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Seasonal and Rotational Influences on Corn Nitrogen Requirements

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Abstract
This project is designed to study the N fertilization needs in continuous corn and corn rotated with soybean 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 the determination of N requirements for each rotation practice, 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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Introduction

This project is designed to study the N fertilization needs in continuous corn and corn rotated with soybean 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 the determination of N requirements for each rotation practice, 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 McNay Research Farm was 1999. The study area was cropped to no-till soybeans in 1998. Therefore in the initial year, all yields follow soybean. The two rotations, continuous corn and corn rotated with soybean, were initiated in 1999. The soil at this location is Haig silty clay loam.

Tillage is fall chisel plowing (spring chiseling in 1999) and disk/field cultivation before planting. Rates of N applied to corn are 0–240 lb N/acre in 40-lb increments. Ammonium nitrate fertilizer is the N source and is surface sidedress applied. No N is applied before planting or with the planter. The farm superintendent chooses the corn hybrid and soybean variety. Weeds are controlled using practices typical of the region. Soil is sampled for routine soil tests; phosphorus, potassium, and lime are applied as called for by the soil tests.

Corn and soybeans are harvested with a plot combine. Yields are corrected to standard moisture. Corn ear leaf greenness, which is an indicator of chlorophyll and nitrogen, is measured with a Minolta SPAD meter at the R1 (silking) growth stage. Relative SPAD readings are calculated using the reading at 240 lb N/acre as 100%. The SPAD meter will not indicate excess N; therefore, readings typically do not increase above a maximum greenness even with additional N.

Results and Discussion

In 2001 corn ear leaf greenness (SPAD readings) and grain yield were quite responsive to applied N (Tables 1 and 2). Relative SPAD values over 95 often indicate there will be no yield increase from additional N. The spring was quite wet, with the plot area flooded by a large rainfall around June 21. Sidedress N application in 2001 was late, after the June wet period. Overall response to applied N was good even with the late application and early water stress, although yields may have been diminished somewhat because of the wet conditions and no preplant N.

This study will continue, with the best value occurring after accumulation of multiple years of data. The results in this report cover only a few years and are not meant to represent N recommendations. They do, however, represent responses for the specific years.

Acknowledgments

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Table 1. Corn grain yield as influenced by N fertilizer rate, McNay Research Farm, 2001.

	1999		2000		2001	
N Rate	C-C	C-S	C-C	C-S	C-C	C-S
lb N/acre	---------- bu/acre ----------					
0	---	80	85	138	20	64
40	---	98	123	149	61	81
80	---	129	143	154	85	120
120	---	146	154	154	109	135
160	---	162	154	161	128	136
200	---	165	155	153	125	143
240	---	160	151	156	121	151
Economic N, lb N/acre	---	190	115	79	174	188
Yield at Economic N, bu/acre	---	163	153	154	124	146
LSNT, ppm	---	4	10	18	---	---
Soybean Yield, bu/acre	---	47	---	41	---	34

Economic N calculated at a 10:1 corn:N price ratio.
Yield at Economic N calculated from the fitted response equation.
LSNT samples from the zero N rate. Average soybean yield for the site.

Table 2. Corn ear leaf greenness (Minolta SPAD readings at the R1 growth stage) as influenced by N fertilizer rate, McNay Memorial Research Farm, 2001.

	1999				2000				2001			
N Rate	SPAD Reading		Relative SPAD		SPAD Reading		Relative SPAD		SPAD Reading		Relative SPAD	
lb N/acre	C-C	C-S	C-C	C-S	C-C	C-S	C-C	C-S	C-C	C-S	C-C	C-S
0	---	42	---	70	38	57	60	88	39	40	65	67
40	---	51	---	85	53	61	83	95	49	48	82	80
80	---	55	---	92	58	63	92	97	55	56	92	93
120	---	57	---	95	62	63	97	97	58	58	97	97
160	---	59	---	98	63	63	99	97	59	59	98	98
200	---	60	---	100	64	63	101	97	62	61	103	102
240	---	60	---	---	63	65	---	---	60	60	---	---

Relative SPAD readings calculated relative to the value at 240 lb N/acre.