AERIAL PHOTOGRAPHS TO GUIDE CORN FERTIGATION DECISIONS

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Corn producers with pivot irrigation have the potential to apply in-season nitrogen (N) fertilizer much more easily than their non-irrigated counterparts. A demonstration project was initiated in 2006 to take advantage of this potential.

One advantage for in-season N application is that the risk of N loss prior to crop uptake is minimal. Another advantage is the opportunity to diagnose N need. A range of studies have shown that N need can vary widely from one field to another, as well as within a field. Research has also shown that corn color can be used to predict the amount of N needed. Inability to easily apply N in-season has been a major obstacle to adoption of color-based diagnosis of N need.

Aerial photographs provide a way to evaluate the color of fully-canopied fields quickly and reliably. Our previous research has shown that corn color from aerial photographs, relative to color from reference areas that have received a high N rate, can be used to predict how much additional N will give the greatest economic return.

Methods

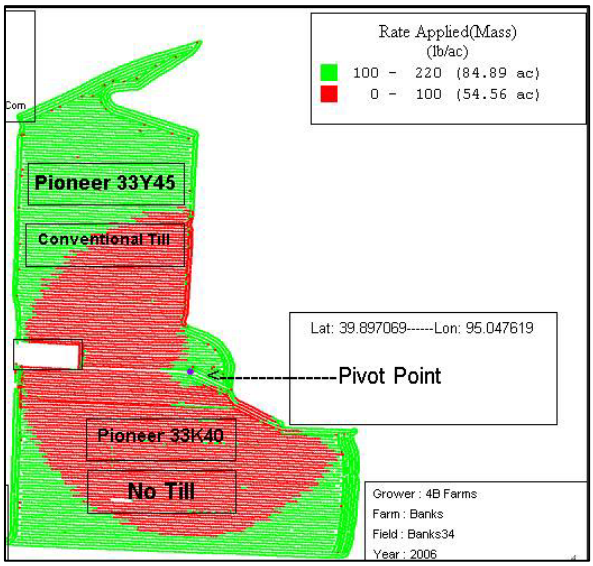
Cooperators were identified who were set up to apply N fertilizer in their pivot irrigation water, and who wanted to try this approach. In most cases, producers limited preplant N applications under the pivot to rates well less than their total normal rate. They also created one or more high-N reference areas during their preplant N applications. This was done by double- or triple-applying one or two strips, or by using a variable-rate applicator to apply a high rate in a georeferenced location.

One demonstration was conducted in 2006, and eight demonstrations were conducted in 2007.

Once corn reached approximately waist high, aerial photographs were acquired as soon as conditions allowed. A high resolution color digital camera was used for image acquisition. Fields were divided into 45° wedges. Average green was measured in each wedge (bare spots were avoided) and also in high-N reference areas. Relative green was calculated as (wedge green value / high-N green value). This was used to predict optimal N rate using a previously-developed calibration (Scharf and Lory, unpublished data). Nitrogen rate recommendation maps were developed for each field.

Results

Results are presented in this paper for the 2006 demonstration field. In that field, a variable-rate NH3 applicator was used to apply preplant N at a rate of 100 lb N/acre under the pivot and 200 lb N/acre in the corners (see figure).



In the aerial image acquired on June 13, the corn receiving 200 lb N/acre was only slightly darker than the corn receiving 100 lb N/acre in the north part of the field (figure below). We recommended application of 45 lb N/acre through the pivot for this area. In the south half of the field, there was no difference in greenness between the two N rates, indicating that the corn receiving 100 lb N/acre was sufficient for N at least to that point in the season. Our recommended rate for N through the pivot was 30 lb N/acre for this area.

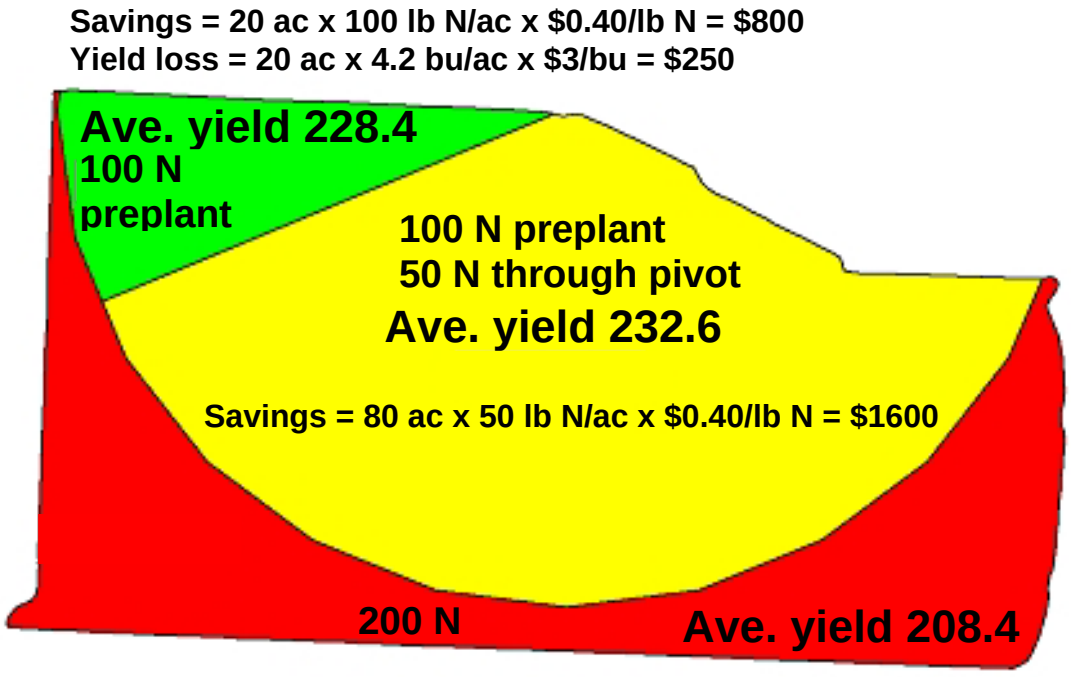
Aerial photo June 13, 2006
Waist high corn

North field: slightly darker outside of pivot
N recommendation = 45 lb N/acre

South field: same color under pivot and outside of it
N recommendation = 30 lb N/acre

The producer applied 50 lb N/acre through the pivot for both the north and south halves of the field, except for a 20-acre area in the southwest part of the field where he applied no additional N through the pivot. He ended up with a total N rate of 150 lb N/acre for most of the field, which was 50 lb N/acre less than he normally would have applied.

Yields were excellent in this field. In the south field, a yield comparison confirmed that need for fertilizer N was low. Average yield was 228.4 bu/acre in the area that received 100 lb N/acre preplant and no fertigation. Where 50 lb N was applied through the pivot, average yield was 232.6 bu/acre. This was not enough of a yield response to pay for the cost of the N. The small yield response suggests that no yield potential was lost by reducing N rate from the producer's normal 200 lb N/acre to the 150 lb N/acre rate that he used over most of the field.



A corn harvest of 228 bu/acre would typically remove around 180 lb N/acre. The fact that this yield was produced with less N (100 lb N/acre) than was contained in the grain indicates that the soil was supplying a substantial amount of N to the crop. This situation resulted in the potential to save on fertilizer expense without sacrificing yield. Aerial photos successfully diagnosed the situation.

Overall, in the south half of the field, $2400 worth of N was saved and about $250 worth of potential yield was lost, for a net benefit of $2150 over the 100 irrigated acres.

An additional $1160 worth of N was saved in the north field. Based on the yield comparison in the south field, which confirmed the low N need diagnosed from the aerial photographs, it is likely that no yield potential was lost due to N deficiency in the north field.

What to do in the corners was an obstacle to producer adoption of this program. Producers who participated handled the corners in a variety of ways:

1) Use a variable-rate N applicator so that higher rates could be applied in the corners than under the pivot.
2) Double-spread the corners during preplant application.
3) Extend the soybean planting in an adjacent field into the corners.

Summary

A modest preplant N application followed by fertigation of additional N as diagnosed by crop color in aerial photos appears to have some promise for:

1) Protecting full yield potential. This results from both reduced potential for N loss and from ability to react and supply enough N for full yield when corn color indicates deficiency.
2) Identifying fields where the soil N contribution is substantial and N rate can be reduced.
3) Allowing management of some coarse variability in soil N supply by changing N rate applied through fertigation in different parts of the field.

PROCEEDINGS OF THE

THIRTY-SEVENTH NORTH CENTRAL EXTENSION-INDUSTRY SOIL FERTILITY CONFERENCE

Volume 23

November 14-15, 2007
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Des Moines, IA

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Published by:
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