

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 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 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 were following soybean. The soil 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 are 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 2013 season had an early wet spring and relatively dry rest of the growing season. The economic optimum N rate (EONR) in 2013 was 182 lb N/acre in CC and 134 lb N/acre in SC, in line with expected needed N rates for both rotations. The corn yield (Table 1) at the EONR was 146 bushels/acre in CC and 164 bushels/acre in SC, at the yield average for the years of study at the site. The soybean yield for 2013 was 34.7 bushels/acre, well below the 48.9 bushels/acre average for the site in the last 14 years.

The average N fertilization requirement over time (2000-2013) has been higher for CC compared with SC (194 lb N/acre in CC and 155 lb N/acre in SC). Several years with high precipitation has contributed to a higher than normal expected N rate requirement. For the past 14 years, corn yield has averaged 14 percent less with CC than SC (143 vs. 167 bu/acre).

Figure 1 shows the yield response to N rate each year for SC and CC, yield each year at the (EONR), and yield if a constant Maximum Return To N (MRTN) rate was applied each year. Only in very responsive (wet) years did the corn yield at the MRTN rate fall below the yearly EONR yield. This occurred in five years for SC and CC. That frequency reflects the poorly drained soil and recent occurrence of excessive rainfall periods. In years with early season wet conditions, alternative N management practices such as split application, late sidedressing, or applying additional N at mid-vegetative growth stages will be needed to optimize yield.

In excessively dry years, with little N application requirement, the MRTN rate would be more than needed, however, such seasons are difficult to predict.

Acknowledgements

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

N Rate	SC	CC
lb N/acre	----- bu/acre -----	
0	44	11
40	89	45
80	115	61
120	151	103
160	162	130
200	164	145
240	167	146

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

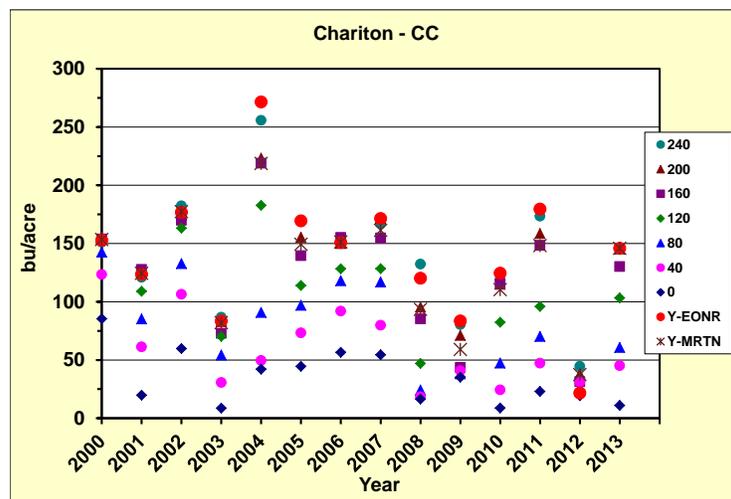
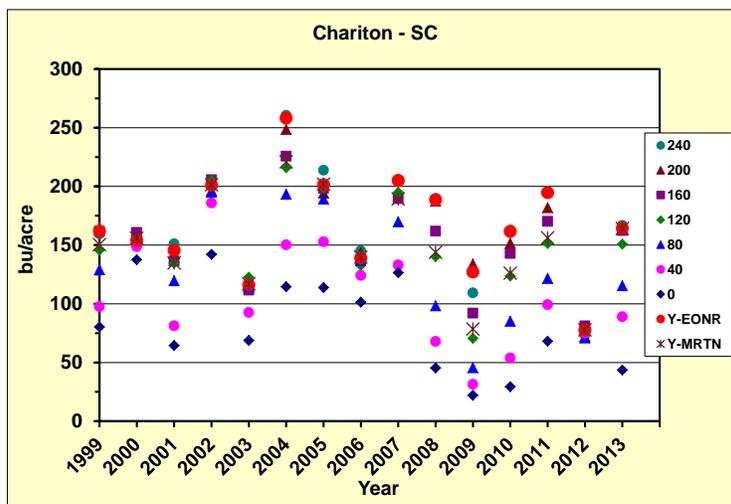


Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant Maximum Return To N (Y-MRTN) rate was applied each year, McNay Memorial Research Farm, Chariton, IA, 1999–2013. The MRTN rate used was 134 lb 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).