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# Response of Wheat to Residual Fertilizer Nitrogen Applied to Previously Failed Corn

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# Response of Wheat to Residual Fertilizer Nitrogen Applied to Previously Failed Corn


## Abstract

When drought conditions result in poor corn growth and yield, the potential exists for carryover of fertilizer nitrogen (N) to wheat. Soil sampling at the wheat jointing stage showed that $NO_3$-N levels increased slightly as previous N rate increased up to 240 lb/a N, but did not appear sufficient for the wheat yield increase to previous N rate. The relationship between wheat normalized difference vegetative index (NDVI) measurements at jointing and wheat yield was linear. The use of crop active sensors such as the GreenSeeker (Trimble Navigation Ltd., Sunnyvale, CA) may provide plant response data to supplement soil sampling to more adequately determine residual effects on a following wheat crop.



## Keywords

residual nitrogen, wheat, drought, corn

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## Summary

When drought conditions result in poor corn growth and yield, the potential exists for carryover of fertilizer nitrogen (N) to wheat. Soil sampling at the wheat jointing stage showed that $NO_3$-N levels increased slightly as previous N rate increased up to 240 lb/a N, but did not appear sufficient for the wheat yield increase to previous N rate. The relationship between wheat normalized difference vegetative index (NDVI) measurements at jointing and wheat yield was linear. The use of crop active sensors such as the GreenSeeker (Trimble Navigation Ltd., Sunnyvale, CA) may provide plant response data to supplement soil sampling to more adequately determine residual effects on a following wheat crop.

## Introduction

In 2012, extreme hot and dry conditions reduced corn crop yields. These drought-induced, low-yielding conditions likely resulted in low N uptake by corn. As a result, the potential exists for unused fertilizer N left in the soil, but the potential carryover of unused N fertilizer is uncertain because of the dynamics of N cycling. The objective of this study was to determine the effect of residual N that had been applied to a previous, drought-failed corn on the following wheat crop.

## Experimental Procedures

A study was started in 2012 to determine the effect of N rates and nitrification inhibitors on short-season corn grown with no tillage. The experimental design was a split-plot arrangement of a randomized complete block with four replications. Nitrogen fertilizer rates were the whole plots and nitrification inhibitors were the subplots. An untreated control was included in each replication. Because of replanting and hot, dry weather, corn yields were less than 30 bu/a with no response to nitrification inhibitors and a slight decline in yields as N rate increased (data not shown).

Because many farmers rotate winter wheat after corn and the 2012 experiment would not be repeated, 'Everest' wheat was drilled on October 12, 2012, with no added fertilizer and no tillage. The same plots with the same experimental design were used to study the residual effect of the N treatments. Wheat was harvested on June 25, 2013. In early April when the wheat was beginning to joint (Feekes 6), soil samples were taken from

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each plot to a 12-in. depth and analyzed for $NH_4$-N and $NO_3$-N. At the same time, a GreenSeeker handheld crop sensor was used to take NDVI readings.

## Results and Discussion

The use of nitrification inhibitors on the previous corn crop had no residual effect on soil inorganic N levels and wheat NDVI readings taken in early April or wheat yield in June (data not shown), but residual from the previous N rate treatments did show carryover effects on soil $NO_3$-N and NDVI readings at jointing and on wheat yields (Table 1). However, previous N rate treatments had no effect on soil $NH_4$-N levels in the top 12 in., which were less than 20 lb/a N. The residual soil $NO_3$-N levels in the top 12 in. increased from 5 to 20 lb/a N as the previous N rate increased from 0 (control) to 240 lb/a N. This small increase found at jointing from the control to the highest previous N rate was consequently expected to have minimal effect on wheat yield. Even though NDVI values were less than 0.70, the NDVI values increased with initial increments in previous N rate, but little change was measured at previous N rates above 120 lb/a N. Wheat yield increased more than 17 bu/a as N rate increased from the control to the previous 120 lb/a N fertilizer rate, but with no statistical increase with greater previous N rates.

To assess fields, producers should first sample for available N in the soil. In this situation, because $NH_4$-N levels were constant, a change in soil $NO_3$-N of only 5 lb/a appeared to result in improving yield from 60% of the maximum to more than 90%, but there was little change as soil $NO_3$-N increased another 10 lb/a (Figure 1A). In contrast, the relationship between NDVI at jointing and relative wheat yield was linear (Figure 1B).

The potential for carryover of fertilizer N when the corn crop fails because of drought exists for a following wheat crop. A producer's first step to determine potential fertilizer N residual is to soil sample; however, with the dynamics of N processes, those results may not always be a reliable indicator of the residual effect of previous N fertilization. The use of crop active sensors, such as the GreenSeeker, may provide plant response data to supplement soil sampling to more adequately determine residual effects on a following wheat crop.

**Table 1. Effect of previous fertilizer N rate applied to failed corn in 2012 on soil $NO_3$-N at the 0–12-in. depth and wheat normalized difference vegetative index (NDVI) readings taken at jointing and wheat yield in 2013.**

| Previous N rate | $NO_3$-N | Wheat NDVI | Wheat yield |
|---|---|---|---|
| lb/a | lb/a | | bu/a |
| 0 | 5.3 | 0.46 | 30.1 |
| 60 | 7.8 | 0.52 | 35.0 |
| 120 | 10.5 | 0.63 | 47.2 |
| 180 | 15.6 | 0.64 | 50.0 |
| 240 | 19.5 | 0.67 | 48.9 |
| LSD (0.05) | 5.0 | 0.04 | 3.6 |

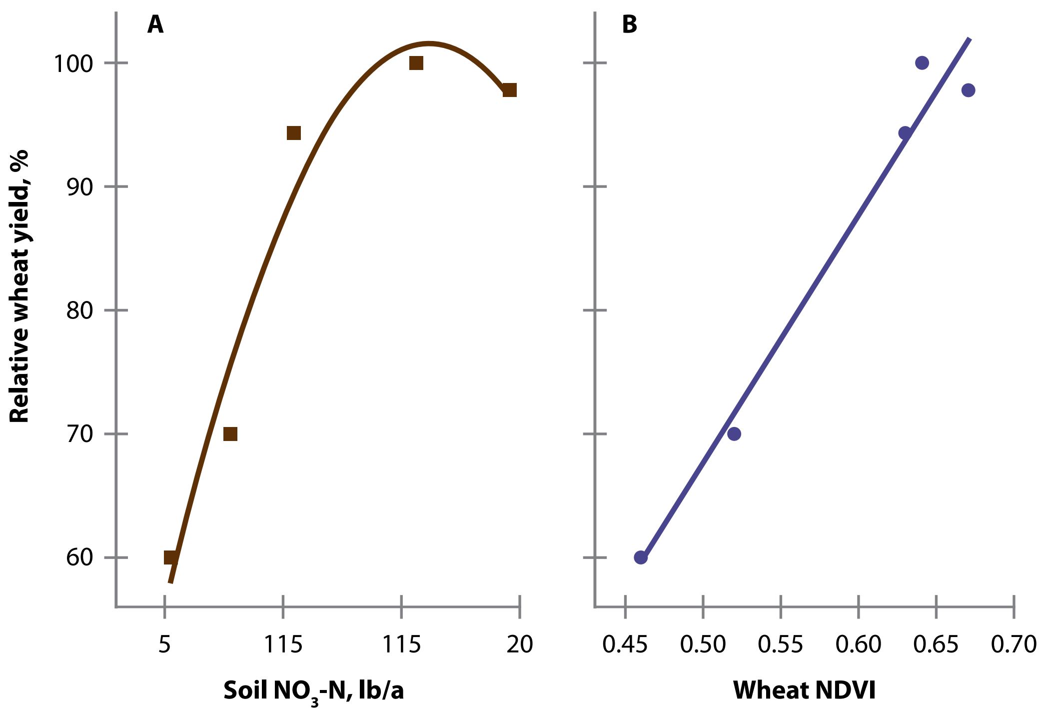


**Figure 1. Effect of soil $NO_3$-N levels in the 0–12-in. depth and wheat normalized difference vegetative index (NDVI) readings taken at jointing (Feekes 6) on relative wheat yield in 2013.**