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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 the 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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Disciplines
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Seasonal and Rotational Influences on Corn Nitrogen Requirements

RFR-A1264

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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 the 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 Armstrong Research Farm was 2001. The study area was cropped to soybean in 2000. The two rotations were initiated in 2001. The soil is Marshall silty clay loam.

Tillage was fall chisel plow and spring disk before planting. Rates of N applied to corn are 0 to 240 lb N/acre in 40-lb increments. In 2012, urea-ammonium nitrate solution (32% UAN) was sidedress injected after planting. No N is 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 are harvested with a plot combine and yields corrected to standard moisture.

Results and Discussion

In 2012, corn yields were much lower than previous years due to the dry conditions experienced during the 2012 growing season (Table 1). The calculated economic optimum N rate (EONR) in 2012 was also low, 91 lb N/acre for SC and 147 lb N/acre for CC. These results are a response to drier than normal conditions, and the second year in a row with reduced optimal N rates.

The corn yield at the economic optimum N rate (EONR) was 63 bushels/acre higher in the SC rotation compared with CC, with stress from the dry conditions resulting in greater yield reduction in CC than SC (Table 1). Also, the yield with no N applied was very low for CC. For the past eleven years, corn yield has averaged 10 percent higher in the SC rotation (189 vs. 170 bu/acre), including 2002 and 2012, which were two years with very low yield due to dry conditions. Soybean yield in the SC rotation averaged 32 bushels/acre in 2012.

Figure 1 shows the yield response to N rate each year for SC and CC. In addition, the graphs show the yearly yield 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 close to the maximum yield. Only in 2009 for SC and 2010 for both rotations 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 2012, Armstrong Research Farm.

N Rate	SC	CC
lb N/acre	- - - - - - - - bu/acre - - - - - - - -	
0	104	14
40	123	39
80	138	60
120	131	74
160	142	66
200	138	77
240	142	83

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

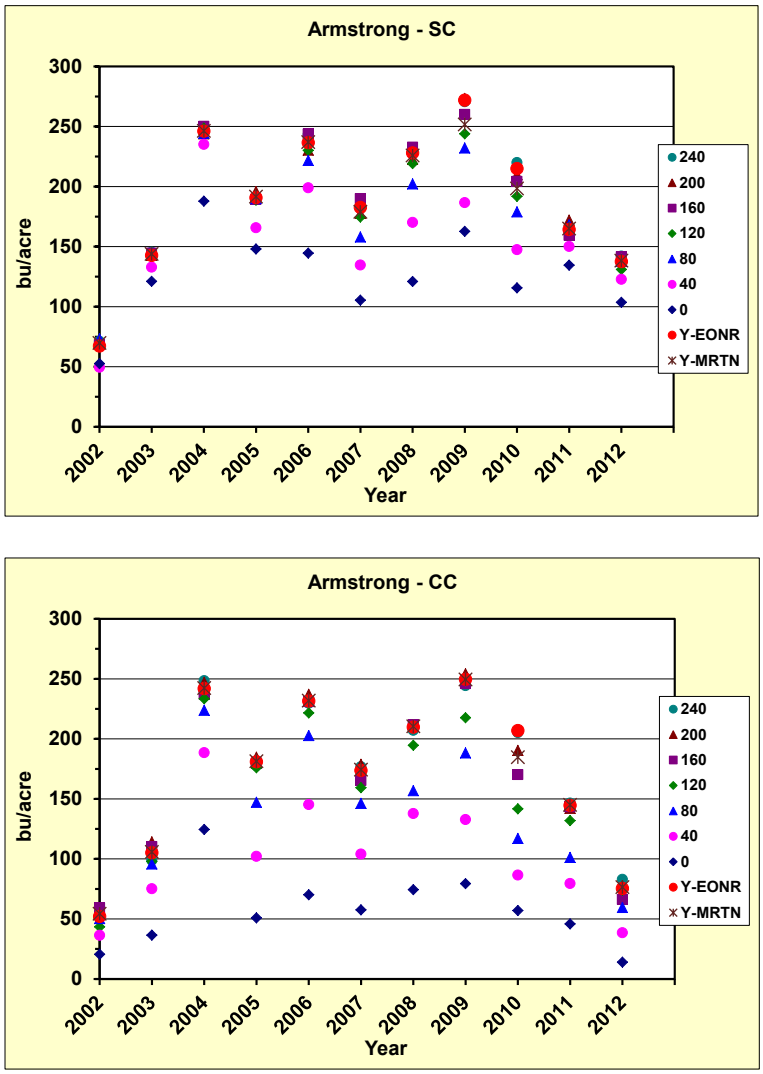

Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant Maximum Return To N (Y-MRTN) rate was applied each year, at the ISU Armstrong Research Farm, 2001–2012. The MRTN rate used was 135 lb N/acre for SC and 192 lb N/acre for CC (rates from the 2012 Corn N Rate Calculator web site at a 0.10 price ratio, $/lb N:$/bu corn grain).