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Seasonal and Rotational Influences on Corn Nitrogen Requirements

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Abstract
This project is 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 are 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-A1174

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Introduction

This project is 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 are 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 Southeast Research Farm, Crawfordsville, IA was 1999. The study area was cropped to soybean in 1998, therefore, in the initial year all yields follow soybean. The two rotations were initiated in 1999. The soil is Kalona silty clay loam.

Tillage was fall chisel plowed and disked, with spring phoenix harrowing before planting. Rates of N applied to corn are 0 to 240 lb N/acre in 40 lb increments. Urea-ammonium nitrate solution (32% UAN) fertilizer was sidedress injected between corn rows after 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.

Spring wet conditions occurred again in 2011. This resulted in more than normal N stress and variation across the site.

Results and Discussion

Corn yield levels were quite good in 2011 for corn following soybean (Table 1). The calculated economic optimum N rate (EONR) for SC was 225 lb N/acre; and for CC the maximum N rate applied, 240 lb N/acre. These are high rates and an indication of wet spring conditions and wet soils with slow internal drainage. For CC, grain yield increased to the maximum N rate applied six of the last eight years.

For the past twelve years, corn yield has averaged 17 percent higher in the SC rotation. In 2011, soybean yield averaged 42 bushels/acre.

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 the very responsive (wet) years does the yield at the MRTN rate fall below the yearly EONR yield; with SC 2007, 2008, and 2011; and for CC four of the last eight years when the yield response was to the highest rate applied. These results indicate that the MRTN rate does provide for optimal economic corn grain production, but in years with wet conditions additional N management practices, such as

late sidedressing or applying additional in-season N, will be needed to optimize yield.

Acknowledgements

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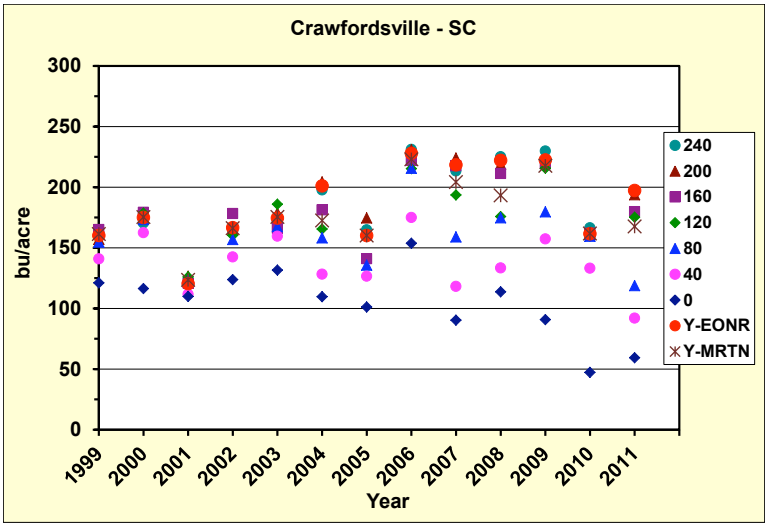
Table 1. Corn grain yield as influenced by N fertilization rate.

N Rate	SC	CC
lb N/acre	- - - - - - - bu/acre - - - - - - -	
0	59	27
40	92	38
80	119	78
120	175	105
160	180	148
200	194	154
240	196	160

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



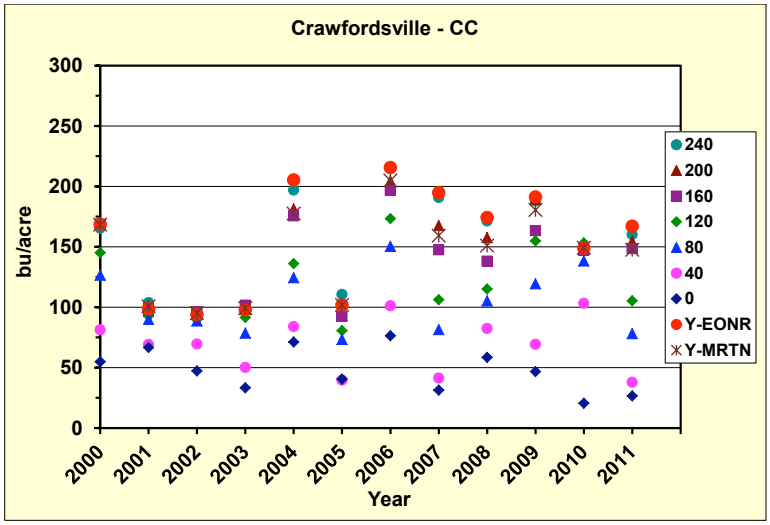


Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant Maximum Return To N (Y-MRTN) rate was applied each year, Southeast Research Farm, 1999–2011. The MRTN rate used was 133 lb N/acre for SC and 190 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).