NITROGEN MANAGEMENT EVALUATION TOOL

USER'S MANUAL

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Nutrient Management Spear Program

Collaboration among the Cornell University Department of Animal Science, PRODAIRY and Cornell Cooperative Extension

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Contents

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Downloadable from: http://nmsp.cals.cornell.edu/projects/curriculum.html.

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Introduction

The Nitrogen Evaluation for Corn Tool automates calculation of nitrogen (N) guidelines using information about soil type, crop rotation, legume management in the rotation, drainage and manure and fertilizer applications. In this calculator white cells (boxes) are open for data entry and yellow cells (boxes) are calculated values. The yellow cells present results based on data entered into white cells. Yellow cells are locked and cannot be manipulated. Efficient use of N is an important economic and environmental goal for many farms. Nitrogen can be difficult to manage due to its multiple and very mobile forms. Fine-tuning N management requires developing site-specific knowledge through on-farm measurements. The Nitrogen Management Evaluation Tool is a Microsoft Excel spreadsheet that combines multiple tools for N management for improved understanding and evaluation of farm-specific, field-specific N conditions. The tool requires Microsoft Excel to be installed (Microsoft Office 2003® or 2007®).

Warning: Useable output requires realistic values as input variables. The quality of the output is dependent on the data used and is the responsibility of the person using the calculator.

The Nitrogen Evaluation for Corn Tool integrates four stand-alone tools:

- Cornell Corn N Guidelines
- Pre-Sidedress Nitrate Test (PSNT)
- Illinois Soil Nitrogen Test (ISNT)
- Corn Stalk Nitrate Test (CSNT)

Each individual tool can be used to develop skills for accurately assessing farm-specific conditions that impact N availability and evaluating and fine-tuning decisions. Use of these tools can lead to improved N use efficiency over time.

Items Needed to Fill Out Sheets

Farm name
Farm address
Crop year
Field ID
Field size
County
Soil type
Soil drainage (Y/N)
Crop variety
Corn population density
Row spacing
Cover crops in rotation
Crop rotation
Percent legume in sods when rotated into corn
Sod termination timing
Sod termination method
Current manure application rate
Manure application rate last year
Manure application rate two years ago
Manure type
Month of application
Application method
Manure analysis
Density
Percent solids
Percent inorganic-N

Percent organic-N
Percent phosphate equivalent
Percent potash equivalent
Fertilizer
Percent nitrogen
Percent phosphate
Percent potash equivalent
Application rate
Density (if liquid)
Application method
Field Conditions
Crop Yield
Additional field observations
Soil Analysis
Pre-Sidedress Nitrate Test
Illinois Soil Nitrogen Test
Corn Stalk Nitrate Test

Quick Review of Nitrogen Basics

A review of nitrogen basics is suggested by reading the two fact sheets listed below. The factsheets can be downloaded from http://nmsp.cals.cornell.edu/guidelines/factsheets.html.

- *Agronomy Fact Sheet #2: Nitrogen Basics – The Nitrogen Cycle.*
- *Agronomy Fact Sheet #41: Soil Organic Matter.*

Farm Contact Information

Proper labeling of field information as it is collected is important for tracking and linking farm management information with analysis results. This spreadsheet provides a place for Farm Name and Address, and the crop year to which the crop information and soil and plant analysis are applicable (Figure 1).

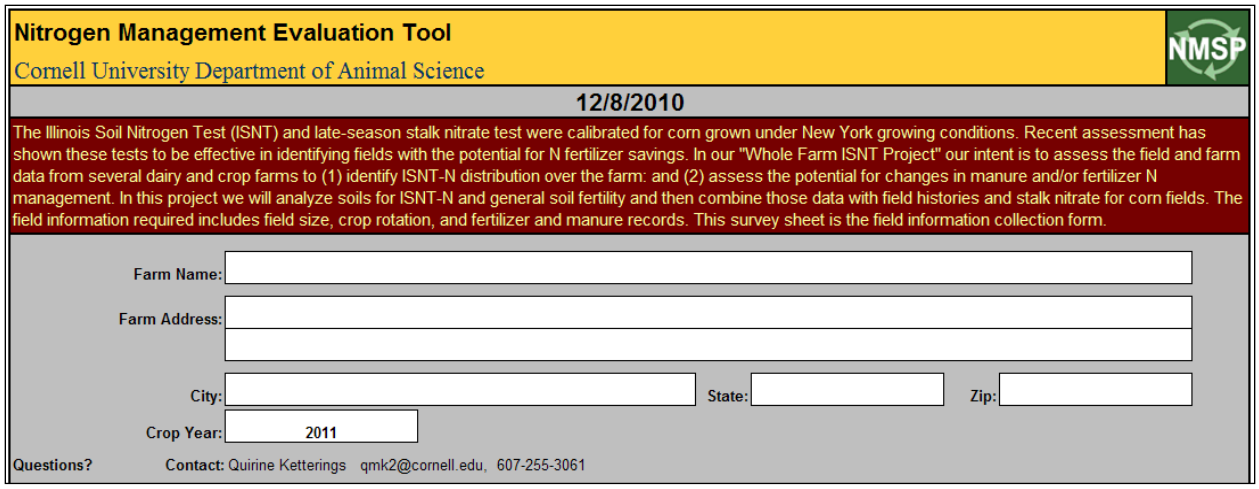

Figure 1: Contact, identification and crop year information needed to link analysis results with farm management practices.

Field and Crop Characteristics

Field characteristics such as soil type, drainage, rotation and sod legume content are used to estimate the amount of nitrogen required to reach the optimal yield for the corn crop. Cornell nitrogen guidelines use soil type and drainage to define the corn yield potential, soil N contribution, and nitrogen uptake efficiency based on research database values. The corn yield potential, soil nitrogen, and nitrogen uptake efficiency values are used along with sod N credits in the Cornell N Guidelines for Corn equation:

Recommended N = (yield potential*1.2 – Soil N – Sod N)/(N uptake efficiency/100)

These database values are built into the Nitrogen on Corn Evaluation Tool and are used to calculate a start-of-year N need for the field. The values can also be found in "Nitrogen Guidelines for Field Crops in New York", an extension document that is downloable from http://nmsp.cals.cornell.edu/publications/extension/Ndoc2003.pdf.

In addition to the data needed for estimating corn N needs, crop characteristics such as population density, row spacing, and sod termination date and method help with accurate interpretation of sampling results. When these data are combined with Field ID and field size, producers and advisors can work together to develop field specific guidelines (Figure 2).

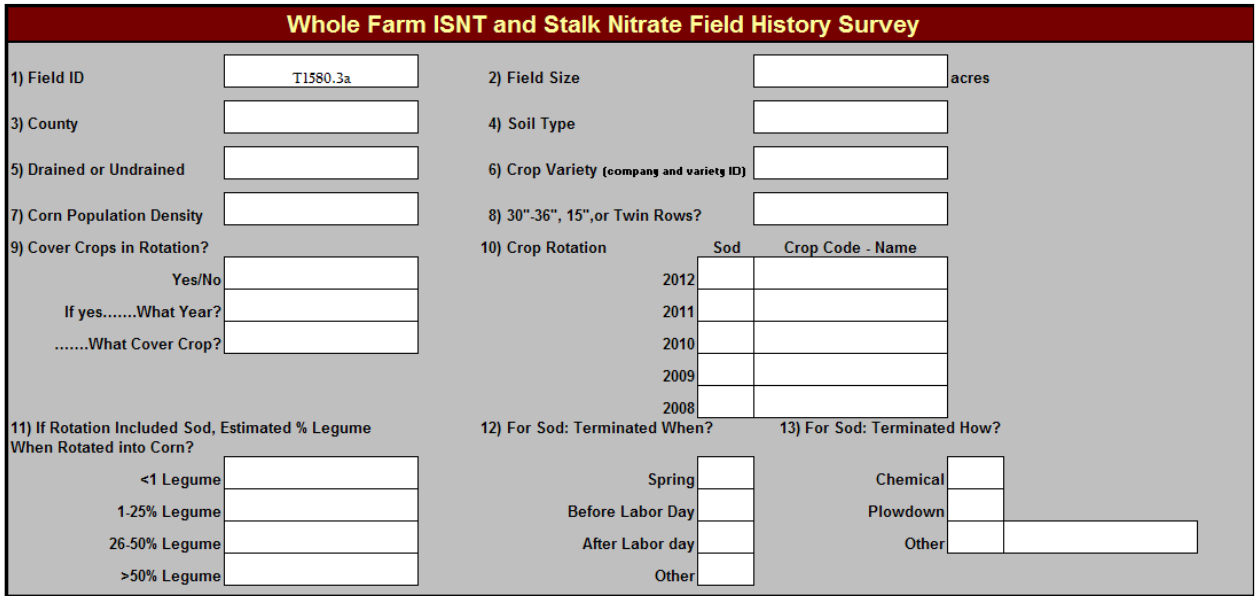

Figure 2: Field and crop information needed for estimating N needs, evaluating analysis results and developing site-specific recommendations.

Current and Past Manure Application

Manure application information is collected for the current growing season and the past two growing seasons (Figure 3). This information allows estimation of the manure N credits for the current corn crop.

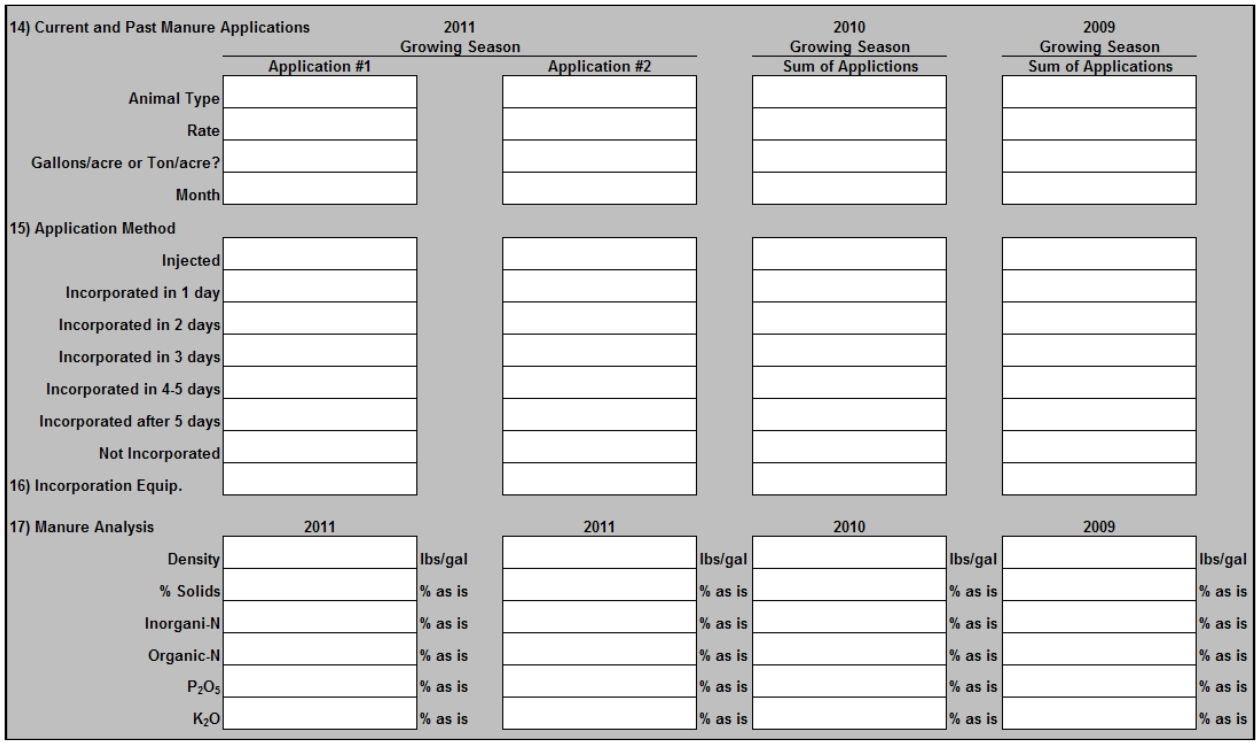

Figure 3: Manure application information needed to estimate N credits for corn crops in New York State.

Manure application information is requested per growing season. A growing season is the time between the harvest of the last crop and the end of the growth of the next crop (i.e. September or October of 2010 to September or October of 2011 for the 2011 growing season) (Figure 4).

Growing Season	2010 Growing Season												2011 Growing Season											
Month	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
Calendar Year	2009			2010												2011								

Figure 4: Growing seasons begin after final crops are removed the preceding year, usually by October 1st.

The manure applied in the current growing season can be a source of ***inorganic N*** depending on timing and application methods. The calculator uses the manure analysis, manure rate, timing and application method to calculate the amount of inorganic N to be credited (Table 1).

Manure applied in the current and past two growing seasons supplies the current crop with N from mineralization of the **organic N** in the manure. Nitrogen credits from the organic fraction depend on the species of animal that the manure came from, the solids content of the manure and the manure application rate (Table 2).

Table 1: Estimated ammonia-N losses as affected by manure application method*.

Manure Application Method	Ammonium-N	
	Credited	Lost
Injected as sidedress on row crops	100	0
Spring incorporated within 1 day	65	35
Spring Incorporated within 2 days	53	47
Spring Incorporated within 3 days	41	59
Spring Incorporated within 4-5 days	23	77
Topdressed or incorporated after 5 days	0	100
Fall incorporated or injected	0	100
Surface application on frozen or saturated ground	0	100

*Source: Ketterings, Q.M., S.D. Klausner and K.J. Czymmek (2003) Nitrogen Guidelines for Field Crops in New York. Department of Crop and Soil Science Extension Series. E01-4. Cornell University, Ithaca, NY. 39 pages.

Table 2: Decay series for stable organic N in manure by animal type. A "last year release rate" of 12% indicates that an estimated 12% of the organic N applied in the manure is expected to be utilized by the crop a year after application*.

		Release rate for organic N in manure (%)		
Source	Total Solids (%)	Present Year "Decay_current"	Last Year "Decay_lastyr"	Two Years Ago "Decay_2yrs"
Cows	<18	35	12	5
Cows	≥18	25	12	5
Poultry	<18	55	12	5
Poultry	≥18	55	12	5
Swine	<18	35	12	5
Swine	≥18	25	12	5
Horses	<18	30	12	5
Horses	≥18	25	12	5
Sheep	<18	35	12	5
Sheep	≥18	25	12	5

*Source: Ketterings, Q.M., S.D. Klausner and K.J. Czymmek (2003) Nitrogen Guidelines for Field Crops in New York. Department of Crop and Soil Science Extension Series. E01-4. Cornell University, Ithaca, NY. 39 pages.

Fertilizer Additions

Information on pre-plant, starter, and sidedress fertilizer treatments are important for determining where additional fertilizer may be needed or where fertilizer savings can be made. The data needed in the calculator are the fertilizer analysis (N:P_2O_5:K_2O), rate (in lbs/acre or gallons/acre), the density (for liquid fertilizers), and method of application (Figure 4). This information is used to calculate how many pounds of each nutrient are applied:

Pounds per gallon * gallons per acre = pounds per acre

Pounds per acre * percent nutrient = pounds of nutrient per acre

In addition, information on the how/when it was applied is collected as a reference when evaluating N management practices later in the season (Figure 4).

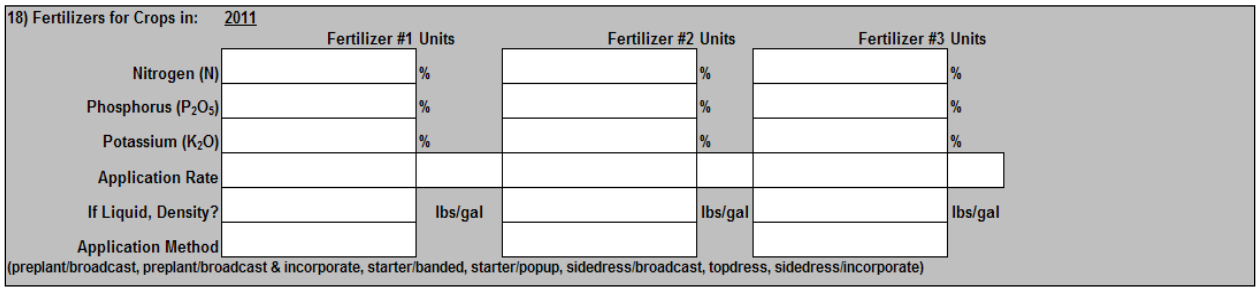

Figure 4: Fertilizer analysis, rates and application methods are needed to identify potential areas where additions or reductions in fertilizer could be made.

Crop Conditions

Conditions in the field during crop development can impact nutrient dynamics during the growing season. Therefore it is important to keep notes and field observations to help interpretation and evaluation of soil and tissue testing results (Figure 5). Additional field information to track for N availability includes rainfall events and temperature.

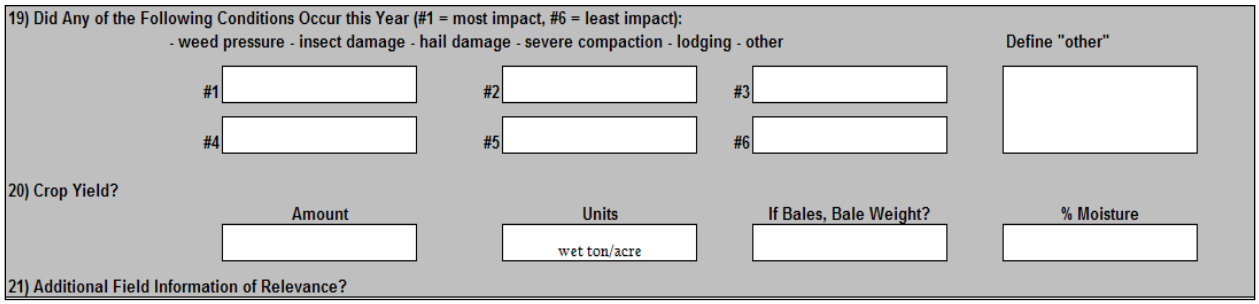

Figure 5: The ISNT/CSNT calculator provides a place to record observation of field conditions during the growing season to aide in evaluation later on.

Soil Test Results

The calculator provides a place to record soil analysis results that relate directly to N availability (ISNT and PSNT) as well as other soil nutrient levels that could interact with plant uptake of nitrogen (Figure 6). Recording all soil analysis results allows the most comprehensive interpretation of N availability during the growing season.

22) Most Recent Soil Test Data				
Lab Name	Date	Sample ID	Extraction Method	pH
P (lbs/acre) (Morgan Extraction or Converted)	K (lbs/acre) (Morgan Extraction or Converted)	Mg (lbs/acre)	Ca (lbs/acre)	Ex. Acidity (ME/100g)
Al (lbs/acre)	Fe (lbs/acre)	Mn (lbs/acre)	Zn (lbs/acre)	OM (%)
Buffer pH	CNAL LOI (%)*	CNAL - ISNT-N (ppm)*	ISNT-N Critical Value (ppm)	PSNT (ppm)
pH $CaCl_2$	pH (0-1 inch; notill)	Soluble Salts (mmho)	B (lbs/acre)	CEC (NH_4OAc)

Figure 6: Nutrient analysis results are recorded and when combined with additional field conditions listed in previous sections allows a comprehensive evaluation of nitrogen availability during the growing season.

Nitrogen Balance

Keeping track of the nitrogen balance prior to and during the growing season can help estimate the quantity of fertilizer or manure needed at planting and sidedress time. According to the information entered in the spreadsheet on soil type, drainage, crop rotation, percent legume in the previous sod and manure and fertilizer additions the N balance for this field shows a 26 lb/acre deficient remaining (Figure 7).

(1) Corn N Balance	
Yield Potential for Corn (bushels/acre)	168
	(lbs/acre)
Soil N Credit	70
Sod N Credit	30
N uptake efficiency	75%
Past Manure N Credit	12
Preliminary N Need	78
Preplant N (lbs/acre) 0	
Starter N (lbs/acre) 30	
Sidedress N (lbs/acre) 0	
Fertilizer N Credit	30
Organic-N (lbs/acre) 22	
Inorganic-N (lbs/acre) 0	
Current Manure N Credit	22
Corn Nitrogen Balance	-26

Figure 7: Corn nitrogen balance is calculated based on information entered in the calculator.

The preliminary N need is calculated using the Cornell Nitrogen Guidelines for Corn equation:

[(Yield potential of the soil*1.2-SoilN-SodN)/(N uptake efficiency of the soil/100)]

Then, past manure credits are subtracted to give the 'Preliminary N Need' at the beginning of the cropping season. Filling in the equation using the information shown in Figure 7 would provide:

$$[(168-70-30)/0.75]-12 = 78 \text{ lbs N/acre}$$

Since the beginning of the growing season the corn crop has already received manure and starter fertilizer. The Preliminary N Need is subtracted to give the corn N balance:

$$(22+30) - 78 = -26 \text{ lbs of N/acre}$$

The crop is still short about 26 lbs of N per acre.

Pre-Sidedress Nitrate Test

The Pre-Sidedress Nitrate Test (PSNT) is an in-season soil nitrate test that can be used to estimate where additional fertilizer may not be needed. This test is taken at corn sidedressing time just before the period of major N demand by corn. It should be used on fields with a history of manure and/or sod incorporation and cannot be used on fields that received N beyond 30 lbs N/acre in the starter band. The PSNT is designed to (1) estimate the soil's N supplying potential from organic N sources, and (2) decide if that is enough N to meet crop needs.

Field T1580.3a shown in Figure 8 received a PSNT value of 21 (this value was entered in the soil test results section above and in the evaluation table is marked with an 'x' and highlighted in yellow) (Figure 8).

(2) Pre-Sidedress Nitrate Test (PSNT) Evaluation

	Field Name :	T1580.3a
	Nitrate-N (ppm)	**N Guidelines**
	≥25	No additional N needed.
X	21-24	If you expect a yield response, consider sidedressing 25-50 lbs N/acre.
	<21	Apply sidedress N according to the Cornell N guidelines for corn.

Figure 8: PSNT results are highlighted in the PSNT evaluation table and marked with an 'x'.

Illinois Soil Nitrogen Test

The Illinois Soil Nitrogen Test (ISNT) estimates the amount of readily mineralizable soil organic N and when coupled with the organic matter levels in the soil (loss-on-ignition (LOI)) the ISNT-N value can be used to determine if a field is likely or unlikely to respond to additional N (i.e. if the soil has sufficient mineralizable N to not need external supplies in the form of fertilizer N).

For example, Field T1580.3a shown in Figure 9 reports 2.5% LOI and an ISNT-N value of 375 ppm, indicating only a small starter N application is needed.

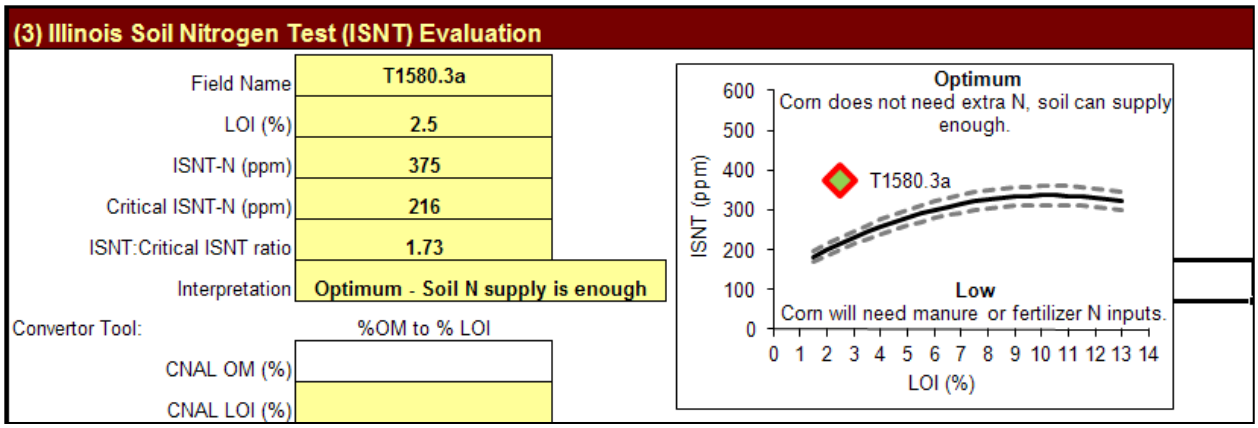

Figure 9: ISNT x LOI results show that field T1580.3a falls above the critical value line and is likely to not need extra N (beyond a 20-30 lbs of starter N).

Corn Stalk Nitrate Test

The CSNT is useful as an end-of-season test for evaluation of the N supply during the growing season because it helps identify opportunities for reducing fertilizer inputs or re-allocation of manure. If the field had a CSNT greater than 2000 ppm, the crop received more than enough N that growing season. If the field had a CSNT between 750 and 2000 ppm the crop was supplied with adequate N to reach full yield potential. If the CSNT of the field was under 750 and 250 ppm the plants had marginal access to N and if the field tests below 250 the crop did not receive enough N or the plants could not access the N that was supplied (other limiting nutrients, water logged conditions, high losses etc…).

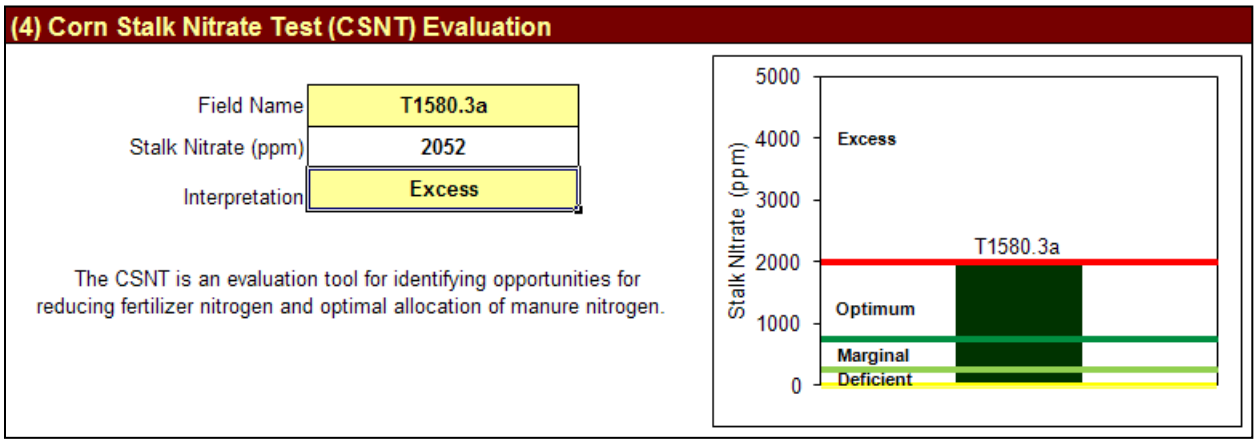

Figure 10: Corn Stalk Nitrate results are graphically displayed in the N evaluation tool.