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 Northern Research Farm, Kanawha, Iowa, was 2005. The study area was cropped to soybean in 2004, with the two rotations 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 were 0 to 240 lb N/acre in 40 lb increments. Urea fertilizer was the N source and was broadcast and incorporated with secondary tillage before 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 grain yields were at the highest level recorded across the years of this study (Figure 1). The N rate response was high in each rotation (Table 1) and in contrast to the low response the prior year. These yearly differences would be due to the contrasting wet and dry years, especially spring rainfall in 2013. The calculated economic optimum N rate (EONR) for each rotation in 2013 was high; 240 lb N/acre for SC (highest N rate applied) and 223 lb N/acre for CC. The average EONR (2006-2013) for both rotations is fairly typical for CC (178 lb N/acre) and high for SC (151 lb N/acre). The average EONR for SC increased 13 lb N/acre due to the high N rate response in 2013.

In 2013, corn yield was 21 bushels/acre more in the SC rotation compared with CC. For the past eight years, corn yield has averaged 19 percent more in SC (174 vs. 140 bu/acre). Soybean yield averaged 44 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 were applied each year. Despite the large variation in yield between years and N response, the MRTN rate resulted in corn yields quite close to the yearly EONR and maximum yield. Only with SC in 2013, due to the high N rate response, did the yield at the MRTN fall below the yield at the EONR. These results indicate the MRTN rate does provide for optimal corn grain yields, and like yearly EONR, yields near maximum production each year.

Acknowledgements

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

N Rate	SC	CC
lb N/acre	- - - - - - - - bu/acre - - - - - - - -	
0	115	91
40	135	113
80	163	151
120	170	147
160	184	167
200	184	171
240	204	183

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

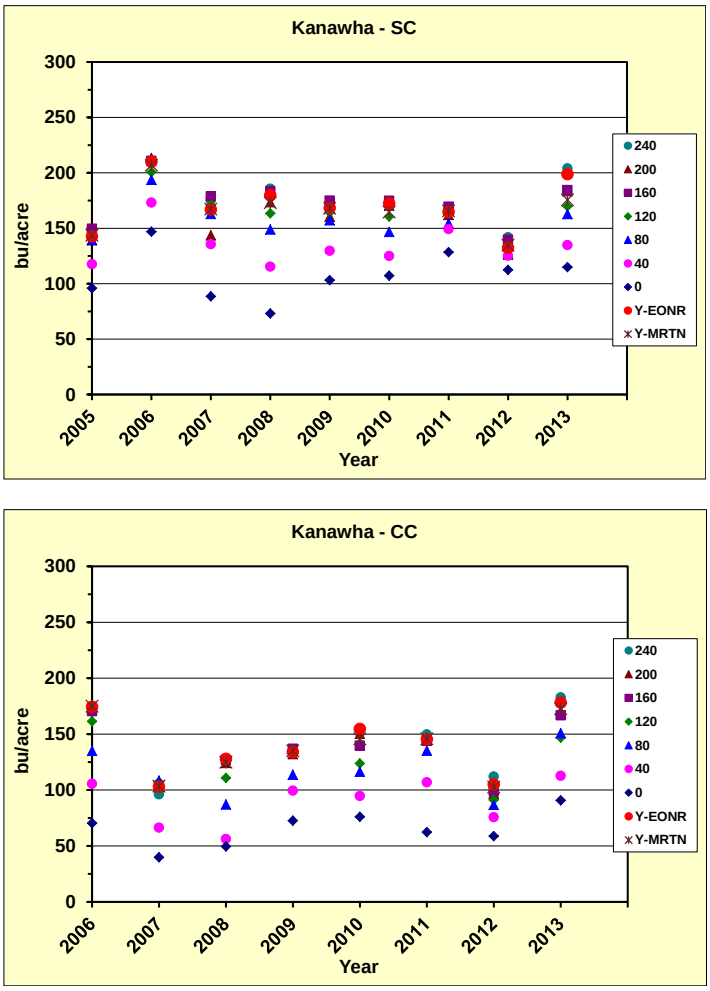

Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant Maximum Return To N (Y-MRTN) rate was applied each year, Northern Research Farm, 2006–2013. The MRTN rate used was 134 lb N/acre for SC and 187 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).