



Illinois Soil Nitrogen Test (ISNT)

Accounting for in-field sources of nitrogen

Plants take up nitrogen (N) from different sources; plant residues, roots, past manure applications, soil organic matter and fertilizer N all contribute to the total amount of N used by a crop. The Cornell N equation calculates an N guideline for corn by taking into account the amount of N needed by the corn crop (based on soil and drainage specific corn yield potentials), and N available from sources already on the farm, including biomass from previous crops (sod N or soybean N credits), N from past manure applications, and N expected to be mineralized from soil organic matter (SOM) that growing season (soil N supply). Once in-field sources are accounted for the final N application value is adjusted (upward) to reflect fertilizer uptake inefficiencies (N fertilizer uptake efficiency under good management ranges from 50-75%). See Agronomy Factsheet #35 (N Guidelines for Corn) for more details.

Variability of soil N supply

A major factor in the Cornell N equation is soil N supply, yet soil N supply is very difficult to predict accurately. The soil N-supply values used for the Cornell N equation for corn are estimates (book values) developed for more than 600 New York soil types. Book values are based on studies of N uptake by continuous corn grown without additional N. For New York soils, soil N supply can range from 50 to 140 lbs N/acre, with 60-70 lbs N/acre typical for many common agricultural soils.

There are many challenges to develop a soil test that can more accurately predict the soil N-supply for a specific field in a timely manner. Soil organic matter levels have been used to gauge soil N availability; however, this method is not accurate. Typically, to determine SOM as reported on a soil fertility report, a soil sample is burned at a very high temperature. This method is called loss-on-ignition (LOI). The difference in mass before and after burning is converted into a percent SOM (%SOM). This LOI value on its own, although useful for other purposes, is not a good

predictor of soil N supply as it does not distinguish between SOM with readily available N and SOM that does not supply N, and proportions vary across fields and farms. Until recently, the best option to estimate if there was sufficient plant available N from organic sources (manure, sod, soil) was the pre-sidedress nitrate test (PSNT) but the PSNT presents some practical sampling challenges, results can be misleading in both dry and wet springs, and often N management decisions need to be made earlier in the season.

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Field research in New York the past 8 years has shown a new soil N test, the Illinois Soil Nitrogen Test (ISNT), to be the best option for determining soil N supply potential for New York corn growers. The ISNT is a laboratory test that estimates the amount of readily mineralizable soil organic N. The test has been 83% accurate in our trials predicting if soil-N supply alone could provide adequate N for a corn crop in New York.

Interpreting the results

To interpret ISNT-N values, we have to know both the ISNT-N value and the LOI value (Figure 1). Three results are possible: (1) above the curve (the black line in Figure 1) and outside the upper marginal grey zone; (2) below the curve and outside the lower marginal grey zone; or (3) close to the curve in the marginal (grey) zone.

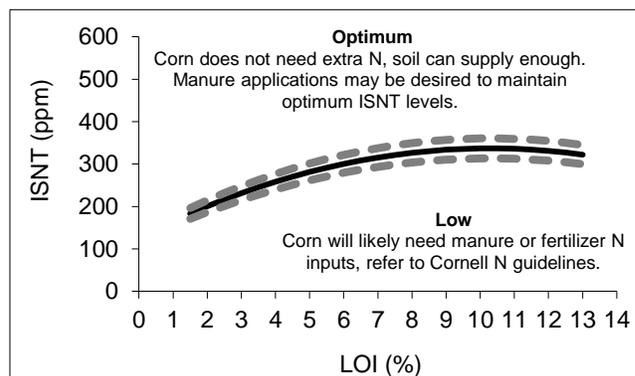


Figure 1: ISNTxLOI critical value curve for predicting if corn will respond to extra N.

(1) **Optimum:** Above the ISNTxLOI curve

The soil can supply enough N for optimum corn yield and no additional N is needed (small amount of starter N only). These soils will supply enough N throughout the growing season to support optimum corn growth and can quickly mobilize N into a plant available form as soils warm up in June and corn begins to grow rapidly.

(2) **Low:** Below the ISNTxLOI curve

The soil alone does not have enough N supply potential to meet crop N needs. These fields will likely show a response to additional N either from fertilizer or manure and the Cornell N equation for corn can be used to estimate how much N will be needed (Agronomy Fact Sheet #35).

(3) **Marginal:** In the grey zone

Soils falling within the gray dotted lines in Figure 1 are considered marginally adequate in soil N supply. These fields might have enough soil N but additional monitoring is needed. These are good fields for fertilizer test strips.

Soil sampling for ISNT

Soil samples for the ISNT can be taken any time during the year, except within 5 weeks after manure spreading or sod/cover crop turnover, with the same sampling and handling methods as used for regular soil samples (0-8 inches, see Agronomy Fact Sheet #1). Since sampling procedures are identical, the same sample can be used for regular fertility assessment as well as for ISNT analyses.

Results from the ISNT analysis will reflect soil organic N mineralization potential for the next 2-3 years. The sample is best taken in the fall after harvest of 1st year corn before manure application to guide decisions for 2nd year corn or higher. First year corn after grass/legume sod does not need N beyond 20-30 lbs N/acre in the starter (Agronomy Fact Sheet #21). Thus, we do not need to evaluate the ISNT and LOI levels of 1st year corn fields.

Sample submission

Soil samples can be submitted to:

Quirine Ketterings
Nutrient Management Spear Program
Dept. of Animal Science, 323 Morrison Hall,
Cornell University, Ithaca NY 14853

See <http://nmsp.cals.cornell.edu> to download a sample submission form.

Alternatively, samples can be submitted to other laboratories that offer ISNT analysis but for accurate interpretation of the ISNT data for New York growing conditions (i.e. to use Figure 1), make sure the laboratory that you submit samples to has implemented a 2-hour and 500°C method for determining LOI. Burning at lower temperatures can result in lower LOI estimates possibly resulting in incorrect interpretations of the ISNT results. The %OM using the 2-hour and 500°C method can be converted to %LOI using the following formulas:

$$\%LOI = (\%OM + 0.23) / 0.7$$

$$\%OM = (\%LOI * 0.7) - 0.23$$

Conclusion

The ISNT can accurately predict soil N-supply capacity for corn in New York, sampling for the ISNT fits nicely into a regular soil sampling protocol (0-8 inch depth samples), and the results can be applied for the following 2-3 years of corn. The ISNT has proven to be a useful tool for fine-tuning N applications and reducing purchased N inputs costs, especially when used together with the corn stalk nitrate test.

Additional Resources

- o Nutrient Management Spear Program Agronomy Fact Sheet Series: nmsp.cals.cornell.edu/index.html
- o Nutrient Guidelines for Field Crops in New York: nmsp.cals.cornell.edu/guidelines/nutrientguide.html
- o New York State Corn Nitrogen Calculator: nmsp.cals.cornell.edu/software/calculators.html

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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