Nitrogen Fertilization of Corn Grown with a Cover Crop

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John Sawyer, professor
Jose Pantoja, graduate assistant
Daniel Barker, assistant scientist
Department of Agronomy

Introduction

Objectives of this project were to study corn nitrogen (N) fertilization requirement and corn-soybean yield response when grown in a rye cover cropping system. Multiple rates of N fertilizer were applied, with measurement of corn yield response to applied N and soybean yield with and without a fall planted winter rye cover crop. The study was conducted at multiple research farms, with the intent for comparison of with and without a cover crop system across varying soil and climatic conditions in Iowa.

Materials and Methods

The first year was in 2009, with 2011 the third year. Locations are the Ag Engineering/ Agronomy Research Farm, Ames (Webster silty clay loam); Armstrong Research Farm, Lewis (Marshall silty clay loam); Southeast Research Farm, Crawfordsville (Mahaska silty clay loam); and the Northeast Research Farm, Nashua (Floyd loam). In 2011 an additional site was added at the Northwest Research Farm, Sutherland (Primghar silty clay loam). Each location is in a corn-soybean rotation.

The winter rye cover crop ("Wheeler" variety) was no-till drill planted at 1 bushel/acre in the fall of 2010 as soon as possible after soybean and corn harvest (Sept. 30-Oct. 7 after soybean and Sept. 17-Oct. 7 after corn). The rye cover crop growth was controlled with Roundup in the spring (Apr. 20-May 2 before corn and May 5-18 before soybean), with the targeted control at least seven days prior to corn planting and at or within one week of soybean planting. The corn and soybean crops were no-till planted in 30-in. rows (May 3-12 for corn and May 6-18 for soybean). Rye control and corn-soybean planting occurred as conditions allowed.

Nitrogen fertilizer rates were applied early sidedress as urea-ammonium nitrate (UAN) solution (0, 40, 80, 120, 160, and 200 lb N/acre). The liquid nitrogen fertilizer was coulter-injected on 60-in. spacing. The corn hybrid and soybean variety were early-season adapted for the location. Pest management practices were those typical for the region and rotations. Corn and soybean were harvested with a plot combine and yields corrected to standard moisture.

Results and Discussion

Rye growth and aboveground biomass production varied between years and sites due to differences in previous crop and spring conditions. In 2011, the rye biomass production was generally less than previous years. Also, the 2011 rye biomass dry matter production was greater before soybeans compared with the biomass before corn (Table 1).

At each location there was no difference in soybean yield with or without the cover crop (Table 2); average yield 59.0 bushels/acre with and 59.5 bushels/acre without the rye. This has been consistent across years.

Across locations in 2011, corn yield at the maximum N response rate averaged 5 bushels/acre lower when planted in conjunction with the rye cover crop (Table 3). The largest differences in yields were at Crawfordsville and Nashua. In 2010 the average corn yield was 20 bushels/acre lower with the cover crop and in 2009 was

7 bushels/acre lower. The rye cover crop has not resulted in a corn yield increase at any site and year.

Across all sites and years, the response to N rate was similar with or without the rye cover crop (Figure 1). The average yield at the economic optimum N rate was 12 bushels/acre lower with the rye cover crop (183 bu/acre with and 195 bu/acre without), but the difference in economic optimum N rate was only 6 lb N/acre higher with the cover crop (164 vs. 158 lb N/acre).

With these three years of study, there was no effect of the rye cover crop on soybean yield. Also, the three years of data for corn showed no effect on economic optimum N rate, but there was a 6 percent yield reduction.

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Table 1. Winter rye biomass dry matter before controlling growth with herbicide, spring 2011.

Cover crop	Ames	Crawfordsville	Lewis	Nashua	Sutherland
			lb/acre		
Before corn	550	1,200	380	245	210
Before soybean	640	1,510	555	320	210

Table 2. Soybean grain yield with and without rye cover crop, 2011.[1]

Cover crop	Ames	Crawfordsville	Lewis	Nashua	Sutherland
			bu/acre		
With cover crop	56.5a	49.4a	66.9a	61.5a	60.6a
Without cover crop	55.7a	53.8a	66.0a	62.0a	60.1a

[1]Yields at a location followed by the same letter are not significantly different, $p \leq 0.05$.

Table 3. Corn grain yield at the maximum N rate response with and without rye cover crop, 2011.[1]

Cover crop	Ames	Crawfordsville	Lewis	Nashua	Sutherland
			bu/acre		
With cover crop	191	179	172	196	208
Without cover crop	193	190	169	207	209

[1]Yields at the point of maximum N response for each location determined from regression equations.

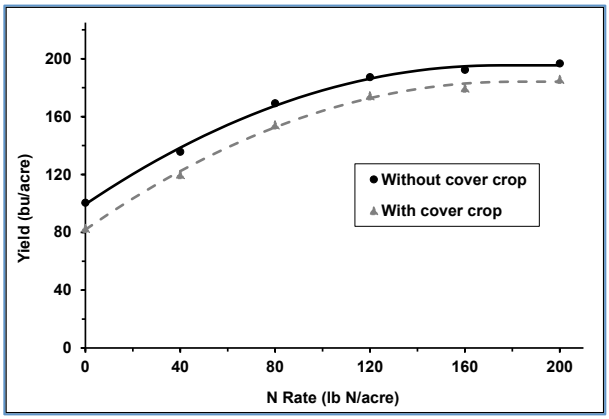

Figure 1. Corn yield response to N rate across Iowa locations with and without rye cover crop, 2009-2011.