# EFFECT OF BARLEY AND WINTER PEA COVER CROPS ON NUTRIENT AVAILABILITY IN NO-TILL CORN

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## ABSTRACT

Cover crops are reported to have long-term soil health improvements, the first of which is reducing erosion. However, popular cereal cover crops, such as rye (*Secale cereale*), have the potential to cause a yield penalty in the following corn (*Zea mays*) crop. Legumes, such as Austrian winter pea (*Pisum sativum*), are thought to reduce this yield penalty in no-till systems. Additionally, sulfur deficiencies have been observed in some studies following cover crops. The main objective of this study is to determine if earlier termination and/or the addition of a legume will reduce cover crop competition for nitrogen. Cover crop treatments include no cover crop control, barley (Hordeum vulgare) alone (which produces less biomass than rye), and an Austrian winter pea plus barley mix. Cover crops were terminated either five weeks or two weeks before planting corn. Five nitrogen rates of 40, 170, 215, 260, and 349 lb N/A were applied, with 40 lb N/A applied at planting, and the remaining nitrogen applied as sidedress to V3 corn. An additional trial was conducted to examine the effect of sulfur on corn yields following a cover crop. Utilizing the same cover crop treatments, an additional 0 or 30 lb S/A as gypsum was applied. Agronomic data collected includes cover crop nutrient composition, cover crop biomass production, SPAD, ear leaf nitrogen content, soil nitrate and ammonium levels, and yield. Preliminary findings show that early termination of the cover crops can lead to an increase in corn nitrogen content during the growing season. Additionally, fertilizer sulfur increased corn yields following a cover crop at one site year.

## INTRODUCTION

Cover crops are needed following soybean harvest to prevent erosion that occurs over the winter. Corn following these cover crops can require more nitrogen and sometimes yield less. Barley produces less aboveground biomass than other comparable cereal grains, while still providing erosion protection (Nalley, 2024). The addition of a legume, like Austrian Winter Pea, is thought to reduce the competition for nitrogen between the cover and corn crops. Early termination of cover crops, 5 weeks before planting as compared to the standard timing of 2 weeks prior to corn planting, has the potential to further reduce this competition for nitrogen due to a lower amount of aboveground biomass present.

Sulfur is classified as the fourth most important nutrient after nitrogen, phosphorus, and potassium (Aula et al., 2019). Sulfur deficiency in agricultural crops is becoming more common as the rate of sulfur deposition has declined over the past 20 years (Sharma et al., 2024). An application of sulfur has been shown to have the potential to increase corn yield in certain cases. However, there is limited research available on the demand of sulfur in a cover crop and how that affects availability of sulfur in the following corn crop. The objective of this study is to evaluate the effect of cover crop management on nitrogen and sulfur dynamics in no-till corn.

## MATERIALS AND METHODS

Two studies were conducted to evaluate the outlined objectives. Both studies were conducted at the University of Kentucky's North Farm in Lexington, KY and on-farm in Glendale, KY for both the 2024 and 2025 growing seasons, resulting in four site-years per study: LEX24, GLN24, LEX25, and GLN25. Treatments, outlined in Table 1, were arranged in a split-plot randomized complete block design where the main plot is cover crop with four replications. Cover crops were terminated with 40 oz/ac of glyphosate (trade name Roundup WeatherMax). Urea ammonium nitrate was applied at planting at 40 lb N/acre. The remaining nitrogen was applied side dress at V3. When applicable, sulfur was hand applied as gypsum. Drip irrigation and soil moisture sensors were installed in Lexington both years to limit water as a limiting factor. All plots were managed so that weeds, insects, and diseases did not adversely affect yield.

Cover crop biomass samples were taken from a 1$m^2$ area from each cover crop replication and analyzed for biomass and nutrient composition, for the nitrogen study only. Soil Plant Analysis Development (SPAD) readings were taken at both the V10 and R1 stages as an estimation of chlorophyll and nitrogen. Soil samples were taken after V10 for analysis of soil nitrate and ammonium from the 40 and 349 lb N/ac nitrogen treatments. Ear leaves were collected at R1 for nutrient analysis. Yield, kernel weight, and kernel number were determined after harvest.

| | **Nitrogen Study** | **Sulfur Study** |
|---|---|---|
| **Cover Crop** | Barley<br>Barley+ Austrian Winter Pea (Mix)<br>Fallow Control | Barley<br>Barley+ Austrian Winter Pea (Mix)<br>Fallow Control |
| **Termination** | 5 weeks before planting<br>2 weeks before planting | 5 weeks before planting |
| **Fertilization Rate** | 40 lb N/acre<br>170 lb N/acre<br>216 lb N/acre<br>260 lb N/acre<br>349 lb N/acre | 130 lb N/acre<br>220 lb N/acre<br>+<br>0 lb S/acre<br>30 lb S/acre |

Table 1. Treatment table for Nitrogen and Sulfur studies.

# RESULTS AND DISCUSSION

## Cover Crop

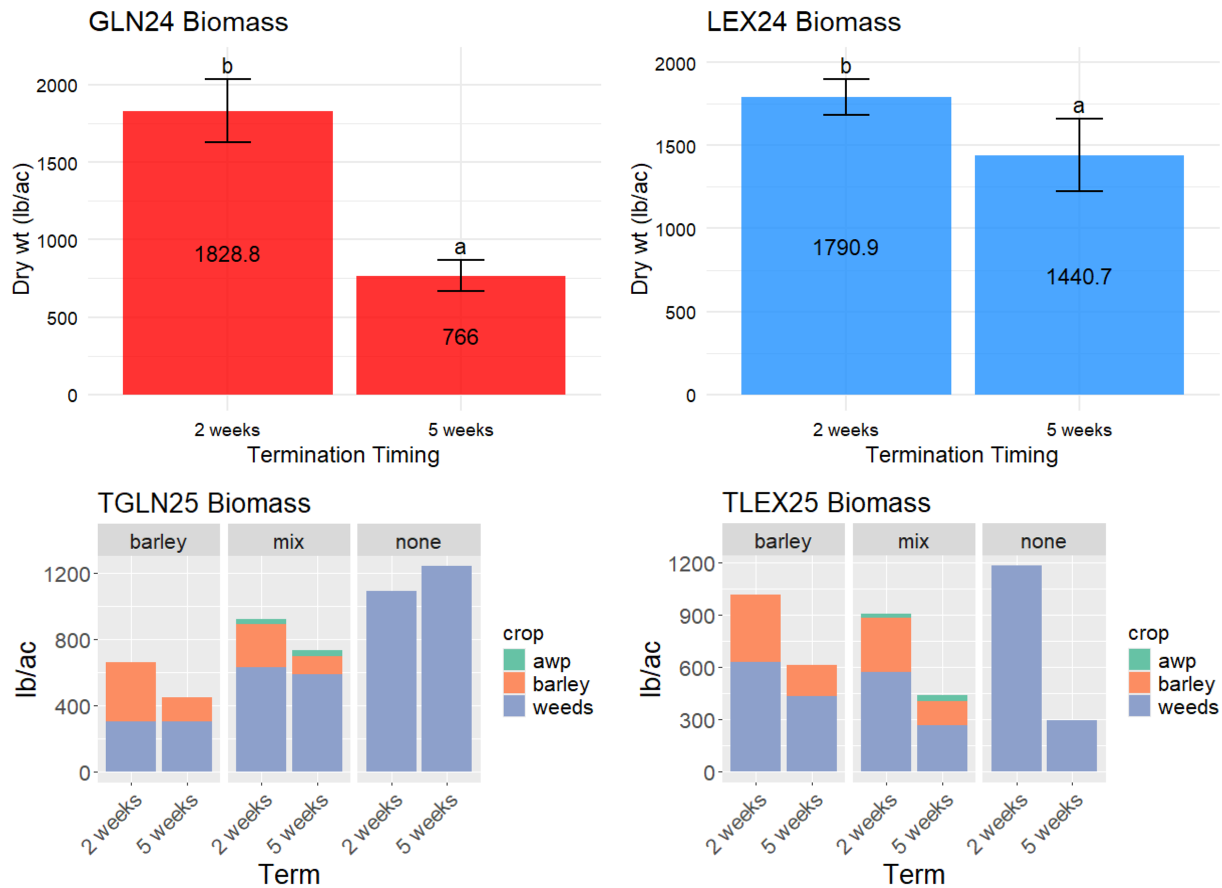


Figure 1. Cover crop biomass by site-year.

Biomass was significantly lower for the 2025 season at both locations. This can most likely be attributed to a very cold winter, limiting above ground growth. Cover crop dry biomass was statistically lower when terminated 5 weeks before planting in every site-year, except GLN24. Which still saw an 84 lb/acre increase in biomass between the 5 week and 2 week termination timings. The effect of cover crop type was variable between the site-years. Both barley and the mixture had significantly more biomass compared to the weedy fallow, but not any different from each other at both locations in 2024. Cover crop biomass was not significantly different for LEX25 while the weedy fallow had the most biomass at GLN25. Biomass was only separated in the 2025 season. At both locations, barley and winter annual weeds outcompeted the winter peas, potentially reducing their ability to offset a nitrogen penalty from the barley.

## **Corn Yield and Nitrogen**

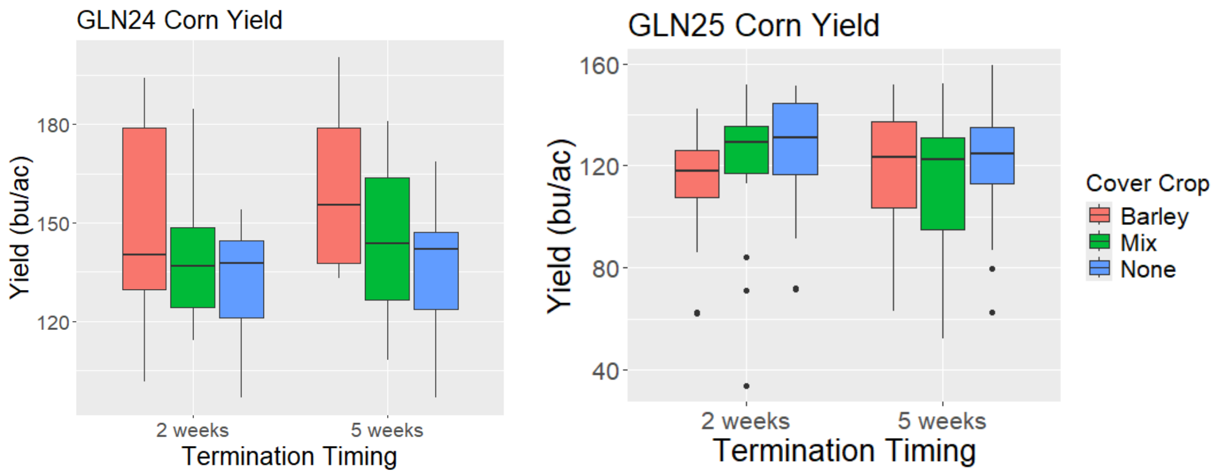


Figure 2. Corn yield by cover crop type and termination timing across all nitrogen rates.

Differences in corn yield due to cover crop was only observed at Glendale. GLN24 showed corn following barley yielded significantly higher than either the mixture or control. GLN25 revealed an inverse, with corn following barley yielding significantly lower than the fallow control. Yield was not significantly different due to termination timing.

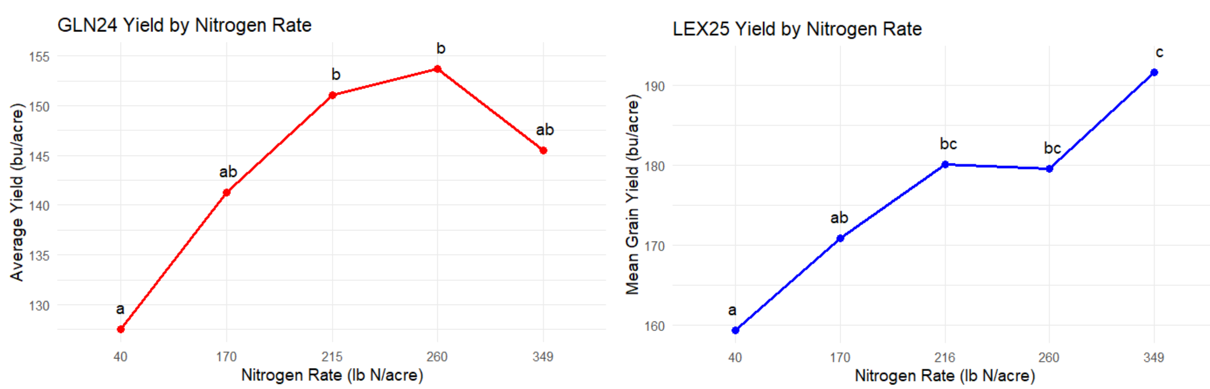


Figure 3. Corn yield by nitrogen rate across all cover crop types and termination timings for GLN24 and LEX25. (Note the differences in scale between the two graphs.)

Yield was significantly different due to nitrogen rate across all site years, except for LEX24. Corn at GLN25 (not shown) only had a yield difference at the lowest nitrogen rate, with an average yield of 70 bu/acre.

### Corn Yield and Sulfur

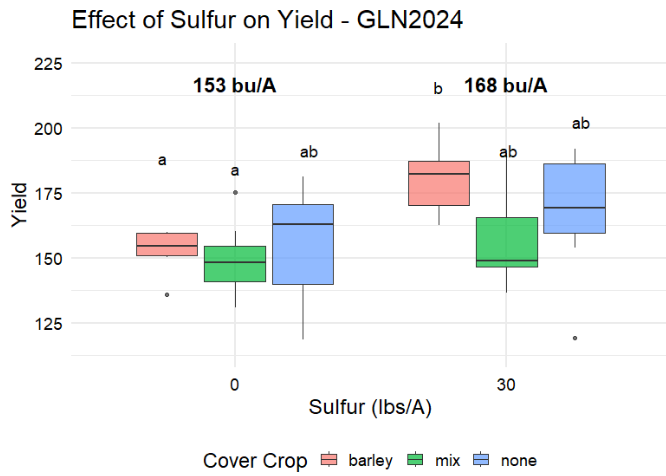


Figure 4. Corn yield following each cover crop and sulfur rates across both nitrogen rates at GLN24.

In the sulfur study, differences in yield were observed for GLN24 (Figure 4), where corn following barley showed the biggest response to sulfur. Overall, there was a 15 bu/acre increase across all cover crops and nitrogen rates, when 30 lb/acre of sulfur was applied. Yield differences were observed at GLN25 due to nitrogen rate only for this study.

## REFERENCES

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