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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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Seasonal and Rotational Influences on Corn Nitrogen Requirements

RFR-A12124

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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 two rotations were established in 1999. The study area was cropped to no-till soybean in 1998, therefore, in the initial year all yields are following soybean. The soil at this location is Haig silty clay loam.

Tillage is fall chisel plowing and disk/field cultivation 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 were corrected to standard moisture.

Results and Discussion

The 2012 year had below normal rainfall and drought conditions; opposite of the previous four years where there was excessive rainfall and wet soils. The effect of the dry conditions is evident in both rotations with the very low corn yields, low N response, and zero economic optimum N rate (EONR) (Table 1). These results for corn are common in growing seasons with excessively dry conditions. The soybean yield for 2012 was good at 43.5 bushels/acre and reflected the late season rainfall received.

The average N fertilization requirement over time (2000–2012) has been higher for CC compared with SC (195 lb N/acre in CC and 157 lb N/acre in SC). Several years with high precipitation has contributed to the higher than normal expected N rate requirement. For the past 13 years, corn yield has averaged 15 percent less with CC than SC (142 vs. 167 bu/acre).

Figure 1 shows the yield response to N rate each year for the SC and CC, yield each year at the (EONR), and yield if a constant Maximum Return To N (MRTN) rate were applied each year. Only in a very responsive (wet) year did the yield at the MRTN rate fall below the yearly EONR yield. 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. In an excessively dry year like 2012, with no or little N application requirement, the MRTN rate would be much more than needed, however, such a season is difficult to predict.

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Table 1. Corn grain yield as influenced by N fertilization rate in 2012, McNay Memorial Research Farm.

N Rate	SC	CC
lb N/acre	- - - - - - - bushels/acre - - - - - - -	
0	77.7	19.4
40	74.9	31.1
80	70.9	26.3
120	73.4	31.9
160	81.1	31.5
200	72.1	37.9
240	73.4	44.5

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

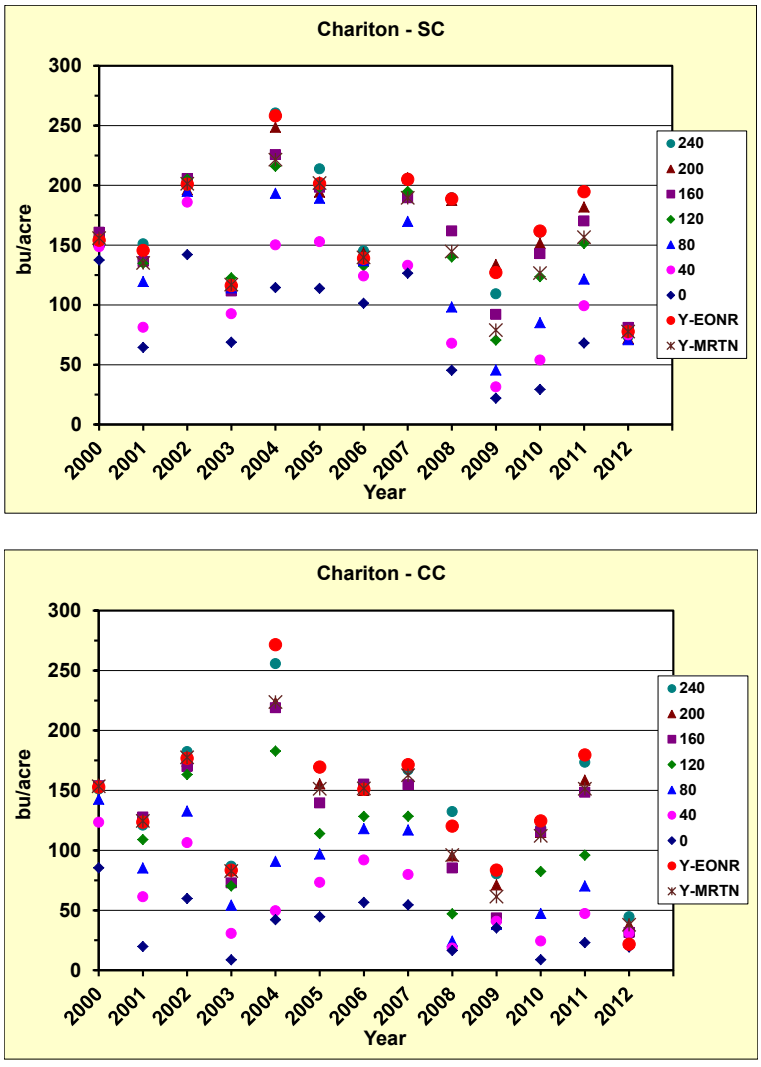

Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant Maximum Return To N (Y-MRTN) rate was applied each year, McNay Memorial Research Farm, 2005–2012. The MRTN rate used was 135 lb N/acre for SC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