

COMPARISON OF WHEAT AND BARLEY TO RYE AS A COVER CROP FOR MAIZE

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ABSTRACT

Cereal rye (*Secale cereale* L.) is a popular cover crop before corn (*Zea mays* L.) due to its sizeable biomass production and superior nitrate uptake ability. Wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L.) are other winter cereals with similar fibrous root systems and may have comparable value as winter cover crops. A field study was conducted at the University of Kentucky North Farm in Lexington, KY, in 2022. This study aimed to determine if wheat and barley have a lower nitrogen penalty or provide similar soil benefits compared to rye as a winter cover crop for corn. The research design was a split-plot, randomized complete block with three replications. The cover crops treatments consisted of a no cover crop control, 'Somerset' barley, 'Pembroke' wheat, and 'Aroostook' rye. Liquid UAN (32-0-0) was surface applied at 40 lbs/ac to all plots at planting. The remaining nitrogen was accomplished with urea (46-0-0) that was broadcast to the soil surface at planting (AP) or at side-dress (SD) at rates of 0, 70, 170, 270, and 370 pounds lbs N/ac, totaling 40, 110, 210, 310 and 410 lbs N/ac. Cover crops were terminated two weeks before corn planting. At VT growth stage, nitrogen content was measured using a SPAD chlorophyll meter and ear leaf tissue samples from 5 randomized points in each plot. The grain yield, kernel number, kernel weight, and harvestable ears per plot data were collected at harvest. Cover crop did not affect corn SPAD readings at VT nor grain yield. A delayed December cover crop planting resulted in lower cover crop biomass. Corn yields were greatest for the three highest N rates (264 to 271 bu/ac), and the side-dress timing resulted in greater yields than the at planting timing. The 210 lbs/ac treatment with 40 pounds of Nitrogen at planting followed by 170 pounds of Nitrogen at sidedress was the optimum rate and timing since it used the smallest sufficient rate of fertilizer for the highest yield. This study will continue in the 2022-2023 growing season with two locations in Kentucky.

INTRODUCTION

Farmers use cover crops in Kentucky to prevent soil erosion and uptake residual nitrogen between cash crops' growing seasons. Winter cereals are often used for their establishment and value from planting in fall, winter durability, and regrowth in spring before a cash crop is planted. As a cover crop, rye has proven to produce higher biomass and total shoot nitrogen than wheat. Rye has a higher potential to limit corn yield to a more significant level than wheat (Kaspar & Bakker, 2015). Barley and wheat are cereal grains with fibrous root systems similar to rye and have the potential to serve as viable winter cover crops with potentially reduced grain yield risk. Adequate nitrogen levels are critical for a successful corn crop. There is an optimal nitrogen rate when yield is maximized, and the further rate increase will not significantly increase yield (Shapiro et al., 2016). Nitrogen fertilizer will also be volatile at a higher level once a soil nitrogen threshold is met (Ma, B. 2010). Nitrogen needs can vary based on location and soil type. This variability could be due to indigenous nitrogen supplies or soil nitrogen thresholds. A split or sidedress fertilizer application has been shown to reduce the rate needed

significantly from single fertilization before planting (Davies et al., 2020). Various rates and timings could be used to determine if fertilization can assist in alleviating penalties from cover crops. Starter fertilizers did not assist in reducing the yield penalty associated with a rye cover crop (Quinn, 2021). The objectives of this study were to determine if wheat and barley had a lower nitrogen penalty and quantitatively measure their effectiveness compared to rye.

METHODS AND MATERIALS

Cover crops were planted on December 3rd, 2021, at the University of Kentucky North Farm in Lexington, KY, with a John Deere 750 no-till planter in 10-foot strips. The cover crops were planted into soybean residue since a corn/soybean rotation is typical for the region. The cover crops treatments consisted of a no cover crop control, Somerset barley, Pembroke wheat, and Aroostook rye. The soil type for all plots was predominately Lowell-Bluegrass Slit Loam. The following spring, cover crops were terminated on April 27th, 2022, with glyphosate herbicide (Roundup brand). Maize planting occurred two weeks later, on May 11th, to avoid potential yield penalties from the cover crops (Quinn, 2021). Dekalb hybrid (DKC 65-95RIB, 115-day maturity) was planted at a 2-inch depth at 38,000 seeds per acre in four 30-inch rows with a Wintersteiger pneumatic planter with a slotted disc system and cone seed delivery. The Kinze row units were fitted with Martin-Till row cleaners set to remove residue from the seed row, but not create a soil disturbance any deeper than ½-inch. Soil cores were collected at a 6-in depth before planting and after harvest to quantify soil organic matter and soil nitrates. Soil samples were analyzed at the University of Kentucky Regulatory Services.

The research design was a split-plot, randomized complete block with three replications. There were two fertilization timings with five nitrogen treatments. All plots received 40 pounds of urea ammonium nitrate (32-0-0) per acre at planting. Both nitrogen timings used the same 40 lbs/ac control. The five nitrogen rates of 0, 70, 170, 270, and 370 lbs/ac were applied at planting (AP) or sidedress (SD) at the V3 growth stage with urea (46-0-0) as surface broadcast by hand. Total N applied was 40, 110, 210, 310 and 410 lbs/ac. In late June, around the V6 phenological stage for the plots, drip irrigation was installed to limit water stress. Drip lines were placed between rows 1/2 and 3/4 for each plot. Nitrogen Content was measured on five randomized corn leaves per plot with SPAD at the 10th leaf and ear leaf for V10 and VT growth stages, respectively. Five randomized ear leaf tissue samples were collected per plot at VT. Disease ratings were taken throughout the early reproductive period, a low disease incidence was observed, and no fungicide was applied. Maize plots were harvested with a Wintersteiger Delta plot combine with a Geringhoff corn head and Juniper Weighing Systems HarvestMaster weigh bucket on October 3rd, 2022. Grain yield, kernel number, kernel weight, and harvestable ears per plot data were collected at harvest. Preliminary data were analyzed with SAS statistical software at $p < 0.10$ considered significant.

RESULTS AND DISCUSSION

Cover Crop Biomass

A late cover crop planting date resulted in reduced cover crop biomass growth. Wheat produced significantly more biomass than barley or rye ($P=0.0523$). Wheat averaged 775 lbs/ac compared to 562 lbs/ac for rye and 227 lbs/ac for barley. The cover

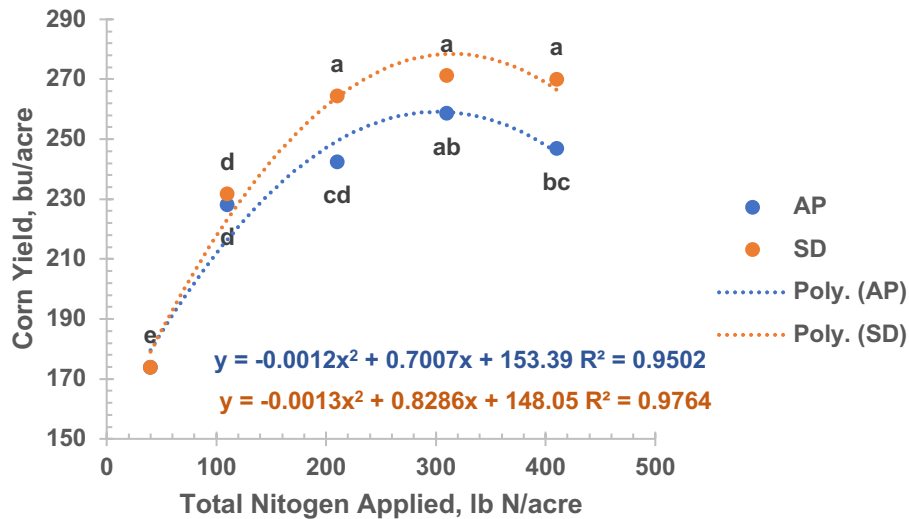
crop did not affect corn yield response to N rate or timing. While cover crop planting date was late, it was consistent with private farms in the area, and thus, provides relevant data to the season experienced. Cover crops were planted in October of 2022 and should result in greater biomass yields, and potentially more N interactions, in spring of 2023.

Table 1. Nitrogen Rates /Timings and Cover Crops Effects on SPAD and Yields, Lexington, KY 2022.

Treatment		SPAD at R1 Chlorophyll Content		YIELD Bu/A
Nitrogen Timing	Total lbs N/ac			
At Planting (AP)	40	41.3	e	174 e
	110	50.4	d	228 d
	210	56.2	b	242 cd
	310	56.7	ab	259 ab
	410	56.0	b	247 bc
Side-Dress (SD)	40	41.3	e	174 e
	110	52.1	c	232 d
	210	55.6	b	264 a
	310	57.9	a	271 a
	410	56.2	b	270 a
Cover Crop Effect				
	None	54.3	a	246 a
	Barley	53.7	a	245 a
	Rye	53.2	a	240 a
	Wheat	53.2	a	241 a
<i>LSD (0.10) NR</i>		<i>1.5542</i>		<i>14.58</i>
<i>LSD (0.10) CC</i>		<i>1.0362</i>		<i>9.7176</i>
<i>P value NR</i>		<i><.0001</i>		<i><.0001</i>
<i>P value CC</i>		<i>0.2689</i>		<i>0.6315</i>
<i>P value NRxCC</i>		<i>0.1177</i>		<i>0.2194</i>

Means are compared within N Rate and Cover Crop.

Means in the same column with different letters are significantly different ($p \leq 0.10$).



**Figure 1: Corn Yields Averaged Across Cover Crops Response to N Rates, Lexington, KY 2022
SPAD Measurement at VT**

The SPAD readings at VT growth stages were greatest for 310 lb N/ac at both timings (Table 1). SPAD readings for the 210 and 410 rates were less than the 310 rate but greater than the 40 and 110 N rates. Cover crop and N timing did not affect SPAD readings.

Corn Yields

Corn treated with 40 and 110 lbs N/ac yielded less than corn at the higher nitrogen rates (Table 1). Corn yields at 210, 310, and 410 lbs N/ac were similar to each other for each timing and ranged from 264 to 271 bu/ac averaged across all plots. At the three higher N rates, corn yielded greater with SD than AP timing. Corn receiving a total of 210 lb N/ac (40 AP and 170 SD) was the optimal N rate for this season and location.

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