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Soil Nitrogen and Carbon Management Project

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Abstract
Nitrogen management and cropping system history (tillage and crop rotation) have direct impacts on soil organic nitrogen (N) and carbon (C) pools, and the tie between soil organic N and C. Specific organic-N pools in soil can be an important source of plant-available N. Nitrogen availability in the soil environment also plays a significant role in determining soil C status. The objectives of this project are to demonstrate corn N fertilization needs and the short- and long-term N–C relationships across diverse soils, productivity, and crop management systems; and to evaluate and demonstrate the potential of a new soil N test (the Illinois N Soil Test, which is based on a readily mineralized organic-N fraction – amino sugar-N) in Iowa.

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Introduction

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The objectives of this project are to demonstrate corn N fertilization needs and the short- and long-term N–C relationships across diverse soils, productivity, and crop management systems; and to evaluate and demonstrate the potential of a new soil N test (the Illinois N Soil Test, which is based on a readily mineralized organic-N fraction – amino sugar-N) in Iowa.

Materials and Methods

The first year of this research was 2001, at the Armstrong Research Farm. This site is one of 14 studied across Iowa in 2001. Most were in producer's fields.

The soil at this location is Marshall silty clay loam. The previous crop was corn in 1997 and then three years of soybean from 1998–2000. In 2001, corn was no-till planted. Six rates of N (0–200 lb N/acre in 40-lb increments) were applied shortly after planting (from planting to V2 growth stage) as surface applied ammonium nitrate. The N rates were replicated four times. No other N was applied.

The farm superintendent chose the corn hybrid. Weeds were controlled using practices typical of the region. Soil was sampled for routine soil tests, and phosphorus, potassium, and lime were applied as indicated by the soil tests.

Each site was sampled for routine soil tests, soil N tests, and soil C and N characterization. Corn ear leaf greenness, which is an indicator of chlorophyll and leaf nitrogen, was measured with a Minolta SPAD meter at the R1 (silking) growth stage. Relative SPAD readings were calculated using the reading at 200 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. Corn was hand-harvested, with yields corrected to standard grain moisture.

Results and Discussion

Corn grain yield and ear leaf greenness (SPAD readings) increased with applied N (Table 1). The response was not large in 2001 (5.7% yield increase from applied N at the maximal response above the no-N check), with yield and ear leaf greenness increasing up to approximately 40 lb N/acre. Relative SPAD values over 95 often indicate there will be no yield increase from additional N.

Table 2 shows the total soil N and C characteristics of the site. As is typical of soils, total N and C decrease with depth. The amount of total N found is not all crop-available. Only a small portion becomes crop available each year.

Some soil analyses were not completed by the date of this report, and therefore not all analyses are reported. This study will continue in the future to monitor crop residue and soil carbon in future soybean and corn crops. In 2003, fertilizer N will be applied to corn.

Acknowledgments

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Table 1. Corn grain yield, ear leaf greenness (Minolta SPAD meter reading), and post-harvest crop residue as influenced by N fertilizer rate, Armstrong Research Farm, 2001.

Nitrogen Rate	Grain Yield	SPAD Reading	Relative SPAD	Crop Residue
lb N/acre	bu/acre			lb/acre
0	167	58.1	93	505
40	176	60.2	96	---
80	174	61.3	98	551
120	174	52.3	100	---
160	179	62.9	101	581
200	177	62.4	---	583
Economic N, lb N/acre	31			
Yield at Economic N, bu/acre	176			

Economic N calculated at a 10:1 Corn to Nitrogen price ratio.
Yield at economic N calculated from the fitted response equation.
Crop residue measured after corn harvest, fall 2001.

Table 2. Total soil nitrogen (N) and carbon (C) at different depths before N fertilizer application, 2001.

Sample Depth	Carbon	Nitrogen	C:N Ratio[1]
inch	- - - - - lb/acre - - - - -		
0 - 2	13,490	1,022	13.2
2 - 4	10,899	859	12.7
4 - 6	9,629	753	12.8
6 - 12	11,209	859	13.1
12 - 24	7,821	585	13.4

[1] C:N Ratio is the ratio of total soil carbon to soil nitrogen.