Integrating Rye Seed Production and Red Clover into Corn Systems and Nitrogen Management

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Introduction

This study is designed to investigate nitrogen (N) response in cereal rye seed production, influence of a red clover cover crop on corn N fertilization requirement, and the overall integrated-production system on soil nitrate-N. The study is conducted at two locations. This report has preliminary results for the rye crop production from the first year.

Materials and Methods

The study started in fall 2017 with rye planting at two Iowa State University Research and Demonstration Farms: the Agricultural Engineering/Agronomy Research Farm, Boone, Iowa, and the Northern Research and Demonstration Farm, Kanawha, Iowa.

The treatments were arranged in a split-split-plot randomized complete block design, with red clover as the whole plot (with and without red clover), cereal rye as the split-plot (two varieties), and N rate as the split-split-plot (0, 25, 50, 75, 100, 125 lb/acre, urease inhibitor treated urea).

Two cereal rye varieties (ND Dylan and Elbon) were planted October 19 and 20, 2017 (approximately 1.1 million pure live seeds/acre). The N rates were split-applied, with 25 lb/acre at rye planting and the remainder in spring at rye green-up. Red clover (Ruby brand, inoculated) was broadcasted mid-March at 15 lb/acre. After rye harvest, the non-clover areas were mowed as needed for weed control. The clover was not mowed.

The sites were soil sampled in fall 2017 and phosphorus, potassium, sulfur, or lime were applied as needed before rye planting.

Plant height, number of heads/acre, 0-2 plant lodging score scale, and grain yield were determined in the rye cereal crop. Post-rye harvest soil profile nitrate-N to the two-ft depth was measured at 0, 75, and 125 lb N/acre rates. Rye leaf SPAD meter readings were used to assess the rye N status. Nitrogen response equations were used to determine the agronomic optimum N rate (AONR) of the cereal rye seed production.

Results and Discussion

When averaged across N rates, the ND Dylan variety had significantly greater yield compared with Elbon at both locations (Table 1). In addition, the preliminary results showed relatively low rye yields (approximately 40 bu/ac at both sites, mean across both varieties). The low yields may be due to late planting and weather conditions in 2018 (monthly temperature was below normal in April and above normal in May, and with high precipitation in the spring), which caused rye plant stress and compromised yield potential.

Cereal rye yield was significantly increased with N rate. The agronomic optimum N rate (AONR) was 75 lb N/acre at Boone and 109 lb N/acre at Kanawha. When averaged across sites, the AONR was 89 lb/acre. At the AONR, the mean yields in Boone were 45 and 35 bushels/acre for ND Dylan and Elbon varieties, respectively; whereas at Kanawha,

ND Dylan yield was 46 bushels/acre and Elbon 34 bushels/acre.

The SPAD meter readings followed a similar pattern as the yield response to N rate, with readings increasing with increasing N rate (data not shown). The SPAD readings with Elbon were greater than ND Dylan. The ND Dylan variety was slightly taller than Elbon, and also had a greater seed head count. Both varieties increased in plant height and number of heads with N application.

Lodging was a problem for both varieties, either with or without N fertilization. Lodging was greater at Boone than Kanawha and Elbon had greater lodging at both sites than ND Dylan. Lodging also increased with N application.

Soil nitrate-N (data not shown) in the top two feet of soil after rye harvest was overall low (less than approximately 30 lb N/ac at Kanawha and 20 lb N/ac at Boone), not affected by the under-sown clover, and increased approximately 5 lb N/acre at each location with the highest N rate compared with the no-N application.

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Table 1. Rye seed production and plant measurements, 2018. Preliminary data and analysis.

	Boone				Kanawha			
	Yield (bu/ac)	Height (in.)	Heads no./ac x 1,000	Lodging 0-2 Score	Yield (bu/ac)	Height (in.)	Heads no./ac x 1,000	Lodging 0-2 score
Variety								
ND Dylan	41.4a†	53a	1341a	1.1b	39.8a	49a	1455a	0.7b
Elbon	32.7b	50b	1297a	1.6a	27.5b	46b	1245b	0.9a
N Rate (lb/ac)‡								
0	30.7	50	1173	0.9	24.2	43	1154	0.0
25	33.0	52	1210	1.2	27.1	45	1146	0.1
50	37.0	51	1256	1.6	30.7	48	1314	0.5
75	40.7	53	1402	1.6	37.7	49	1368	1.1
100	40.0	51	1418	1.6	40.1	51	1558	1.5
125	41.1	51	1453	1.4	42.0	50	1562	1.6
Pr>F§	0.012	0.071	0.002	0.024	<0.001	<0.001	<0.001	<0.001
AONR¶ (lb N/ac)	75	---	---	---	109	---	---	---

†Rye variety main effect significantly different at the 0.10 probability level when letters are different.
‡Total N applied, 25 lb N/acre applied at rye planting, remainder top-dressed at rye green-up in spring.
§Significance of mean N rate.
¶AONR, agronomic optimum N rate.