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Seasonal and Rotational Influences on Corn Nitrogen Requirements

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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 Armstrong Research Farm, Lewis, Iowa, was 2001. The study area was cropped to soybean in 2000, and the two rotations 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 were 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 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 were harvested with a plot combine and yields corrected to standard moisture.

Results and Discussion

In 2013, corn yields were lower than what often occurs at this site, especially in the SC rotation (Table 1). The calculated economic optimum N rate (EONR) in 2013 was near normal rates for both rotations, 133 lb N/acre for SC and 184 lb N/acre for CC.

The corn yield at the economic optimum N rate was 33 bushels/acre lower in the SC rotation compared with CC. This yield trend is opposite what is normally found, that is, yield in the SC rotation are typically higher than in CC. No specific reason is known for why corn yield in SC plateaued at a low yield level. With the zero and low N rates, yields were as typically found for both rotations with yield in SC higher than CC; but not for the higher N rates (Table 1). For the past 12 years, corn yield averaged 8 percent lower in the CC rotation (186 vs. 171 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 57 bushels/acre in 2013, with no effect of the prior year N rates applied to corn.

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 for each rotation was 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 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 does provide for optimal corn grain yields, and like yearly EONR, near maximum production each year.

Acknowledgements

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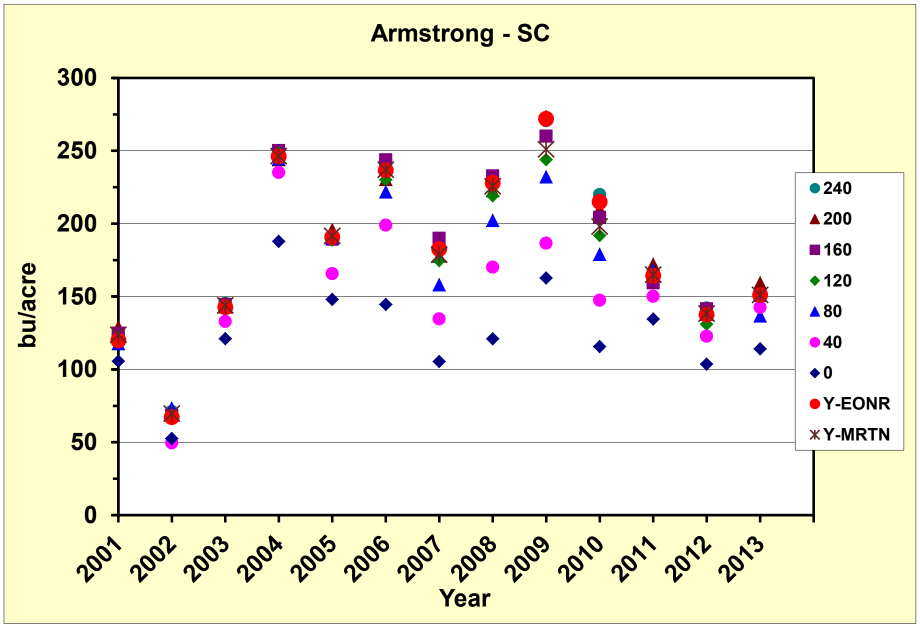
Table 1. Corn grain yield as influenced by N fertilization rate in 2013, Armstrong Research Farm.

N Rate	SC	CC
lb N/acre	- - - - - - - - bu/acre	- - - - - - - -
0	114	68
40	142	104
80	137	129
120	149	140
160	151	169
200	159	182
240	150	186

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



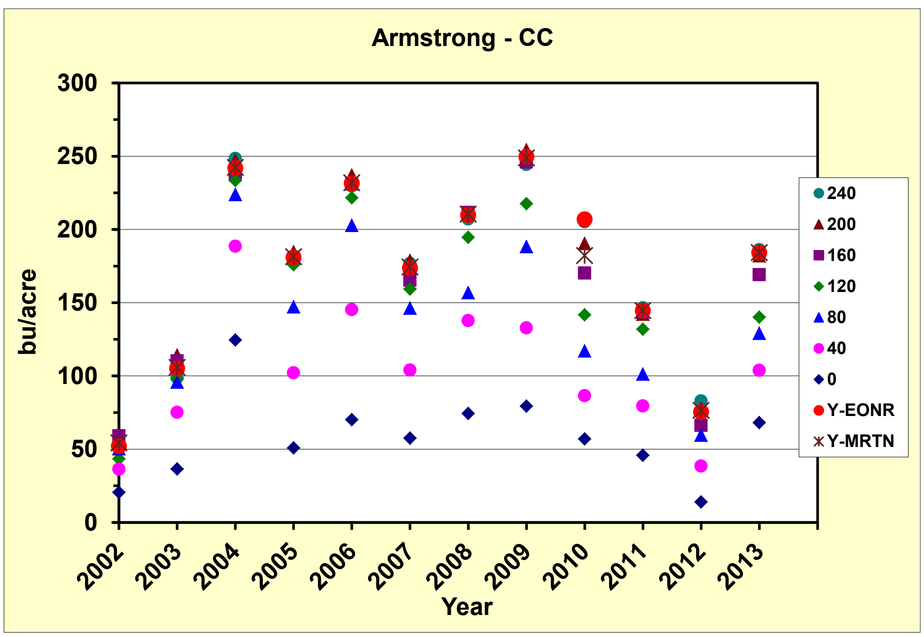


Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant Maximum Return To N (Y-MRTN) rate was applied each year, Armstrong Research Farm, 2001–2013. The MRTN rate used was 134 lb N/acre for SC and 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).