Adaptive Management of Nitrogen for Corn

Accurate yield records and field management information are essential to guide N fertilization decisions for corn. The Cornell yield database offers a starting point, but farms are encouraged to determine actual field yields and document practices over multiple years to fine-tune N management. Currently, certified nutrient management planners can choose to override the Cornell provided yield potential (YP) if the farm has documented three years of yield data showing higher than YP yields. From time to time, planners and producers operating in a Comprehensive Nutrient Management Plan (CNMP) context raise concerns about Cornell guidelines limiting crop yields in high yield fields. Legitimate questions are raised about maintaining optimal soil fertility with current guidelines for such fields; more fertility may be required to support yields and/or maintain soil test levels in the optimum ranges over time if documented yields are consistently above the estimated yield potential of the soil type. Also, within a given soil type in any field, there can be high and low yielding areas.

Two existing and two new approaches to N management for corn were outlined in Agronomy Factsheet 77. In this factsheet, the fourth approach, adaptive management, is described in detail.

Step 1: Determine New N Guideline

Yield potential is defined as the a theoretical average yield of the best 4 out of 5 crop years (i.e. drought or other poor crop years excluded) under good crop management. Each of the nearly 600 different soil types in New York has an estimated YP in the Cornell University soil database. If a particular field has or is expected to yield higher than the yield documented in the database, the recommended N can be adjusted by replacing the Cornell University documented YP with the anticipated yield in the following equation:

Recommended N =
(YP*1.2-SoilN-SodN)/(Neff/100)

In this equation, YP is the user-selected yield potential in bushels/acre. SoilN is the estimated annual N contribution from the soil organic matter in lbs N/acre, SodN is the expected N release from a decomposing sod in lbs N/acre, and Neff is the soil specific fertilizer N uptake efficiency as a percentage. In step 1, the SoilN, SodN and Neff are not user-selected; the end-of-season evaluations will show if adjustments need to be made over time.

Figure 1: Accurate yield records and field management information are essential to guide N fertilization decisions.

As an example, using the information presented in Agronomy Factsheet 35, the N recommendation for a corn crop in the well-drained Hamlin soil in continuous corn is:

*[(155*1.2) – 80 – 0] / (75/100) =*
141 lbs N per acre

If you expect the yield to be 175 bu/acre, the new N recommendation becomes:

*[(175*1.2) – 80 – 0] / (75/100) =*
173 lbs N per acre

If a liquid manure source contains 10 lbs of ammonium N and 12 lbs of organic N per 1,000 gallons of manure and the manure is injected in the spring prior to corn planting, the adjustment in yield potential means the rate can be increased from about 13,000 gallons/acre [141 / (10*0.65+12*0.35)] to about 16,000 gallons/acre [173 /

(10*0.65+12*0.35)]. This example assumes no fertilizer is applied. The sum of the fertilizer N and available N from manure should equal or be less than the revised N recommendations for the field determined in step 1 and management should be within the limits of the New York P index and N leaching index.

Step 2: Keep Records of Applications
Document the application rates, manure analysis, and fertilizer N use (source, rate, timing, method). Manage the crop to enable high yields (good weed and pest management, etc.). Keep notes of major events or stress factors that occur during the growing season such as hail or drought that can all impact the growth of the crop and the N use efficiency of fertilizer and/or manure.

Step 3: Determine and Document Yield
Document individual field yield data in the nutrient management plan records for each of the years where YP is adjusted. Individual year yield data can be used to set up a new YP for future N recommendations. The yield documentation could consist of a sum of weighed loads, a tally of loads multiplied by an average load weight, or data from a calibrated combine or forage yield monitor for the specific field(s). See Agronomy Factsheet 71.

Step 4: Corn Stalk Nitrate Test
A representative Corn Stalk Nitrate Test (CSNT) sample (minimum density of 1 stalk per acre) is taken from each 2nd or higher year corn field or sub-field management zone where an enhanced YP is used to increase manure and/or commercial fertilizer application rates (2 year minimum). Accurate CSNT samples can be taken prior to harvest or directly after corn silage harvest (within 5 days assuming no rain, post-harvest soil disturbance, or manure spreading). See Agronomy Factsheets 31 and 72 for protocols.

Step 5: Adjust Management if Needed
In the conditions above, a series of excessive CSNT values indicate that the soil overall has a greater N supply capacity than the Cornell database gives credit for. Therefore, if CSNT results from a 2nd or higher year corn field exceeds 3,000 ppm for two years, manure application information, yield data, and soil information should be evaluated to actively reduce N application rates to attempt to manage the CSNT below 3,000 ppm. An Illinois Soil Nitrogen Test (ISNT) sample is recommended to better assess soil organic N supply in these situations. Continue to use the CSNT each year until management changes reduce values below 3000 ppm. In a scenario where CSNT results exceed 3,000 ppm for one year, but not the other, measure the CSNT a third year to further evaluate current management. To account for sod N credits, the corn N equation should be used to determine manure and fertilizer rates for first year corn after sod. Yields measured during the prior corn years in the rotation may be used in the corn N equation and the adaptive N approach described in steps 1 through 5 may be employed for second year corn and beyond.

Concluding Remarks
The Cornell guidelines for N management for corn offer a starting point. Producers can make refinements over time using an adaptive management approach with determination of yield and CSNT as core guiding measurements.

Additional Resources
- Cornell University soils database: http://nmsp.cals.cornell.edu/publications/tables/soils_database.pdf.
- Nutrient Management Spear Program Agronomy Fact Sheet Series: nmsp.cals.cornell.edu/index.html.
- USDA-NRCS New York State 590 Standard: ftp://ftp-fc.sc.egov.usda.gov/NY/eFOTG/Section_4/Practice_Standards/nyps590.pdf.
- USDA-NRCS Adaptive Management Technical Note 7. http://www.conservationwebinars.net/webinars/adaptive-nutrient-management-nrcs-tech-note.

Disclaimer
This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information

Cornell University Cooperative Extension

Nutrient Management Spear Program
http://nmsp.cals.cornell.edu

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