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Seasonal and Rotational Influences on Corn Nitrogen Requirements

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Abstract
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.

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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 Northeast Research Farm 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 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

Corn yields were good in 2012 for both SC and CC despite the dry growing season (Table 1). The dry conditions, along with wind damage and lodging caused some variation in yields. The calculated economic optimum N rate (EONR) in 2012 was opposite of normal, that is for SC (148 lb N/acre) was higher than for CC (120 lb N/acre). On occasion, that happens at a site, and may be partially due to the yield variation in 2012. The average EONR (2005–2012) is fairly high for both rotations, 158 lb N/acre for SC and 200 lb N/acre for CC, and at the upper end of normally suggestion application rates.

The corn yield at the EONR was 28 bushels/acre higher for the SC rotation compared with CC. For the past eight years, corn yield has averaged 12 percent higher in the SC rotation (201 vs. 177 bu/acre). Soybean yield in the SC rotation averaged 63 bushels/acre in 2012.

Figure 1 shows the yield response to N rate each year for the SC and CC rotations. In addition, the graphs show the yield each year at the EONR and yield if a constant Maximum Return To N (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 quite close to the maximum yield. Only in 2008 for SC and 2008 and 2010 for CC did the yield at the MRTN rate fall below the yearly EONR yield. These results indicate that the MRTN rate provides for optimal economic corn grain production, and like EONR, yields close to the maximum yields each year.

Acknowledgements

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Table 1. Corn grain yield as influenced by N fertilization rate in 2011, Northeast Research Farm.

N Rate	SC	CC
lb N/acre	- - - - - - - - bushels/acre - - - - - - - -	
0	98	64
40	143	102
80	143	124
120	155	145
160	172	134
200	160	136
240	171	138

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

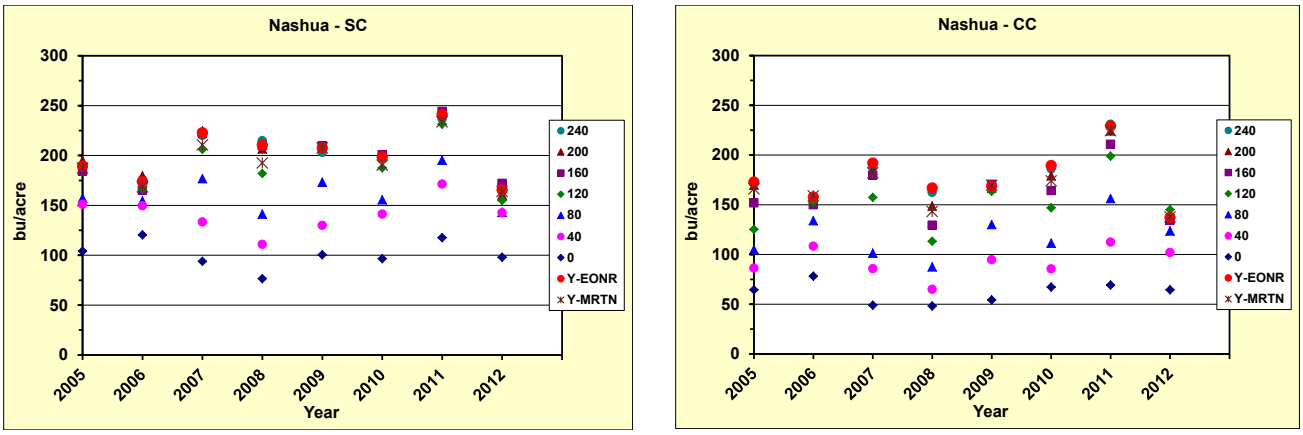

Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant Maximum Return To N (Y-MRTN) rate was applied each year, Northeast Research Farm, 2005–2012. The MRTN rate used was 135 lb N/acre for SC and 192 lb N/acre for CC (rates from the 2011 Corn N Rate Calculator web site at a 0.10 price ratio, $/lb N:$/bu corn grain).