Nutrient Management

# Evaluation of ISNT-Based Nitrogen Management forMulti-Year Corn Sites

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## Introduction

With high fertilizer and low milk prices and greater awareness of the environmental impact of over-application of nitrogen (N) to corn, many producers are interested in tools that help identify sites that don't need extra fertilizer N. Several extension educators and farmers worked together with campus staff in the Nutrient Management Spear and PRO-DAIRY Programs over the past 6 years (67 NY field trials to date) to compare the effectiveness of four soil and two plant tests in identifying fields that do not need extra N. The most promising tests were the Illinois Soil Nitrogen Test (ISNT) and the late-season stalk nitrate test.

In this What's Cropping Up? article we report on evaluation of the Illinois Soil Nitrogen Test (ISNT) for N management of multi-year (3-4 year) studies on two New York farms. Specific questions were "How often does an ISNT sample need to be taken?" and "How big can the fertilizer savings be?".

## Earlier Studies

It is well documented that soil N tends to be a main source of N for corn. It is therefore important to get a better idea of the inherent soil N supply in order to fine-tune N management and reduce the risk of over-application of fertilizer. The ISNT estimates a labile organic N fraction, potentially mineralizable during the growing season(s) following sampling (Khan et al. 2001).

The ISNT-N result alone could not be calibrated for the range of New York state growing conditions and soils. However, when combined with organic matter estimates derived from loss-on-ignition (LOI; 2 hrs at 500$^{o}$C and corrected for initial moisture), the ISNTxLOI combination was effective in separating fields that needed extra N from those that had sufficient soil organic N supply to meet crop needs (Klapwyk and Ketterings, 2006). To ensure this interpretation could be used for corn in rotation, we conducted an additional 34 N-rate studies, most on commercial farms. This dataset confirmed that 1$^{st}$ year corn after sod rotation does not need to be fertilized beyond 20-30 lbs N/acre starter (Lawrence et al., 2008), while the ISNTxLOI calibration was 83% accurate in separating responsive from non-responsive sites for 2$^{nd}$ or higher year corn (Lawrence et al., 2009). This percentage is similar to the accuracy of the pre-sidedress nitrate test (PSNT) in ideal sampling conditions but greatly exceeded the accuracy of the PSNT in more challenging (wet) spring seasons (the PSNT was less than 50% accurate in our most recent study years). In other words, the overall performance of the ISNTxLOI matches the best performance of the PSNT. In addition, the ISNT is more user-friendly than the PSNT as it can be performed on standard soil samples rather than requiring 12 inch cores. Since the test estimates soil N supply potential, current year manure credits and sod N credits need to be taken into account in addition to the ISNT-N values to determine if extra N is needed. And, because the ISNT procedure measures ammonium-N in addition to the labile organic-N fraction, samples should be taken outside the window of elevated ammonium-N levels created by recent manure application or sod kill (i.e. not within five weeks after manure application of sod kill). Samples can be taken any other time of the year. Also, "potential soil N supply" means that if mineralization conditions are not good (e.g. during drought) the full potential to mineralize this soil organic N (as well as other organic N sources) is not realized.

## Sample Once in Two Years or Three?

One question that arose from these studies was: "How quickly do ISNT-N values change over time?" Or in other words, "How often should I sample for ISNT?" The project included ten fields for which ISNT-N was measured two years in a row. A comparison of the data in years 1 and 2 showed that ISNT values were stable over two years (no manure was added to these plots during the study). What about sampling every 3 years as currently required for standard soil testing for regulated farms?

Two non-manured farm fields were studied for 3 or more years, one in Northern NY (3 years) and one in Western NY (4 years). The ISNT-N values of the Northern NY site remained constant during the 3 years (363, 360, and 363 ppm in 2005, 2006 and 2007, respectively), suggesting that sampling once in 3 years might be sufficient. For the Western NY location, ISNT-N was constant in years 1 and 2 but lower in years 3 and 4 (Figure 1). All four years were correctly predicted (no yield response to extra N in years 1-3 and a yield response in year 4), but the decline in ISNT-N after two years at the Western NY location suggests samples should be taken once in 2 years rather than once in 3 years (at least for fields where no manure was added). Earlier research showed that manure application does result in an increase in ISNT-N over time, consistent with current organic N credits from manure.

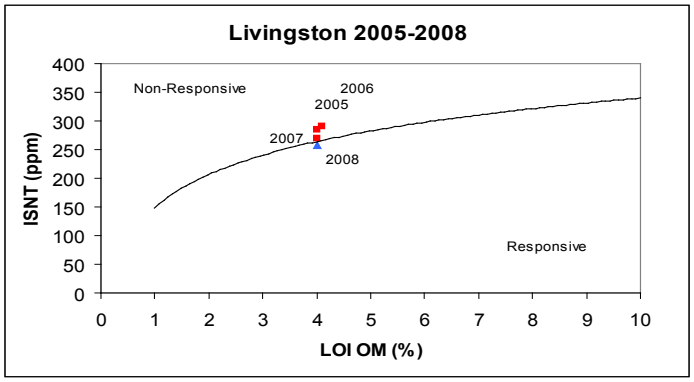


**Figure 1. Illinois Soil Nitrogen Test (ISNT) and Loss-on-Ignition Organic Matter (LOI-OM) over the four years at the Western New York farm field. The ISNTxLOI correctly predicted (1) a lack of a yield response to additional N in 2005-2007, and (2) the need for additional N in 2008.**

### How Big Are the Savings?

The Northern and Western New York sites showed something of great economic interest: no need for extra N for two to three years after sod turnover. For the Western New York site, yields in the first three years in the control plots (starter N only) were 22.3, 29.0 and 19.0 tons of silage per acre (35% DM). The Cornell soils database lists a yield potential of 23 tons of silage/acre which in years 2 and 3 after sod turnover would have resulted in an N recommendation of 110 lbs N/acre and 125 lbs N/acre, respectively. For the Northern New York site yields of the control plots (starter N only) were 26.0, 22.2 and 22.5 tons/acre for years 1, 2 and 3, respectively. Cornell yield potential for this site is 21.3 tons/acre (35% DM) and the recommendations for this site would have been 100 lbs N/acre (year 2) and 125 lbs N/acre (year 3). So, implementation of ISNT-based management would have, with current fertilizer prices, resulted in about $150 to $160 per acre saving in fertilizer N costs (years 2 and 3 combined) for both of these farms. Add to this the actual application costs and it becomes clear that with current N fertilizer prices, the N savings for these two non-responsive fields could have been substantial, a great return for the investment of the soil sampling and analysis.

### Remaining Questions

In our research trials, we had a number of sites whose ISNT value was within 10% of the critical value. Although our field trials show results to be accurate even if the plot ISNT is within 5% of the critical value, reality is that in our field plots, we sample at greater density than is usually done for the average production field. Work is currently ongoing to estimate the number of samples needed to obtain values within 10% of the field mean. We will report on the results of this study in a future What's Cropping Up? article. Keep in mind: no extra N is needed for first year corn fields after a good sod, and don't sample within 5 weeks of manure application for most accurate predictions of soil N supply potential. Also, ISNT-based guidance should not be confused with the official Cornell fertilizer guidelines for corn at this time but given the current economic situation, it might be worth doing an ISNT test to determine priority fields for fertilizer N applications.

### References

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### For More Information

For more information on the project and other work, see our project website: http://nmsp.css.cornell.edu/projects/Nitrogen-forcorn.asp. You will also find a downloadable spreadsheet on this site that graphically shows the results of the ISNT test.

Nutrient Management Spear Program
http://nmsp.css.cornell.edu/
A collaboration among the Department of Animal Science, Pro-Dairy, and Cornell Cooperative Extension.