Seasonal and Rotational Influences on Corn Nitrogen Requirements

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John Sawyer, associate professor
Daniel Barker, assistant scientist
Department of Agronomy

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 Northern Research Farm, Kanawha, Iowa was 2005. The study area was cropped to soybean in 2004, therefore, in the initial year all yields followed soybean. The two rotations were initiated in 2005. The soil is Canisteo clay loam.

Tillage was fall chisel plow and spring disk/field cultivation before planting. Rates of N applied to corn are 0 to 240 lb N/acre in 40 lb increments. Urea fertilizer is the N source and is broadcast and incorporated with secondary tillage before planting. No N is 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 2011, grain yield responded positively to applied N in each rotation (Table 1). The calculated economic optimum N rate (EONR) for each rotation in 2011 was low—122 lb N/acre for SC and 116 lb N/acre for CC. It occurs, but is unusual for the EONR to be lower for CC than SC. At this site, the EONR for CC has been approximately the same as with SC three times. Also, the average EONR across years for the CC rotation has been fairly low, 166 lb N/acre, while the EONR for SC is more typical at 143 lb N/acre. The low EONR with CC resulted in a relatively small difference in EONR between the rotations. These results may be due to the low yields at this site, especially for CC.

The corn yield in 2011 at the economic optimum N rate (EONR) was 10 bushels/acre higher in the SC rotation compared to CC. For the past six years, corn yield has averaged 21 percent higher in the SC rotation (177 vs. 140 bu/acre). Soybean yield in the SC rotation averaged 52 bushels/acre in 2011.

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 MRTN rate resulted in corn yields close to the yearly EONR yield and maximum yield. These results indicate that the MRTN rate provides for optimal economic corn grain production, and like EONR, yields close to the maximum yields each year.

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	128	62
40	149	107
80	154	135
120	166	145
160	169	144
200	162	144
240	167	150

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

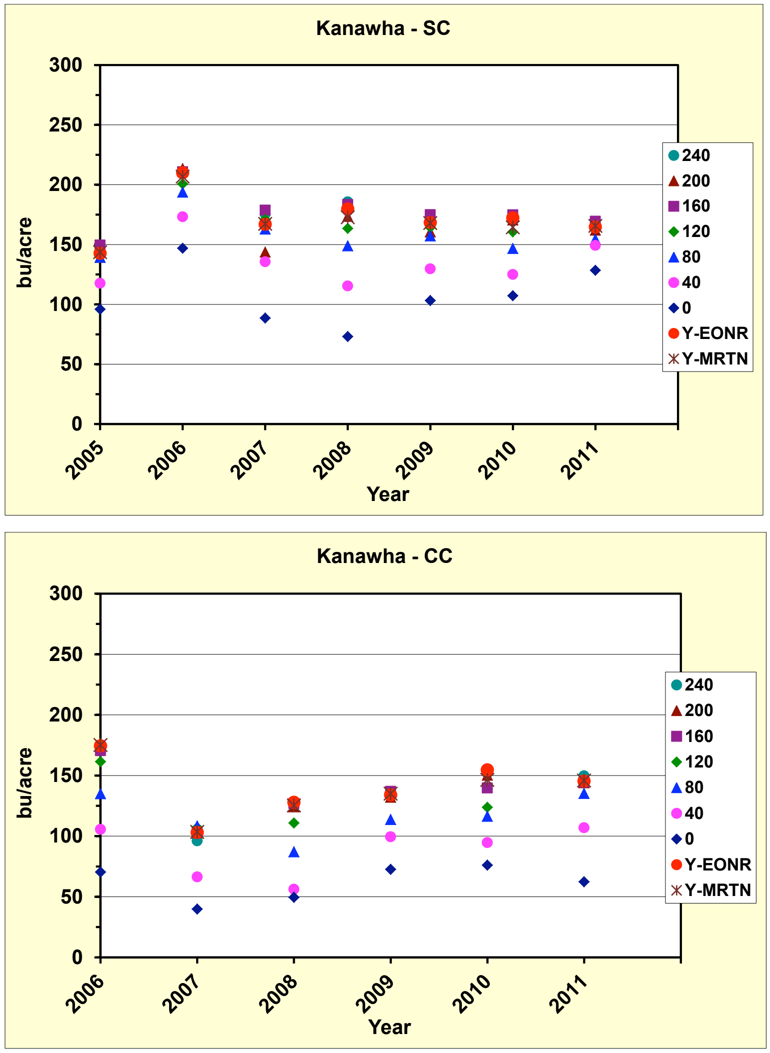

Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant maximum return to N (Y-MRTN) rate was applied each year, ISU Northern Research Farm, 2001–2011. The MRTN rate used was 133 lb N/acre for SC and 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).