Seasonal and Rotational Influences on Corn Nitrogen Requirements

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Introduction

This project was designed to study the N fertilization needs in continuous corn (CC) and corn rotated with soybean (SC) as influenced by location and climate. Multiple rates of fertilizer N were spring-applied, with the intent to measure yield response to N within each rotation on a yearly basis for multiple years at multiple sites across Iowa. This will allow determination of N requirements for each rotation, differences that exist between the two rotations, responses to applied N across different soils and climatic conditions, and evaluation of tools used to adjust N application.

Materials and Methods

The first year of this research at the ISU Northeast Research Farm, Nashua, Iowa, was 2005. The study area was cropped to both soybean and corn in 2004. Therefore, in the initial year (2005) results were available for both rotations. The soils are Readlyn-Floyd-Kenyon loams.

Tillage was fall chisel plow corn stalks and spring field cultivation before planting each crop. Rates of N applied to corn were 0 to 240 lb N/acre in 40 lb increments. Urea fertilizer was the N source and was broadcast and incorporated before planting. No N was applied with the planter. The farm superintendent chose the corn hybrid and soybean variety. Pest control practices are 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

In 2013, corn yields were good for both SC and CC (Table 1) and for soybean (average 69 bu/acre). The calculated economic optimum N rate (EONR) in 2013 was slightly higher than normal for each rotation (SC 147 lb N/acre and CC 190 lb N/acre). These rates would likely be a result of the wet spring conditions in 2013. The average EONR (2005-2013) is fairly high for both rotations (157 lb N/acre for SC and 199 lb N/acre for CC) and at the upper end of normally suggested Maximum Return to N (MRTN) rates from the on-line Corn Nitrogen Rate Calculator. The high economic rates reflect the generally wet conditions across the years of this study.

The corn yield at the EONR was 23 bushels/acre more in the SC rotation compared with CC. For the past nine years, corn yield has averaged 12 percent less in CC than SC (177 vs. 201 bu/acre).

Figure 1 shows the corn yield response to N rate each year for the SC and CC rotations. In addition, the graphs show the yearly yield at the EONR and yield if a constant MRTN rate were applied each year. Despite the large variation in yield between years, the yearly EONR and the MRTN rate resulted in corn yields close to the maximum yield. In 2008 for SC and 2008 and 2010 for CC the yield at the MRTN rate fell significantly below the yearly EONR yield. The overall results indicate the MRTN rate provides for optimal economic corn grain yields, and like yearly EONR, yields near maximum production each year.

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Table 1. Corn grain yield as influenced by N fertilization rate in 2013.

N Rate	SC	CC
lb N/acre	- - - - - - - - bu/acre - - - - - - - -	
0	72	67
40	99	91
80	153	108
120	172	133
160	203	164
200	200	174
240	200	182

SC, corn following soybean; CC, corn following corn.

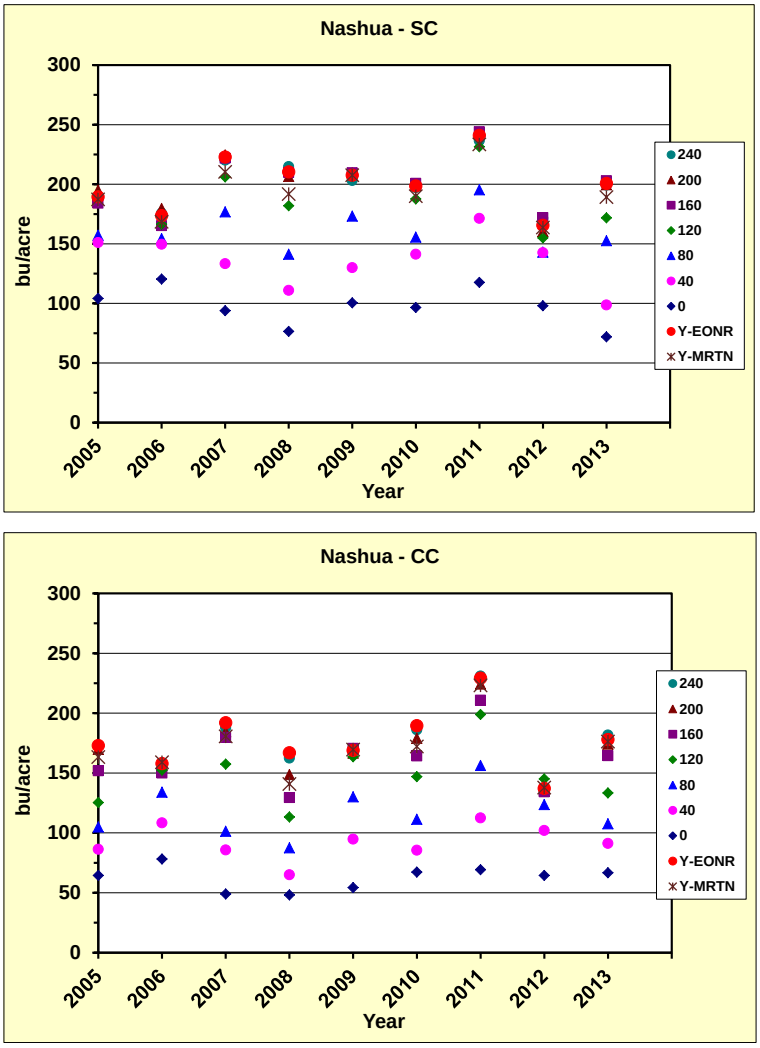

Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant Maximum Return To N (Y-MRTN) rate was applied each year, Northeast Research Farm, 2005–2013. The MRTN rate used was 135 lb N/acre for SC and 192 lb N/acre for CC (rates from the 2013 Corn N Rate Calculator web site at a 0.10 price ratio, $/lb N:$/bu corn grain).