FORAGE MANAGEMENT

By Quirine Ketterings and Karl Czymmek

Using the CSNT and ISNT to take some of the guesswork out of N fertilization decisions

Farm-level tools refine nitrogen management

Although land grant university guidelines for nitrogen management of corn are a decent starting point, on a field by field basis, results can be improvedtime. Until recently, farm-level tools that could be used to refine N management were limited, but a larger package is available now, including the use of an end-of-season corn stalk nitrate test (CSNT) and a test that can be taken any time of year, the Illinois soil nitrogen test (ISNT). How can these tools be used to gain confidence that management changes can be made to reduce cost of production and/or increase yield while reducing environmental loss?

Let's start with the end of season "report card", the CSNT. This test is an analysis of a portion of the corn stalk (between 6 and 14 inches off the ground) at harvest time for corn silage or any time between ¼ milk line and about 3 weeks after black layer formation for corn grain. The results of the CSNT reflect N availability and uptake, representing growing conditions, as well as crop and nutrient management decisions made that year and in previous years. Interpretations may be slightly different from one state or region to another but in general include 4 categories: deficient, marginal, optimal and excess. Most land grant universities include 2000 ppm as the level beyond which more N was available that season than the corn needed for optimal production. Less than 250 ppm is typically classified as deficient. The CSNT range used for a marginal classification varies but typically is between 250 and 700 or 750 ppm. The most useful aspect of the CSNT is that it can identify fields where changes in N management might be feasible (fields with CSNT>2000 ppm).

So, if the CSNT of corn on a field is 3500 ppm, we conclude the corn had more N than needed. Where did it come from and what opportunities are available to reduce N addition and lower the CSNT without giving up on yield or quality? Well, corn cannot fix N, so it must come from sources already in the soil or sources added that season. This includes soil organic matter, previous crops (decomposing sod roots, soybean residues and cover crops), past and current manure applications, and fertilizer additions. So when CSNTs indicate N was available in excess of what the crop needed that year, we look into these sources and evaluate the growing conditions.

In drought years, CSNTs tend to be higher, reflecting that more N was available than the crop could properly utilize due to a shortage of water. For this reason, it is probably not worthwhile to take CSNT samples in a severe drought year. If growing conditions are more favorable and CSNTs are excessive, we can evaluate the contributions of the soil (soil N supply potential) using the Illinois Soil

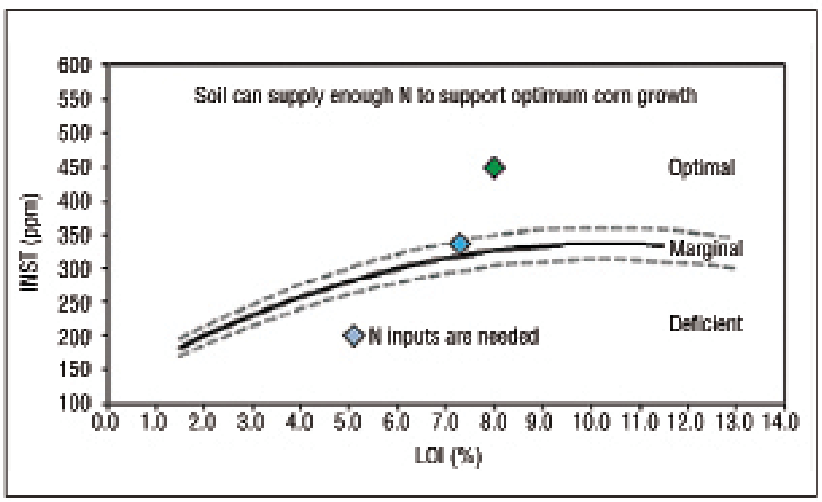

Figure 1: *Interpretations for the Illinois Soil Nitrogen Test (ISNT). If a soil has an ISNT above the dashed lines (optimal; the green field), the soil can supply sufficient N to support optimum yield without additional inorganic fertilizer. If the field is below the dashed line (deficient; grey field), additional N is needed. For fields between the dashed lines (marginal; light blue field), field experimentation with N rates is suggested.*

FYI

■ Karl Czymmek is the PRO-DAIRY specialist in the areas of nutrient and environmental management. Contact him at 607.255.4890. Email: kjc12@cornell.edu

■ Quirine Ketterings is an Associate Professor in Nutrient Management in Agricultural Systems and Nutrient Management Spear Program in the Department of Animal Science. Contact her at 607/255-3061. Email: qmk2@cornell.edu

Nitrogen Test (ISNT), while also looking into actual application rates (manure spreader calibration, fertilizer spreader and calibration).

What is the ISNT all about? Almost from the time of its introduction, the ISNT has been controversial in academic circles. In New York State, we have tested the ISNT in our field research programs for ten years. The work compared other tools for N management, such as in-season chlorophyll measurements, the pre-sidedress nitrate test (PSNT), end-of-season soil testing, and the CSNT. We discovered how to use, and how not to use the ISNT, and found that the combination of CSNT and ISNT testing is very effective at finding fields where N application rates can be reduced. Here's how we use it:

The ISNT results reflect the soil N supply potential. Although we would like a single test that can correctly tell a producer what N rate to use, the ISNT does not work that way because soil N is only one of many sources of N, and all sources need to be taken into account when determining the correct fertilizer N rate. The ISNT is still useful though, as it estimates a readily mineralizable portion of the soil organic N pool, which is a very important pool for N supply for plants. Being able to estimate soil N supply potential is essential to getting better match N management and crop needs on a field by field and year by year basis. For New York conditions, we find that the critical value for ISNT (value beyond which the soil has sufficient mineralizable organic N, and does not need extra fertilizer N) depends on the overall organic matter level as determined by loss-on-ignition (LOI), reflecting a diversity in the soils of New York State (>600 different soil types). The interpretation chart with two examples is shown in Figure 1. To use this figure, soils can be analyzed for ISNT-N any time of the year, except within 5 weeks after manure application, sod turnover, or addition of ammonium-containing fertilizer.

What does the ISNT tells us?

We find that many fields with a long-term history of manure or other significant organic inputs, or reduced tillage practices, have an ISNT above the dashed lines shown in Figure 1 (optimal; e.g. the green field). Conversely, long-term cash crop or vegetable management often shows fields deficient in ISNT-N (e.g. the grey field). For New York, the ranges in ISNT are wide, from less than 100 ppm to greater than 600 ppm. This is not a surprise given the diversity of field histories and soil types and management styles. But we are starting to see some other pictures emerge when it comes to manured fields. Here is what the ISNT can be used for:

1. After three years of study (21 trials), we found that manure could replace the need for starter fertilizer in optimal ISNT fields (above the dashed line). Further, fields deficient in ISNT that do not receive manure showed a benefit from using both starter N as well as sidedress N. So knowing the ISNT of a field can help a producer be more confident that corn can be planted without any fertilizer as long as the fields receive manure and are optimal in ISNT. This could save a producer $10/acre or more in starter fertilizer costs, while also speeding up planting time by eliminating fertilizer fill ups.

Scenario:

- Manure was fall-applied at 8,000 gallon/acre
- Reasonable growing conditions for corn
- Field received 30 lbs N/acre in starter and 150 lbs N/acre sidedress N
- Yield = 27 tons/acre
- ISNT= optimal (above the line)
- CSNT=5600 ppm NO3-N
- What does this tell us?
- ISNT is optimal, did not need starter N and does not need sidedress N, manure alone is enough

Scenario:

- Field did not receive any manure this year and has a limited history of manure application in the past
- Reasonable growing conditions
- Field received 30 lbs N/acre in starter and 150 lbs N/acre sidedress N
- Yield = 23 tons/acre
- ISNT= deficient (below the line)
- CSNT=5600 ppm NO3-N
- What does this tell us?
- ISNT is deficient so extra N is needed
- 180 lbs N/acre was too much as CSNT is well above 2000 ppm NO3-N
- Next year try a reduced N rate

2. For manured fields where the ISNT was optimal and growing conditions were good, we did not see a response to sidedressing of N either; the soil could supply greater amounts of N than typically assumed in fertility recommendation systems, sufficient for optimum crop yield that year. Knowing which fields at a farm fall into this category could, in a more challenging year like 2011, generate significant savings in application and N fertilizer costs for producers. It could give farmers the confidence to eliminate sidedressing of manured fields with optimal ISNT as losses from organic N sources were not as high as losses from pre-plant inorganic N would have been. To tie this back in to the CSNT: if the CSNT of a field is excessive, the ISNT can help gain confidence that fertilizer additions can be reduced or eliminated. Knowing when not to sidedress N can save $35 to $60 per acre!

3. Lastly, fields high in ISNT-N are some of the most stable yielders from year to year. These soils are much more resilient to weather extremes (see "Managing Soils for Better Crops" article).

This last observation makes us think about the possibility of managing fields to increase ISNT levels and maintain them in the optimum category, rather than for a specific manure application rate. Earlier work shows ISNT-N levels increase with manure (and compost) addition over time. Perhaps manure rates for deficient ISNT fields need to be a bit higher with the intent to increase ISNTs over time, and hence stabilize production, while also maintaining a CSNT between 750 and 2000 ppm. Then once above the dashed lines on the ISNT chart, manure rates can be adjusted to maintain ISNTs. While these ideas need more testing, this could lead to greater flexibility in nutrient management plans and improve the link between nutrient guidelines and crop response. ❐