PA SOYBEAN BOARD 2023 RESEARCH REPORT TEMPLATE

1. Name of project: Developing soybean production practices that maximize yield and enhance environmental stewardship in northern climates.

2. Principal researcher & co-investigators (with titles): Dr. Heather Darby (Agronomist, University of Vermont Extension)

3. Funded amount: $26,062

4. Co-funders/collaborators of research (if applicable) N/A

5. Link to further information online. A QR code will be generated for the link.

2023 Conventional Soybean Variety Trial Report
https://legacy.drup2.uvm.edu/sites/default/files/Northwest-Crops-and-Soils-Program/2023%20Research%20Rpts/2023_Conventional_Soybean_VT_Report_Final.pdf

2023 Conventional Soybean Performance Trial Summary Table
https://legacy.drup2.uvm.edu/sites/default/files/Northwest-Crops-and-Soils-Program/2023%20Research%20Rpts/2023_Conv_Soybean_Performance_Trials_Summary.pdf

2023 Interseeding Cover Crops into Soybeans
https://legacy.drup2.uvm.edu/sites/default/files/Northwest-Crops-and-Soils-Program/2023%20Research%20Rpts/2023_Soybean_Interseed_Cover_Crop_Report_Final.pdf

2023 Soybean Cover Crop Termination x Nitrogen Fertility Trial Report
https://legacy.drup2.uvm.edu/sites/default/files/Northwest-Crops-and-Soils-Program/2023%20Research%20Rpts/2023_Soybean_Cover_Crop_Termination_x_Nitrogen_Fertility_Report_Final.pdf

2023 Impact of Winter Rye Planting Date and Seeding Rate on No-till Soybean Yields
https://legacy.drup2.uvm.edu/sites/default/files/Northwest-Crops-and-Soils-Program/2023%20Research%20Rpts/2023_Planting_soybeans_into_rolled_down_rye_Final.pdf

Research summary:

Soybean production in far northern regions has increased considerably in the last year as farmers respond to disruptive fluctuations in markets, climate, and farm economics. To overcome these economic and environmental challenges, farmers need region-specific agronomic information to maximize soybean yields while enhancing conservation efforts. The purpose of our trials is to

develop and evaluate cover crop strategies for soybean systems that maximize both yields and conservation efforts.

Temperatures were cooler than average for most of the soybean growing season. August was particularly cool with an average temperature of 67°F which is 3.73 degrees cooler than the 30-year average. Temperatures were much warmer later in the season, especially in October where the monthly average temperature, 54.4°F, was 4.11 degrees warmer than normal. Heavy rainfall during the season resulted in a total of 31.2 inches of rain. Precipitation was 8.06 inches higher than the 30-year average.

In the conventional variety trial, 29 varieties (maturity groups 00.9-2.2) were evaluated for soybean yield, harvest moisture, and test weight. The average soybean yield in 2023 was 63.4 bu ac^{-1}.

Incorporating cover crops into soybeans can be challenging because the crop is generally harvested in October and November. In the Northeast, the last planting dates for winter rye range between mid-September and mid-October. The goal of this project was to interseed a cover crop into soybeans at later development stages (R7). Depending on the variety, this time frame can also coincide with optimum planting dates for winter rye cover crops in the Northeast. Winter rye was interseeded into an early (0.70) and late maturity (1.7) soybean variety. Interseeding started on September 21st when the early variety reached R7 and September 29th for the late variety. There was no impact on soybean yield or quality when soybeans were interseeded (Figure 1). Fall ground cover and rye biomass after the soybean harvest was highest when the rye was planted on 21-Sep but was not statistically different when planted on 28-Sep (Figure 2). Ground cover and rye biomass was reduced on average 73% when planted in early to mid-October.

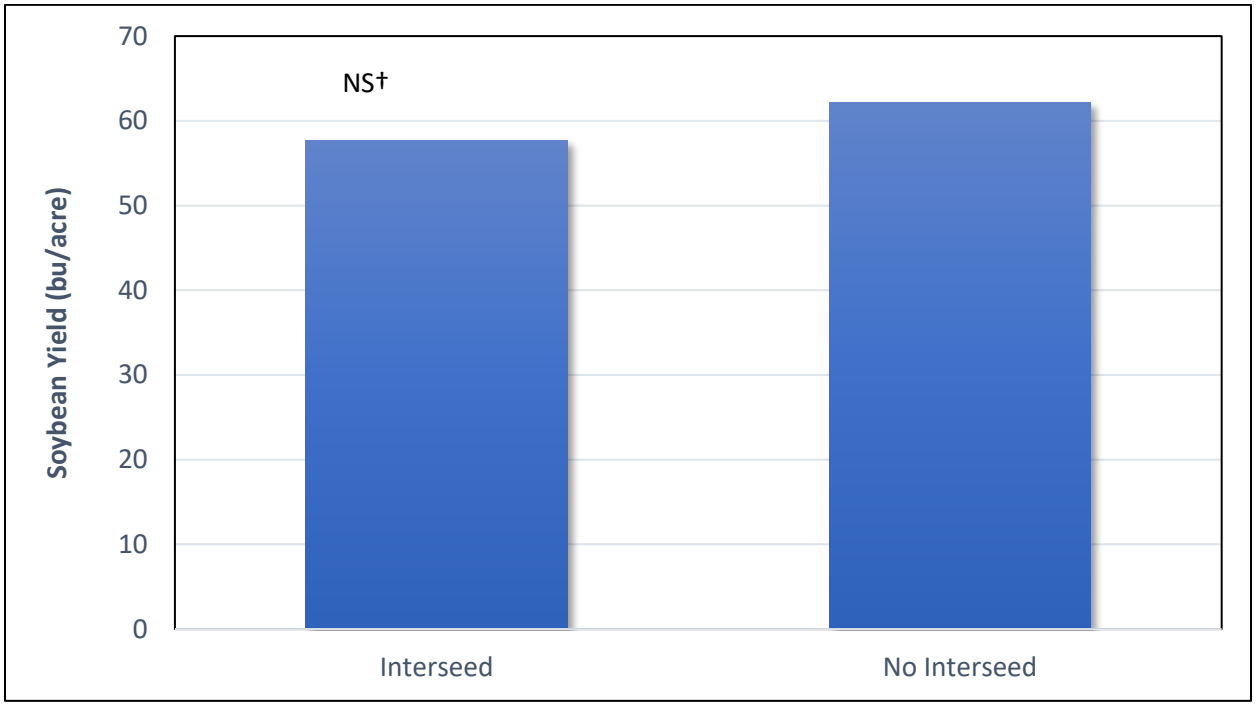

Figure 1. Impact of interseeding on soybean yields. †NS, no significant difference between treatments.

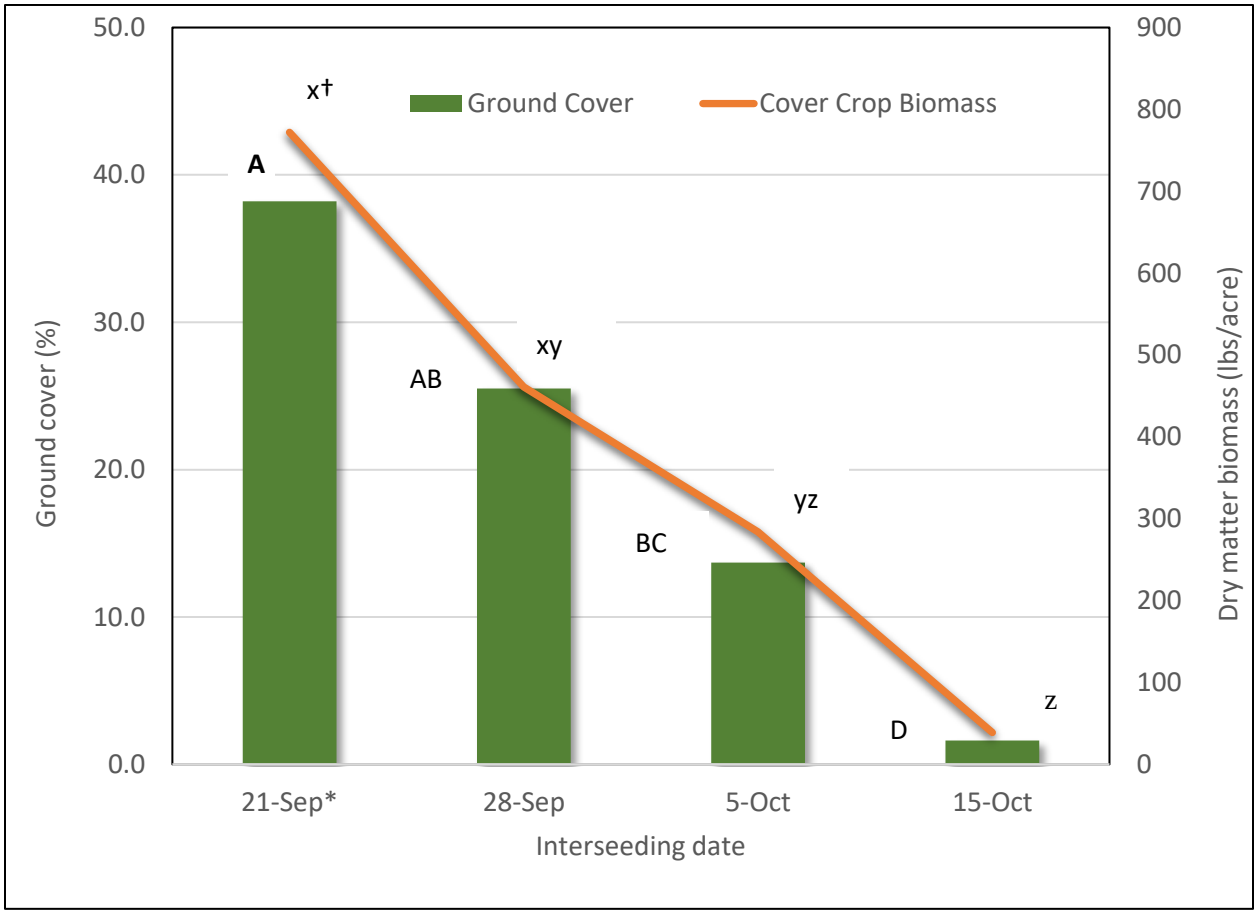

Figure 2. Impact of interseeding date on winter rye ground cover and biomass dry matter yields. *The cover crop could not be interseeded on 21-Sep in the later maturing variety (SG 1708GTLL) because the plants had not begun to dry down yet. †Treatments with the same letter did not perform significantly different from one another.

Second, we evaluated the impact of winter rye planting date and seeding rate on the subsequent yield of no-till soybeans. Soybeans were planted into rolled and crimped rye that had been planted the previous fall, on five planting dates (12-September to 10-October) at six seeding rates (0, 15, 25, 50, 80, 105 lbs ac^{-1}). These data suggest that winter rye planted in mid to late September will establish better in the fall, provide more spring ground cover, and produce higher biomass the following year compared to winter rye that is not planted until early October (Figure 3). Increasing seeding rates will also increase fall establishment, spring ground cover, and spring biomass production for winter rye (Figure 4). Interestingly, those treatments that produced more than 9000 lbs of winter rye biomass per acre resulted in the lowest soybean yields. This data indicates that moderate levels of winter rye biomass will likely not negatively impact soybean yield in a cool and wet growing season. The negative correlation between rye biomass and soybean yield emphasizes the importance of management decisions and the trade-offs that farmers must consider if they plan on adopting these conservation practices.

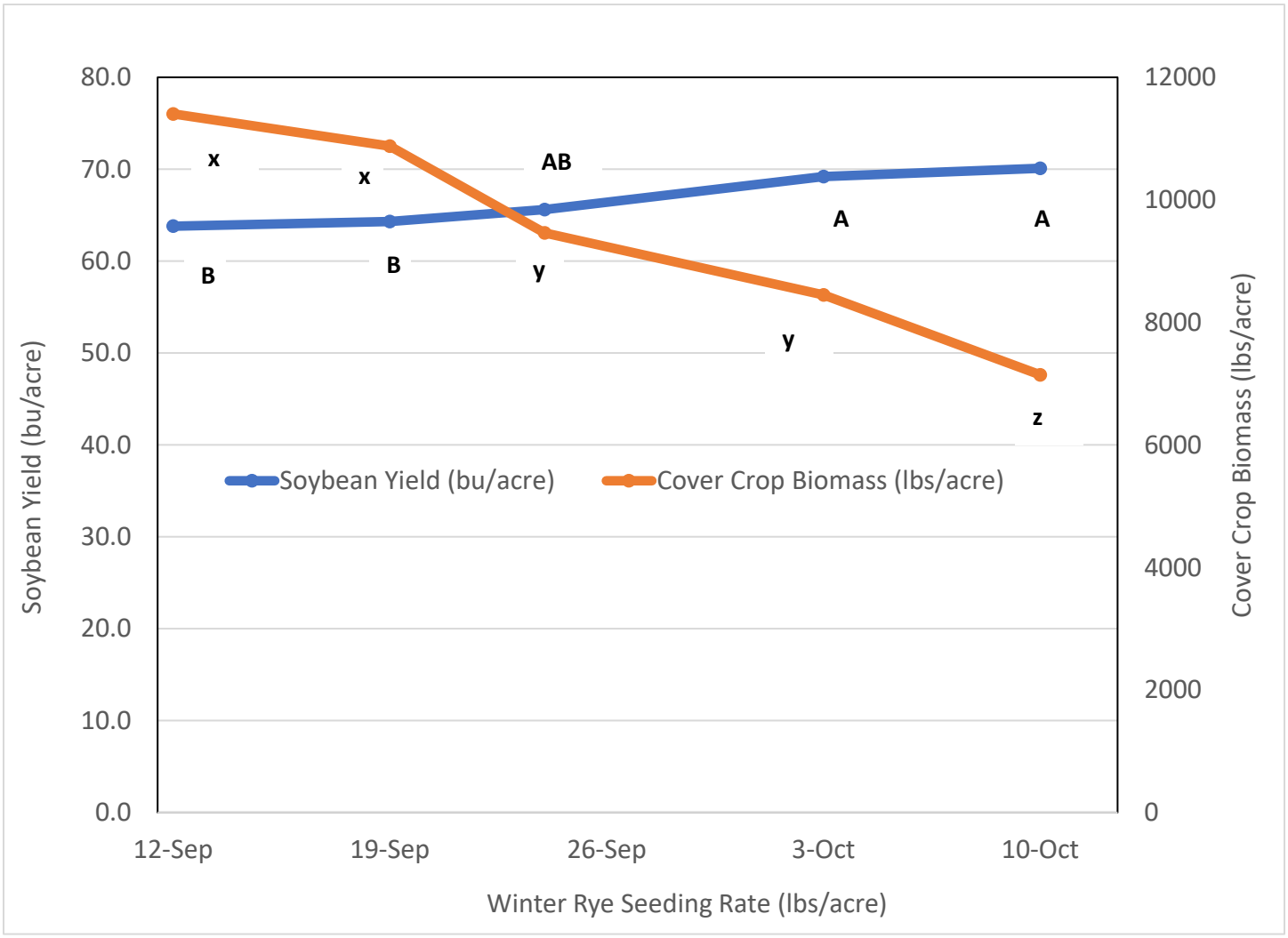

Figure 3. Impact of winter rye planting date on biomass dry matter yields and subsequent soybean yields. †Treatments with the same letter did not perform significantly different from one another.

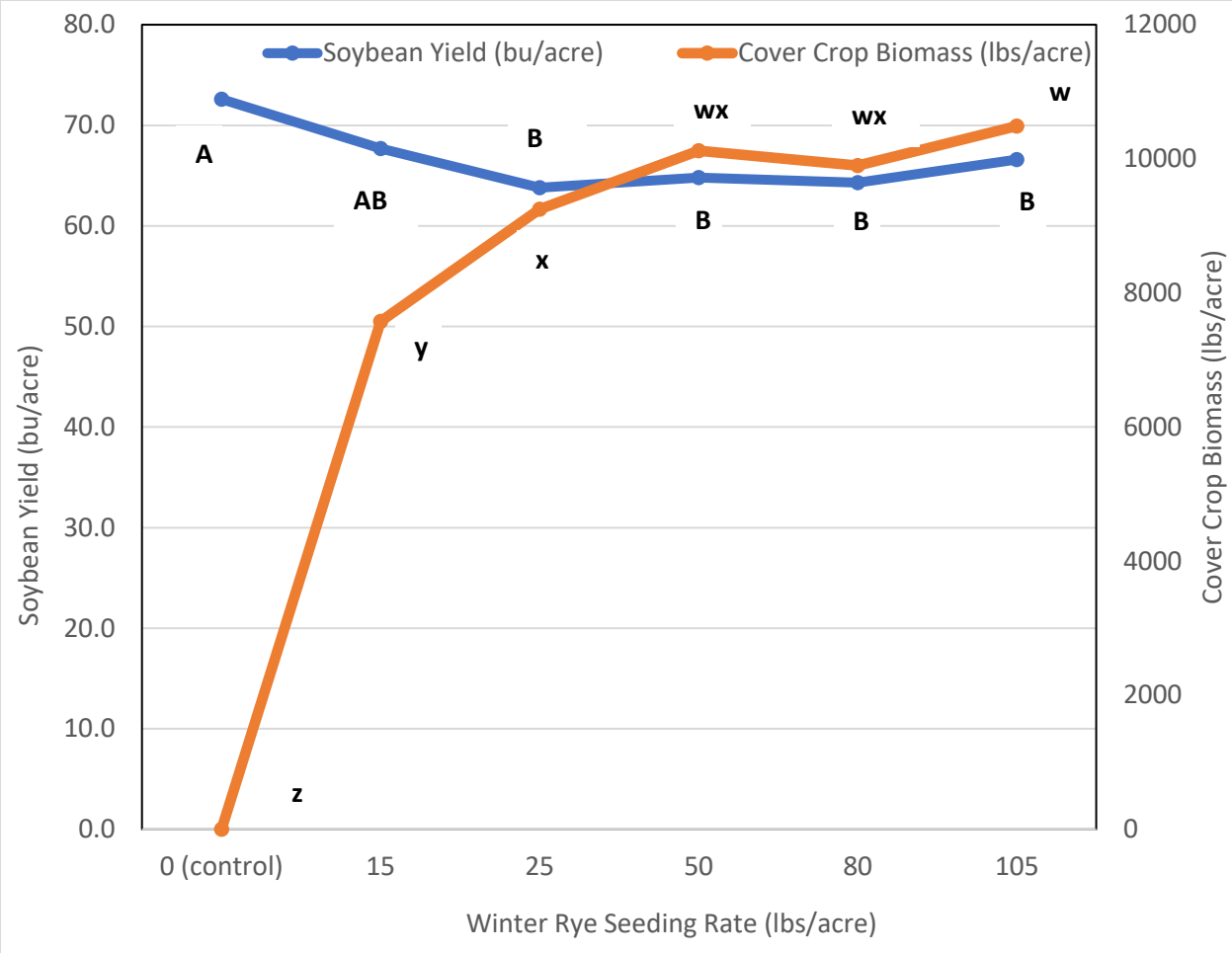

Figure 4. Impact of winter rye seeding rate on biomass dry matter yields and subsequent soybean yields. †Treatments with the same letter did not perform significantly different from one another.

As soybean production expands throughout Vermont, it is important to understand the potential benefits, consequences, and risks associated with growing cover crops in these systems. Low rates of nitrogen applied as starter fertilizer may provide additional nitrogen to meet the needs of the crop and make up for what may be tied up by the winter rye cover crop. The main plots were five spring cover crop termination methods (Table 2) and subplots were four starter nitrogen fertilizer application rates (0, 10, 20, and 30 lbs ac^{-1}). The winter rye was planted on 29-Sep 2022. In the spring prior to cover crop termination, cover crop biomass was measured on 9-May 2023 in the Plow and Spray Early treatments and on 23-May 2023 in the Spray Late, Roll & Plant, and Plant & Roll treatments. There was double the amount of biomass in the late terminated rye treatments compared to earlier termination. There were no statistical differences in rye biomass between any of the late termination methods (Spray Late, Roll & plant, and Plant then Roll). This suggests that any difference in soybean yield between the late termination treatments was not due to statistically greater biomass in any of those treatments. The soil temperature was lowest in the late terminated cover crop treatments; however, soil temperatures did not appear to impact soybean yields. The amount of soil nitrate-N was also statistically greater in the Plow treatment in June and July. There was no statistical difference in soil nitrate-N levels between the Spray Early and Plant then Roll treatment on any sample date except for 21-Jun. This was about one week after the winter rye was roller crimped in the Plant then Roll treatment. Soybean yields were not

statistically different in the Plow, Spray Early, Spray Late, or Roll & Plant treatments. The Plant then Roll treatment had significantly reduced soybean yields and higher seed moisture at harvest. All soybeans were planted on 1-Jun, but the winter rye was not roller crimped in the Plant then Roll treatment until after the soybeans had emerged, which was approximately 2 weeks after planting. Statistical analysis was not done on soybean emergence, but it was observed that soybean emergence was about 5-7 days later in the Plant then Roll treatment than in other termination methods. Cooler soils, late germination, and possibly lower plant populations may have contributed to the yield reductions. The nitrogen application rates had less of an impact on soybean yields compared to cover crop termination methods. Despite differences in application rates, soil nitrate-N levels were only significantly higher than the control on 6-Jul. Nitrogen fertilizer rates had no impact on soybean yield in this year's trial. The significant interaction between termination method and nitrogen application rate for soil nitrate-N on 8-Jun and 21-Jun suggest that increased nitrogen application rates at planting could be beneficial for increasing the available nitrogen in the soil when there is high cover crop residue or biomass. More research needs to be done to better understand the impact that nitrogen applications at planting can have on soybean yields.

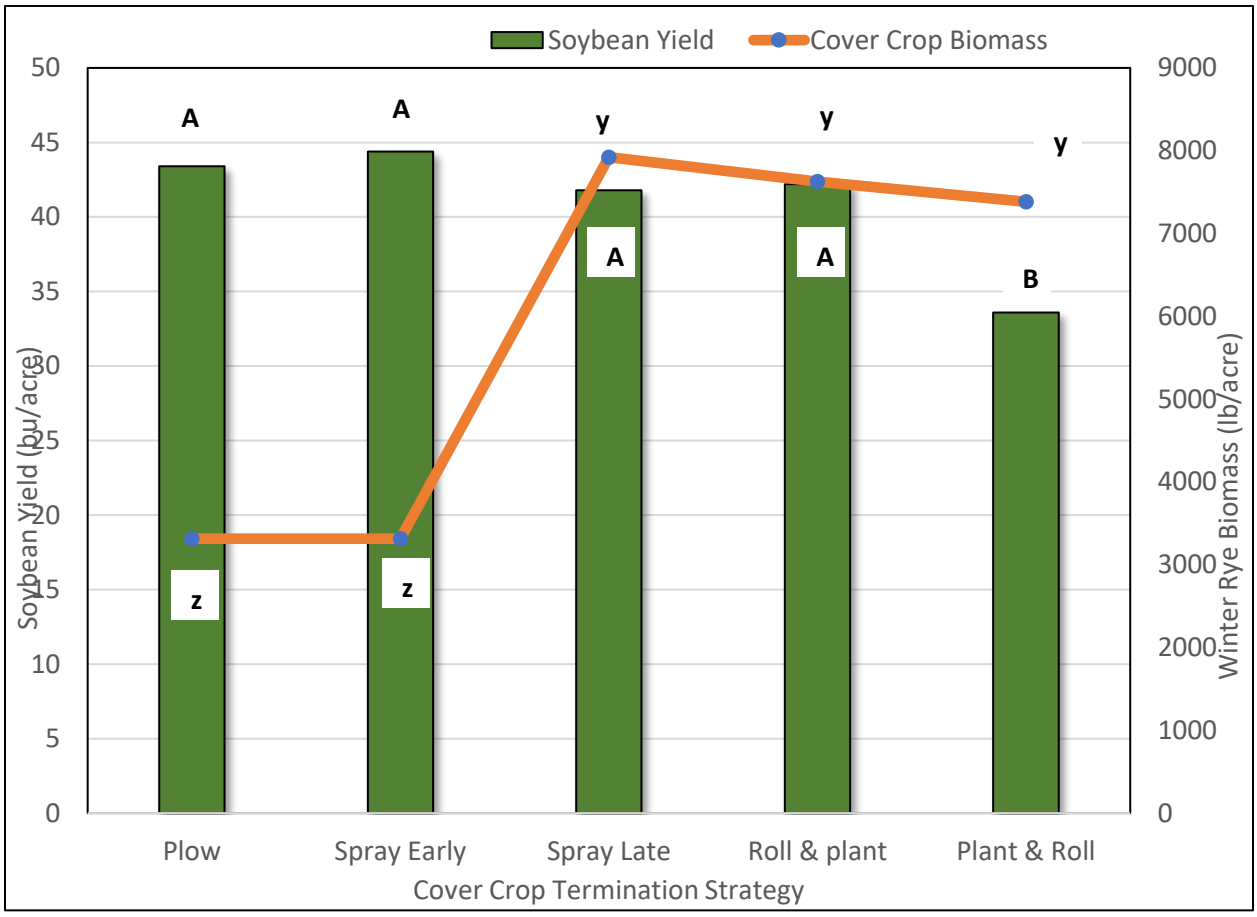

Figure 5. Impact of winter rye termination strategies on cover crop dry matter yields and subsequent soybean yields. †Treatments with the same letter did not perform significantly different from one another.

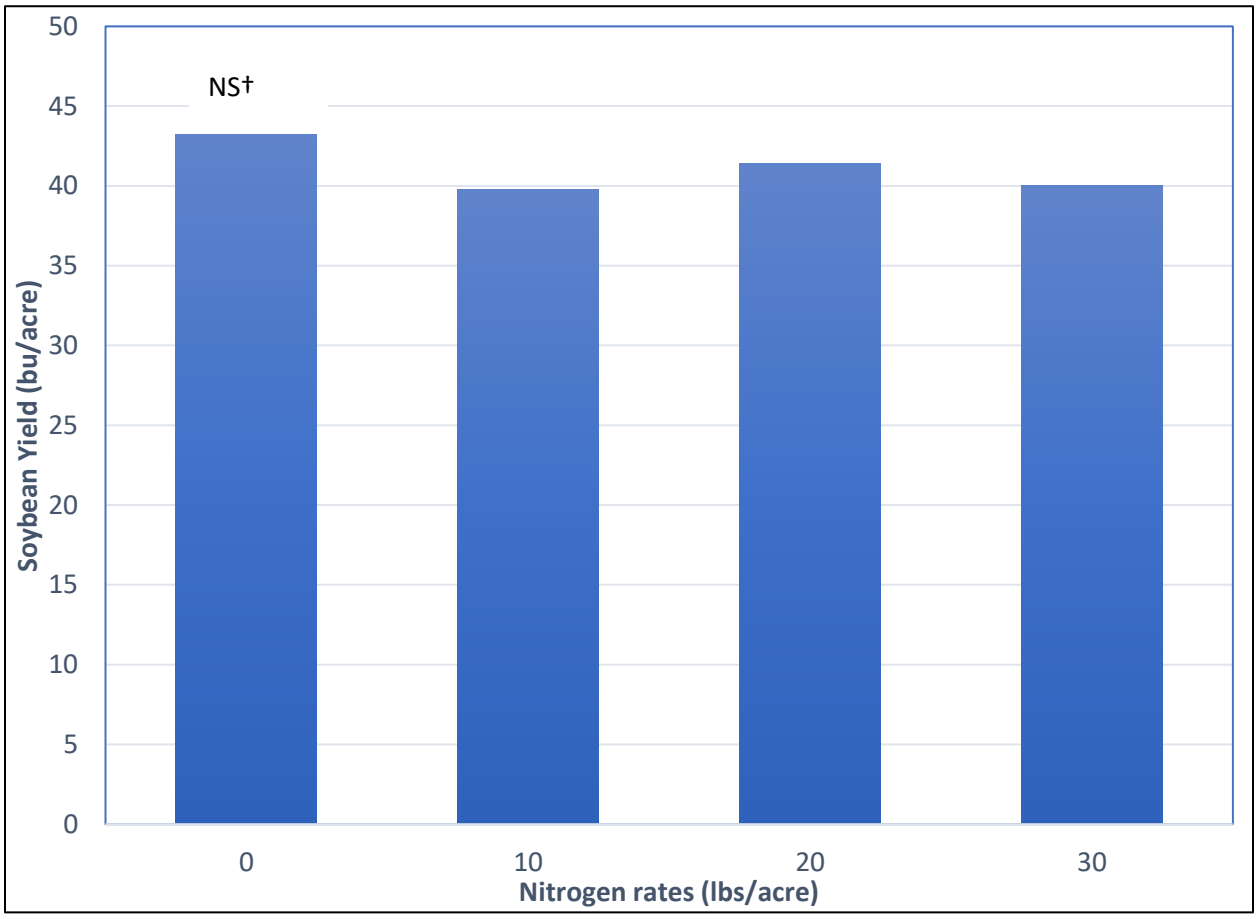

Figure 6. Impact of nitrogen applied as starter on soybean yield. †NS, no significant difference between treatments.