seed yield, while POST termination reduced yield by 7 bu./ac (Figure 6). Typically, delaying cereal rye termination does not reduce soybean seed yield; however, seed yield may have been reduced in 2024 due to extended dry weather in August (Reed et al., 2019). Additionally, these fields had no history of cover crops. Previous research found that lower soybean yield can occur in the first year of cover crop implementation; conversely, soybean yield reductions were not found in future study years when there was a history of cover crop usage (Pinnamaneni et al., 2022).

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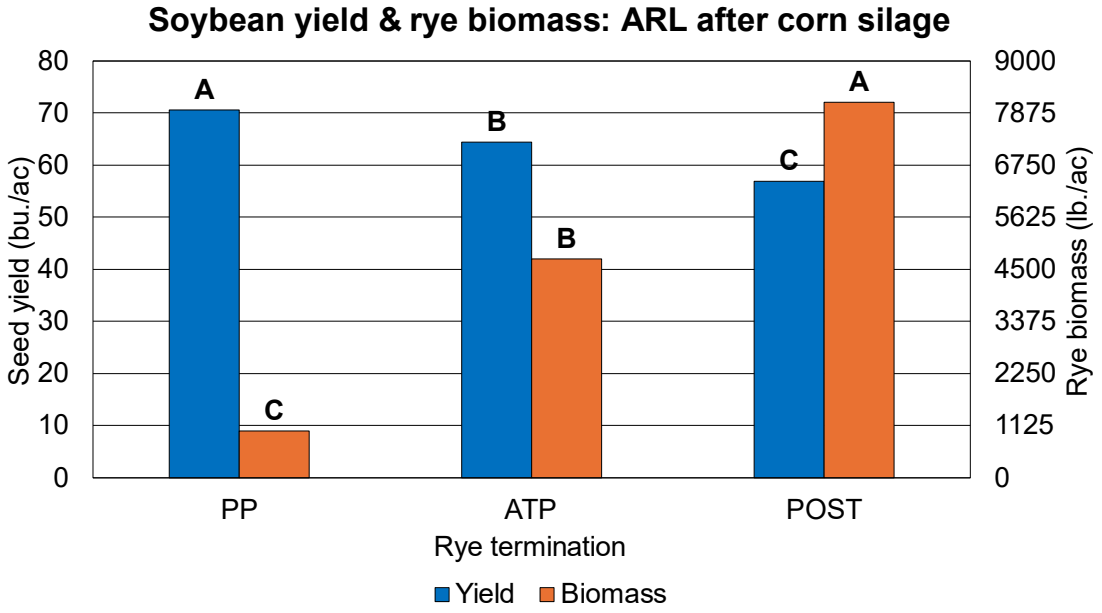

Figure 5. Soybean seed yield and cereal rye biomass (pooled across N rates) comparison among cereal rye termination treatments at Arlington following corn silage. Bars with the same letter yield were not significantly different at alpha=0.05.

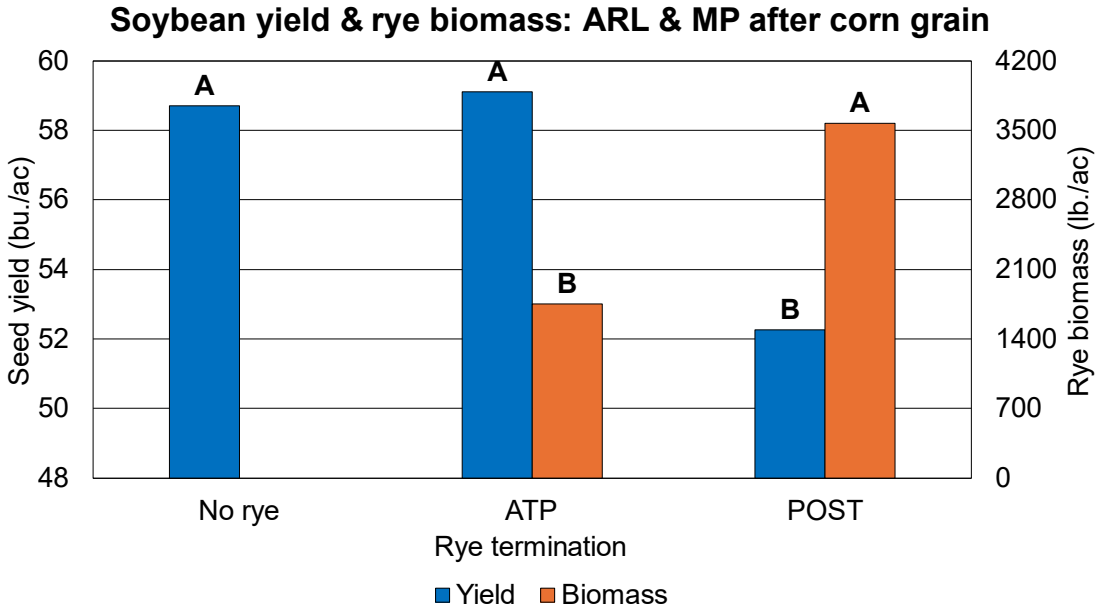

Figure 6. Soybean seed yield and cereal rye biomass (pooled across N rates) comparison among cereal rye termination treatments at Arlington and Mineral Point combined following corn grain. Bars with the same letter yield were not significantly different at alpha=0.05.

Trial #2

The objective of this research is to evaluate the effect of soybean variety maturity group at different cereal rye termination timings on no-till soybean seed yield.

One experiment was conducted in southern Wisconsin near Arlington. Cereal rye was planted on September 30, 2023, following corn silage harvest. Termination of cereal rye with glyphosate occurred at three timings: 14 days before soybean planting, at planting, and 14 days after

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planting. Soybean planting occurred on May 6, 2024. Soybean variety maturity groups (N=14) between 0.5 and 3.0 were tested in this experiment. Maximum soybean seed yield was obtained when cereal rye was terminated prior to soybean planting using maturity groups 1.6 and longer (Figure 7). Maximum soybean seed yield could be achieved when cereal rye was terminated at soybean planting or up to 5 days after planting, but longer maturity groups (>2.0) were needed.

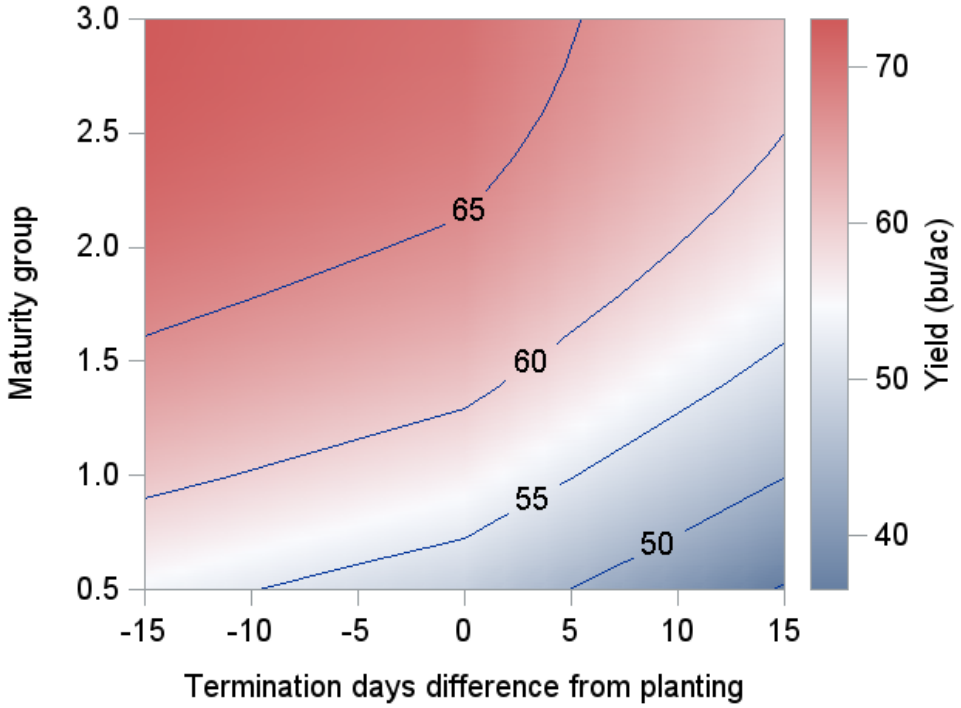

Figure 7. Interaction of cereal rye termination timing and soybean variety maturity group (N=14) on soybean seed yield.

Figure 8. Image from July 8, 2024. Cereal rye terminated two weeks after soybean planting.

Trial #3

The objective of this research is to evaluate the effect of biological and/or stimulants on no-till soybean seed yield when planting green into living cereal rye.

Many biologicals and/or stimulants are available to soybean growers, but their utility in soybean-cover crop systems has not been widely tested. Two experiments were conducted in southern Wisconsin near Arlington with previous crops of corn for silage and corn for grain. Cereal rye was planted on September 30, 2023, following corn silage harvest and on October 23, 2023, following corn grain harvest. Soybean planting occurred on April 23, 2024, and 8 biological

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and/or stimulants were applied as either a soybean seed treatment or in-furrow at planting. Termination of cereal rye with glyphosate occurred on May 8, 2024. No differences in soybean seed yield between the non-treated control (NTC) and the biological and/or stimulants were measured in either experiment.

Treatment	Product	Company	Application method	Yield (bu/ac)
1	NTC			60.5
2	GraphEx-SA[2]	Agrauxine	on seed	57.1
3	Optimize FXC DS	Novozymes	on seed	59.3
4	Symvado ST	Valent	on seed	59.0
5	Soyfx	YieldMaster Solutions	on seed	61.5
6	Envita SC	YieldMaster Solutions	in-furrow	63.7
7	Nutriquire	YieldMaster Solutions	in-furrow	63.5
8	Nutrio Unlock	Wilbur Ellis	in-furrow	61.6
9	Accomplish Max	Loveland	in-furrow	61.7

Table 9. Biological stimulants and average yield (Pr>F=0.94).

These are preliminary results as the data were for one year only. All trials will be repeated in 2025 and 2026.

References

Pinnamaneni, S. R., Molin, W. T. h. o., Anapalli, S. S., Molin, W., & Reddy, K. N. (2022). Effect of Rye cover crop on weed control, soybean (Glycine max L.) yield and profitability. *Frontiers in Agronomy.* https://doi.org/10.3389/fagro.2022.907507

Reed, H. K., Karsten, H. D., Curran, W. S., Tooker, J. F., & Duiker, S. W. (2019). Planting Green Effects on Corn and Soybean Production. *Agronomy Journal, 111*, 2314-2325. https://doi.org/10.2134/agronj2018.11.0711

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