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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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RFR-A11129

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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 the ISU McNay Farm is Haig silty clay loam, and the field has tile drainage.

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 (UAN 32%) solution 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 are those typical for the region and rotations. Corn and soybean are harvested with a plot combine and yields were corrected to standard moisture.

Results and Discussion

The year 2011 was the fourth in a row with excessive rainfall and soil wetness. The effect of these conditions was evident in the N responses (Table 1). For both rotations, corn grain yield increased to the highest N rate. Nitrogen losses would be expected with the rainfall amounts and soil wetness in 2011.

The average N fertilization requirement (2000–2011) has been higher for CC compared with SC (211 lb N/acre in CC and 170 lb N/acre in SC). Several years with high precipitation has contributed to the higher than normal expected N fertilization requirement. For the past 12 years, corn yield has averaged 13 percent less with CC than SC. The soybean yield for 2011 was 50 bushels/acre.

Figure 1 shows the yield response to N rate each year for the SC and CC. In addition, the graphs show the yield each year at the economic optimum N rate (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 MRTN rate often resulted in corn yields close to the EONR yield. Only in the very responsive (wet) years does the yield at the MRTN rate fall below the yearly EONR yield; in 2004 and 2008–2011, especially 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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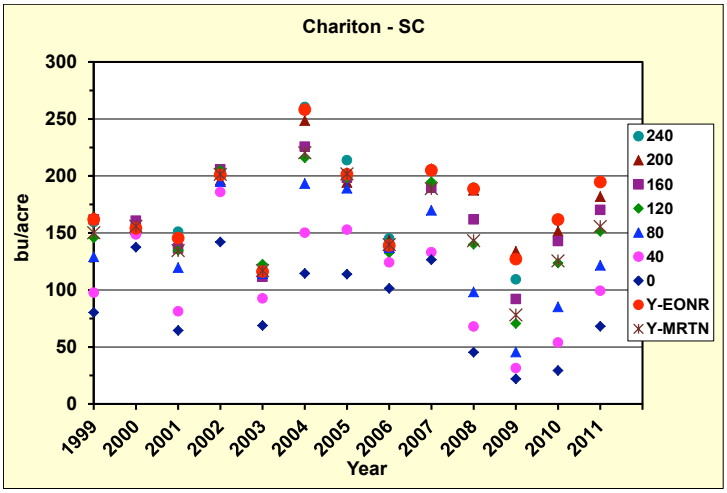
Table 1. Corn grain yield as influenced by N fertilization rate in 2011, ISU McNay Memorial Research Farm.

N Rate	SC	CC
lb N/acre	- - - - - - - bu/acre - - - - - - -	
0	68	23
40	99	47
80	122	70
120	151	96
160	170	148
200	182	159
240	195	173

SC = corn following soybean; CC = corn following corn.



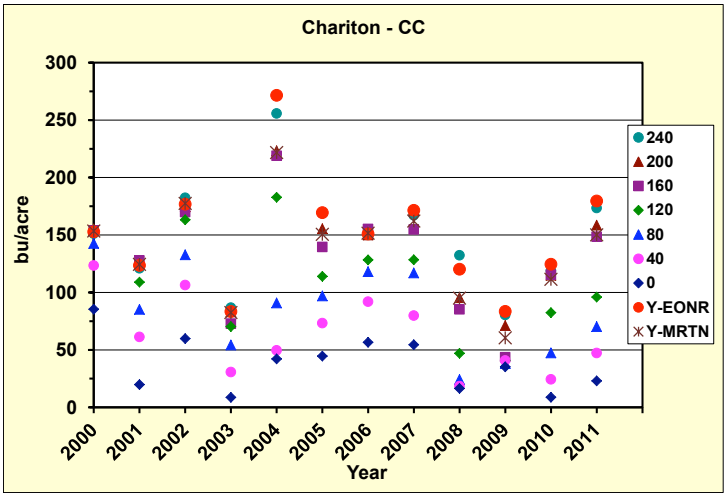


Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant maximum return to N (Y-MRTN) rate was applied each year, ISU McNay Memorial Research Farm, 2005–2011. The MRTN rate used was 133 lb N/acre for 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).