

Nitrogen management tools for corn

The Illinois Soil Nitrogen Test and stalk nitrate test show promise as tools to help dairies fine-tune N management

By *Quirine Ketterings, Jon Klapwyk and Karl Czymmek*

In recent years nitrogen (N) fertilizer prices have risen dramatically, causing dairy producers and researchers alike to look for ways to fine-tune N management for field crops. Since the early 1990s, the presidedress nitrogen test (PSNT) has been the best option to identify if corn fields need additional (sidedress) N where a response to it might be expected. The PSNT measures soil nitrate-N. Since this is highly mobile in the soil, sampling time and depth are critical.

Several years ago, Dr. Richard Mulvaney and Saheed Kahn at the University of Illinois, Urbana-Champaign, developed the Illinois Soil Nitrogen Test (ISNT). It measures ammonium N and estimates amino-sugar-N, which is an organic fraction of N that is more stable in soil than nitrate.

The Illinois researchers believed the ideal soil test for N would measure an organic soil N fraction that readily supplies the plant by mineralization rather than the nitrate that results from mineralization. It turns out that the aminosugar-N is much more stable than soil nitrate and could be an accurate indicator of what N is expected to become plant available.

Like the PSNT, the ISNT, as work in Illinois showed, can be used to determine if corn would possibly respond to sidedressing. But ISNT doesn't have the sampling difficulties inherent with the PSNT.

Research goals

In 2002, we began research on the ISNT in New York to learn:

- If the test could tell us which corn silage fields need extra N and which do not under New York soil and growing conditions.

- If we would need the same 12-inch cores used for the PSNT, or could we use our regular 6- to 8-inch soil samples.

- If the ISNT interpretations differed depending on whether soil samples were taken in spring or fall or during the growing season.

Over three growing seasons, we conducted trials on Cornell research stations and worked with local Cornell Cooperative Extension offices to establish trials on farms throughout the state. More than 30 N trials were conducted from 2002 to 2004 in 12 New York counties.

Trials had three treatments:

1. No starter or sidedress N.
2. Starter N at less than 30 pounds per acre.
3. Starter N plus sidedress N.

We took soil samples at two different depths – 0 to 8 and 0 to 12 inches. Soil samples were taken at planting, at PSNT time when corn is 6 to 12 inches tall and at harvest. More intensive sampling schemes were followed on the research stations.

In addition to on-farm trials, from 2001 to 2004 we analyzed soils from a large-scale manure and compost trial at the Aurora Research Farm for soil nitrate, organic matter (OM) and ISNT. We wanted to determine trends

over time following application rates based on nitrogen needs and phosphorus crop-removal.

We used silage yield and quality information to determine if the corn was responsive to extra N.

Key results

To date, we've found:

1. The original laboratory procedure needed adjusting to improve consistency of results. We developed an enclosed box method which we're using for all our research trials. It was initially thought that dairy producers or consultants could do the ISNT test on-farm. But our experience in



The ISNT provides for greater flexibility in the timing of soil sampling than the PSNT. Plus, the test requires 8-inch cores rather than the 12-inch ones for the PSNT.

FYI

■ **Quirine Ketterings**, head of the Cornell Nutrient Management Spear Program (NMSP), is a faculty member in the Department of Crop and Soil Sciences.

■ **Jon Klapwyk** conducted the New York ISNT research for his master's degree program at Cornell. He is currently teaching at Kemptville College, Ontario.

■ **Karl Czymmek** is a PRO-DAIRY specialist concentrating on nutrient management and CAFO issues.

■ For information on the Penn State end-of-season stalk nitrate test, see: http://www.aasl.psu.edu/Corn_stalk_nitrate.html

■ More information on the University of Connecticut stalk nitrate test can be found at <http://www.canr.uconn.edu/plsci/stkfact.htm>.

■ A description of the sampling protocol for the end-of-season stalk nitrate test can be found at these two websites: http://www.aasl.psu.edu/Corn%20stalk%20nitrate%20sampling_web.pdf <http://www.canr.uconn.edu/plsci/StalkInst.DOC>

the lab suggests that the control measures needed for consistent, accurate results are more than most people in the field would want to deal with.

2. It appears that soil samples taken to 8-inch depth around corn planting and analyzed for ISNT and OM can be used to predict the need for additional N for corn beyond starter fertilizer in New York. (See Figure 1)

In the figure, fields that fall above the line are unlikely to respond to extra N. Fields below the line are N deficient and would likely respond to extra N. For example, if you have a field with 3% OM and the ISNT is 100 ppm, it falls below the line and a response to extra N is highly likely. But if a field with 3% OM has an ISNT of 300 ppm, the field has enough N to carry the crop through the rest of the season. It needs no extra N. We'll test this process one more growing season.

3. Evaluation of the test in manured fields at the Aurora Research Station showed that the ISNT results increased with manure or compost additions, and these increases were consistent with N credits from manure.

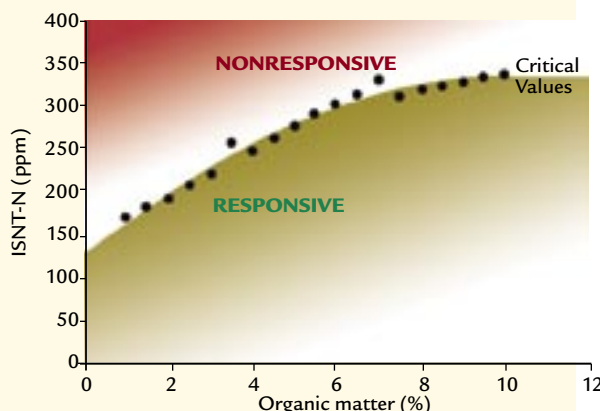
Sampling shouldn't take place within two weeks after application of manure or fertilizers that contain ammonium. Since the ISNT test measures ammonium N and easily mineralizable organic N, you need to avoid sampling close to the addition of ammonium N for an accurate assessment of organic N release.

We need to answer some additional questions before the ISNT can be released for use by New York producers. So far the ISNT has successfully identified sites that need extra N, and samples don't need to be taken at sidedress time. However, we need to test the performance of the ISNT under specific N management scenarios and manure application practices.

Results to date show that this test could benefit corn growers who sidedress N and also by growers who apply pre-plant N.

In 2005, 19 on-farm and research station trials were conducted to determine N needs for first-year corn and to test several tools for N management,

Figure 1. Soil samples taken to 8-inch depth around corn planting, analyzed for ISNT and OM



Note: Fields that fall above the line are unlikely to respond to extra N; fields below the line are N deficient and would likely respond to extra N.

including the ISNT, end-of-season stalk nitrate and soil nitrate tests, and chlorophyll procedure. We'll continue trials in 2006 and if our current work supports our conclusions so far, we expect New York producers to have the ISNT in the spring of 2007.

Follow-up tool

Evaluating how well you did with your nitrogen management at the end of each year is key to improving N management decisions. Dark green corn plants at harvest likely indicate at least an adequate N supply. But a lab test that tells if there's enough, too much or not enough N that year could help fine-tune management over the years.

The end-of-season stalk nitrate test is such a tool. Several states have developed critical values for this test. At Penn State, stalk nitrate levels of 2,000 ppm or greater indicate more than enough N. At the University of Connecticut, the same critical value of 2,000 ppm is used for corn grain but for corn silage the level is 1,000 ppm.

Here at Cornell, we're evaluating the test with our on-farm N trials to see if the critical values in New York are similar to those reported by other states. The test will be offered by the Cornell Nutrient Analysis Laboratory this fall and is available at the Agricultural Analytical Services Laboratory at Penn State, the University of Connecticut Soil Testing Laboratory and several commercial laboratories. ■

Trials will continue in 2006 and if the results support conclusions to date, the ISNT test should be available to New York producers in the spring of 2007.

How to take stalk nitrate samples

For fields harvested for silage, take samples just before harvest. Cut 8-inch long sections of corn stalks 6 inches above the ground. The piece of the stalk should come from the area of the plant 6 to 14 inches above the ground.

Take a minimum of five representative stalks per field and cut the pieces in 2-inch long sections. Even better, take sections from 10 to 15 stalks per field. If possible, dry the stalks, or send them to the lab immediately.