Nutrient Management

A Case Study on the Use of Adapt-N

James LaGioia[1], Harold van Es[1], Jeff Melkonian[1],
Bianca Moebius-Clune[1] and David Shearing[2]
[1]Department of Crop and Soil Sciences, Cornell University and
[2]Western New York Crop Management Association

Precise estimation of corn nitrogen (N) needs has been difficult due to many interacting and complex processes that affect N in soils and crops. Over the past years, we developed the Web-based Adapt-N tool to provide improved in-season N recommendations based on model simulations of soil N dynamics and corn N uptake. The tool is currently available for farms in the Northeast and Iowa, and will be expanded for use in the entire eastern USA for the 2012 growing season. Adapt-N is built around the powerful Precision Nitrogen Management (PNM) model, which uses information of soil and crop management, organic inputs and newly-developed high-resolution weather information (3x3 mile grid) to develop accurate nitrogen recommendations. The Adapt-N tool is especially useful for in-season N rate applications, when the crop N needs are more predictable.

Figure 1: Variability of soils was mapped using aerial photographs and soil survey data.

Study Farm
For the 2011 growing season, we developed a case study to evaluate the utility of the Adapt-N tool for a large grain farm in western New York. The area of interest consisted of 87 corn fields that comprised nearly 1200 acres. Fields were digitized in ArcGIS 9.3 using 2005 aerial photographs (Figure 1). The digitized fields were then used as an overlay to clip a soil survey, and linked to the appropriate attributes that were used as inputs for the Adapt-N tool. Of the corn acreage, 76% was mapped as silt loam, 23% as silty clay loam, and 1% as gravelly soil. Soil organic matter varied widely, from 0.9% to 9.9%. The study area consisted of two sets of fields that were located several miles apart. Therefore, two different location coordinates were set up in the Adapt-N tool to access the high resolution climate data.

Nitrogen was applied to the field through pre-plant broadcast urea plus UAN solution banded at planting. Three rates of urea were used, 112, 126, and 140 lbs/acre, depending on soil type. UAN solution was applied at one of three rates, 54, 58, and 78 lbs/acre.

Western NY experienced unusual weather for the 2011 growing season. The months of April and May proved to be the wettest on record (over 6 inches in each month), but they were followed by a dry period in June (2.5 inches) and July (less than 1 inch). There were two distinct windows for planting: Fifty-eight percent of the corn ground was planted early - before May 1 -, and 42% was planted late in the season - after June 1.

Adapt-N input information varied based on soil and management practices. All fields were planted at 32,500 plants per acre and were grown as first year corn after soybeans without manure applications. Conservation tillage was used with an estimated 75% residue left on the surface. Field specific information was also entered for soil organic matter (from recent soil tests), soil type, planting date, corn variety, fertilization regime, and yield goals. Since the late planted corn's growing season was cut short by over a month, the yield goals were lowered from the earlier planted corn (from 230-to-250 down to 190-to-210 bu/ac). The Adapt-N tool was run through the Web portal every five days starting on June 6, 2011 until the crop was determined to be too high for possible sidedress N application.

Results
Adapt-N provided many outputs, but for this case study we focus on recommended sidedress N rates and levels of excess N. Planting date was the largest factor affecting N rate recommendations: The average recommended rate (i.e., the N deficit in the soil-crop system) for the April-planted corn was around 31 lbs/acre, even though 160-to-200 lbs/ac had already been applied (Figure 2). This is explained by post-planting losses as a result of high rainfall in May.

Conversely, the Adapt-N tool estimated excesses averaging 100 lbs/ac for the fields that were planted in June (Figure 2; note that excesses are indicated by negative N rate recommendations). In these cases, no post-planting losses

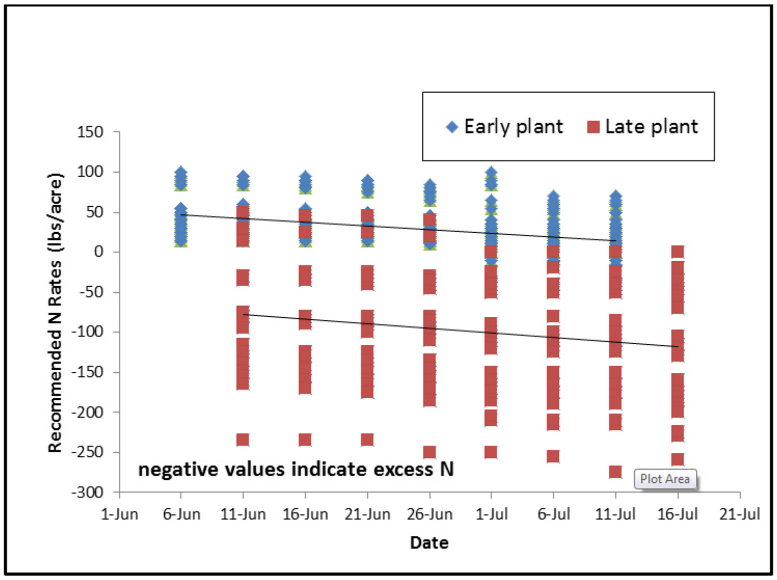

Figure 2: N recommendations for early (before May 1) and late planted (after June 1) corn. Each point on the graph represents an individual field.

were experienced due to dry weather conditions in June and July, and additionally the yield potential was lower due to late planting. Figure 2 indicates that the N rate recommendations modestly decreased (and N excesses increased) over time as June and July weather experienced lack of rainfall, because the probability of post-application N losses declined as crop growth progressed. Organic matter ranged widely on the farm and affected Adapt-N recommendations: As organic matter increased, the recommended N rate decreased for the early planted corn, and excesses increased for the late planted corn (Fig. 3).

Conclusions

In this case study, the Adapt-N tool incorporated multiple factors - especially those associated with weather - into the development of N management recommendations. The main benefit for this farm in 2011 would be the accounting for the effect of early vs. late planted fields and variable soil organic matter contents if most N were applied as sidedress instead of pre-plant. The early-planted corn required additional N to make up for post-planting losses from wet May weather, which would otherwise result in yield losses from N deficiencies. The late–planted corn had considerable excess N, especially on soils with high organic matter. This indicates that pre-plant N rates were too high for June planted corn and could have been reduced by an average of 100 lbs/ac. This would have reduced environmental impacts as well as fertilizer input costs (by about $11,000 for this farm), especially for the soils with high organic matter contents.

In all, this case study shows that delaying the bulk of N applications to sidedress time and estimating fertilization rates with Adapt-N based on localized factors – soil, crop, and weather – can have significant benefits for both farm profits and reduced environmental losses. In upcoming What's Cropping Up? articles, we will report on the results of 2011 strip trials that evaluated the performance of Adapt-N through yield results.

Adapt-N research and demonstration work is supported by funding from the New York Farm Viability Institute and the NRCS Conservation Innovation Grants program. For more information about the Adapt-N tool, visit (http://adapt-n.cals.cornell.edu).

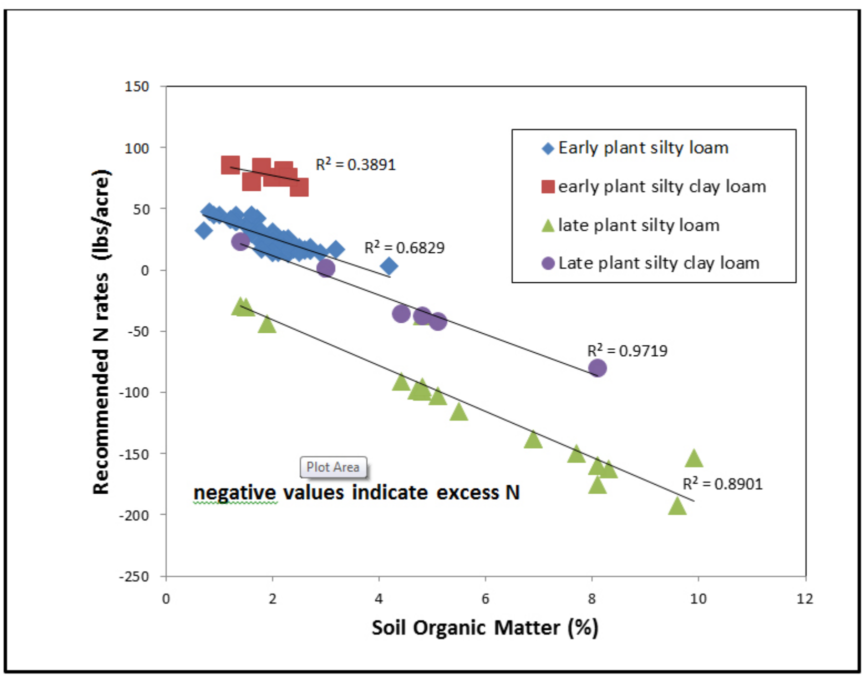

Figure 3. N recommendations as affected by soil organic matter content, soil type and planting period. Each point on the graph represents an individual field.