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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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RFR-A1365

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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 ISU Northwest Research Farm, Sutherland, Iowa, was 2000. The study area was cropped to corn in 1999, with the two rotations initiated in 2000. The soil is Galva silty clay loam.

Tillage is fall chisel plowing after corn stalks were chopped and spring disk/field cultivation. Rates of N applied to corn are 0 to 240 lb N/acre in 40-lb increments. In 2013, urea-ammonium nitrate solution (28% UAN) was sidedress injected after 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 are harvested with a plot combine and yields corrected to standard moisture.

Results and Discussion

In 2013, corn yields were the highest measured across the years of study (Table 1). The calculated economic optimum N rate (EONR) in 2013 was high, 182 lb N/acre for SC and 240 lb N/acre (maximum N applied) for CC. These results would be a response to wetter than normal spring conditions in 2013, and are the highest EONRs measured in the study.

The corn yield at the EONR was 14 bushels/acre lower (6%) in CC compared with the SC rotation. This is a smaller crop rotation difference than normally found. For the past 13 years (including 2004, which had significant hail damage), corn yield has averaged 11 percent lower in CC than SC (178 vs. 159 bu/acre). Soybean yield in the SC rotation averaged 72 bushels/acre in 2013, and was not influenced by the previous year N application to corn.

Figure 1 shows the corn 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 2013 for both rotations, and slightly in 2010 for CC, did the yield at the MRTN rate fall below the yearly EONR yield. These results indicate the MRTN rate does provide for optimal economic corn grain production, and like yearly EONR, yields close to the maximum yields each year.

Acknowledgements

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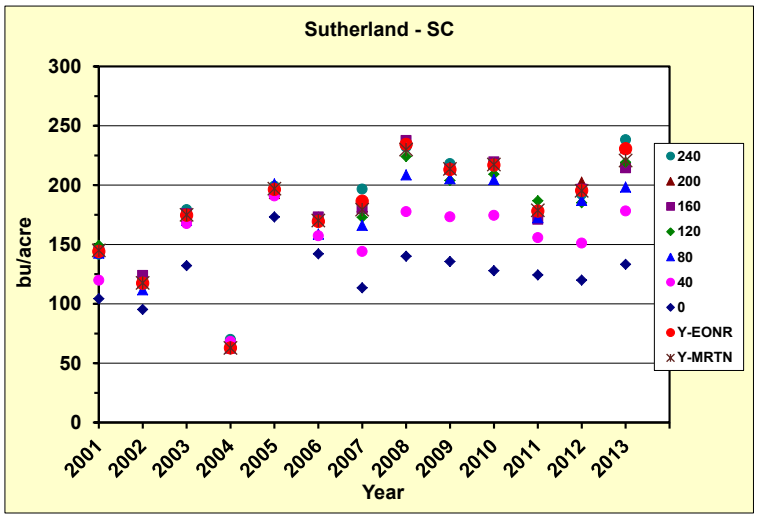
Table 1. Corn grain yield as influenced by N fertilization rate in 2013, Northwest Research Farm.

N Rate	SC	CC
lb N/acre	- - - - - - - bu/acre - - - - - - -	
0	133	99
40	178	109
80	198	150
120	219	163
160	214	183
200	231	202
240	238	216

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



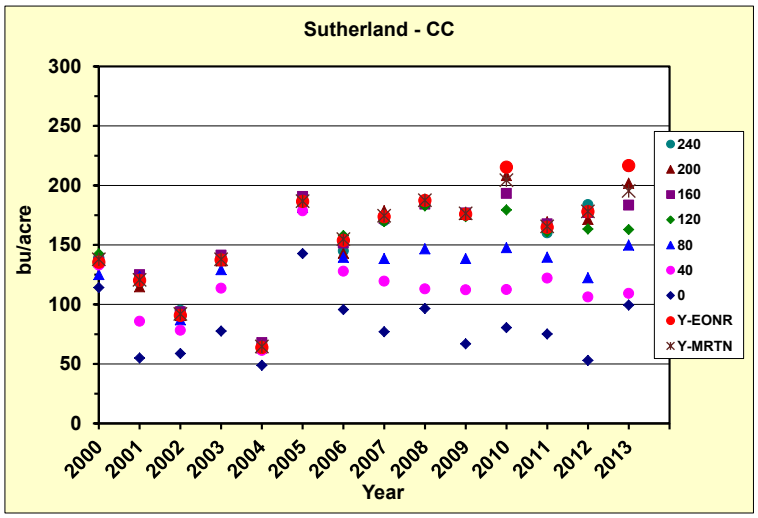


Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant Maximum Return To N (Y-MRTN) rate was applied each year, Northwest Research Farm, 2000–2013. The MRTN rate used was 134 lb N/acre for SC and 187 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).