NNY Agricultural Development Program
2006-2007 Project Report

Nitrogen Needs for Corn Following Grass/Legume Sods

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Cooperating Producers (2007):

- Mike Northrup (Jefferson County); Merle Yancey (Lewis County); David Fisher (St. Lawrence County)

Background:

Nitrogen prices and environmental concerns have caused many corn producers and advisors to rethink their current N management practices. From 2002 to 2004, laboratory and field trials were conducted in NY (including sites in St Lawrence, Jefferson and Clinton County) to evaluate the performance of a new soil N test, the Illinois Soil N Test (ISNT, also referred to as the aminosugar N test) in identifying whether or not additional N is needed. This work showed great promise for the test in New York State and has led to the development of critical ISNT values beyond which additional N from manure or fertilizer is not likely to result in a yield response. Additional field trials were needed specifically on N needs for corn in a corn-sod rotation.

Methods:

In 2007, we conducted four field trials; two were 2nd year corn sites, one was 3rd year corn and one 4th year corn site. Site characteristics for each trial are listed in Table 1. For the on-farm trials in St Lawrence, Lewis and Jefferson County, each trial had 4 treatments (starter N only, starter plus 50, 100 or 150 lbs N/acre) in 4 replicates per treatment. In Willsboro, a fifth treatment was added: no N (no starter, no sidedress N). Each plot was 4 or 6 rows wide (depending on the planter) and 50 feet long. Soil samples were be taken at PSNT time and at harvest (0-8 and 0-12 inch samples) and analyzed for the standard soil fertility package and soil nitrate. Chlorophyll tests were done when the corn was in the 5 leaf stage to assess potential N deficiency and at harvest. Plots were harvested for silage (2 rows of 40 feet each) and sub-samples were taken to determine moisture content, stalk nitrate, N removal and silage quality. Trials were located in St Lawrence, Lewis, Jefferson, and Essex Counties (Willsboro Research Farm).

Table 1: Site characteristics for the 4 nitrogen rate studies in Northern New York in 2007.

	Site location			
	St Lawrence	Lewis	Jefferson	Essex 3
	Soil series			
	Swanton fine sandy loam	Nellis loam		Stafford fine sandy loam
Planted	5/10/2007	5/15/2007		5/8/2007
Sidedressed	6/14/2007	6/18/2007	6/15/2007	6/15/2007
Harvested	9/14/2007	9/6/2007	9/7/2007	9/4/2007
	Cropping history/dry matter yield			
2006	Corn	Corn		Corn
	7.8 tons/acre	145 bu/acre		7.8 tons/acre
2005	Corn	Corn		Corn
	7.8 tons/acre	170 bu/acre		7.8 tons/acre
2004	Grass	Corn		Grass
	2.8 tons/acre	155 bu/acre		NA
2003	Grass			Grass
	2.8 tons/acre			NA
	Legume % in the sod			
	<10%	-		0
	Date sod killed			
	Oct '04	-		May '06
	Manure history (NM = no manure)			
2006	NM	NM	NM	NM
2005	NM	NM	NM	NM
2004	8144 gal/acre	NM	NM	NM
	16-Jun			
2003	16470 gal/acre[2]	NM	NM	NM
	June and Oct.			
	N fertilizer history (lbs N/acre)			
2006	.	130	.	.
2005	.	130		.
2004	.	130		.
2003	46			.
	Fertilizer addition at planting (2007)			
lbs N/acre	22	32		15 (0)[3]
lbs P_2O_5/acre	10 + 35	91		61 (0)[3]
lbs K_2O/acre	0 + 60	63		61 (0)[3] + 90

[1] Two cuttings.
[2] Two applications.
[3] A no starter treatment was included at the two Essex trials (Willsboro Research Farm).

Each of the sites was sampled for basic soil fertility levels when the corn was 6-12 inches tall and at harvest. These data are presented in Table 2. Additional K was applied at the

Willsboro sites and the St. Lawrence County sites (based on 2006 soil test) to assure that P or K would not be a limiting factor for corn growth either.

Table 2: Soil management groups (SMG), soil series and general soil fertility data for the 4 nitrogen rate studies in Northern New York in 2007. L=low; M=medium, H=high, VH=very high, N=normal, E=excessive.

	Site Location			
	St Lawrence	Lewis	Jefferson	Essex 3
	Swanton fine sandy loam	Nellis loam		Stafford fine sandy loam
SMG	4	4		4
pH	6.7	7.4	7.6	6.6
OM (%)	3.3	3.7	5.0	1.9
LOI OM (%)	5.0	5.6	7.5	3.0
P (lbs/acre)	16.9	63.7	20.5	22.2
K (lbs/acre)	191.4	178.9	206.1	74.7
Mg (lbs/acre)	457	133	183	83
Ca (lbs/acre)	3020	6646	14691	2024

Results:

Yields and Optimum Economic N Rates:

The St. Lawrence and Jefferson County sites were non-responsive (Table 3 and Fig. 1).

Table 3: Silage yields for the 4 Northern New York trials.

N Rate	Silage yield (tons/acre 65% moisture)			
	St Lawrence	Lewis	Jefferson	Essex 3
No N				15.9 b
Starter N only	22.5 a	18.0 c	11.4 a	17.6 ab
Starter + 50 lbs N	23.8 a	20.5 b	14.1 a	19.6 a
Starter +100 lbs N	24.2 a	23.0 a	15.9 a	19.3 ab
Starter +150 lbs N	23.2 a	23.2 a	15.6 a	21.1 a
	Moisture content at harvest (% moisture)			
No N				53.2 a
Starter N only	63.3 a	60.8 a	49.6 a	56.5 a
Starter + 50 lbs N	62.1 a	61.4 a	54.1 a	54.1 a
Starter +100 lbs N	63.6 a	62.7 a	52.1 a	51.9 a
Starter +150 lbs N	64.0 a	62.8 a	48.5 a	53.1 a

†Average values with different letters (a,b,c) are statistically different ($\alpha = 0.05$)

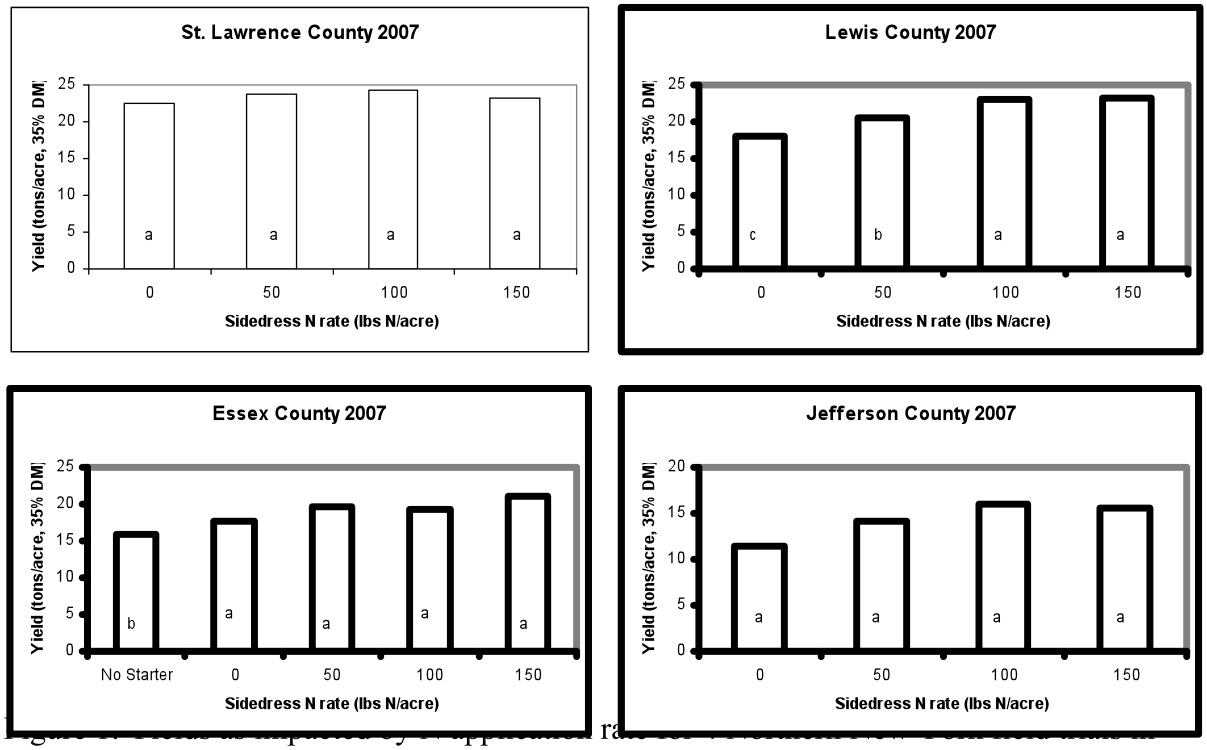

Figure 1. Yields as impacted by N application rate for 4 Northern New York field trials in 2007.

The Lewis County site responded showed a response to sidedress N while the Essex County site showed a response to starter N. Based on the calculation:

$$\text{N rate (lbs/acre)} = [(\text{Yield Potential}*1.2) - \text{Soil N} - \text{Sod N}] / (\text{N efficiency}/100) \quad [1]$$

Essex County site 3 (2nd year corn) would have required 74 lbs N/acre (65-85 lbs) for optimum yield for a yield potential of 18.7 tons/acre at 35% DM. The optimum economic N rate for this site in the 2007 growing season was about 136 lbs N/acre split applied as 30 lbs N/acre in the starter band and about 106 lbs N/acre applied at side-dress time (Table 4) with an actual yield of about 17.6 tons/acre. Assuming a yield potential of 19.4 tons/acre, equation [1] would have predicted an N rate of 103 (95-115) lbs N/acre. If there had been no sod-N carryover into the second year, the recommended N rates would have been 111 lbs (100-120) N/acre assuming an 18.7 tons/acre yield potential and 118 (110-130) lbs N/acre for the actually obtained yield. The Lewis County site (4th year corn) would have required 133 (125-145) lbs N/acre for optimum yield with a yield potential of 23.8 tons/acre at 35% DM. The optimum economic N rate for this site in the 2007 growing season was 147 lbs N/acre split applied as 30 lbs N/acre in the starter band and about 117 lbs N/acre applied at side-dress time (Table 4) with an actual yield of about 23 tons/acre. These combined results suggest that second year N credits might need to be adjusted and additional work is needed.

Table 4: Optimum economic N rates (30 lbs/acre starter plus side-dress N) for Essex 3 and Lewis County as influenced by forage value and N fertilizer costs. See Tables 1 and 2 for site characteristics and Table 3 and Figure 1 for yields.

		Fertilizer Price ($ per lbs of N)			
		$0.30/lbs N	$0.40/lbs N	$0.50/lbs N	$0.60/lbs N
		Essex 3			
Forage Value ($ per ton)	$25/ton	161	141	121	101
	$30/ton	171	154	137	121
	$35/ton	178	164	149	135
	$40/ton	183	171	158	146
		Lewis			
Forage Value ($ per ton)	$25/ton	158	149	140	132
	$30/ton	162	155	148	140
	$35/ton	165	159	153	147
	$40/ton	167	162	157	151

Tools for N Management:

Pre-Sidedress Nitrate Test

The PSNT results predicted a need for addition N for all of the 2007 sites. However, only one site (Lewis) showed a response to sidedress N and the PSNT identified only this one site correctly (Table 5). The inaccuracy of the PSNT in 1st year corn is well documented, but the test is generally more reliable in 2^{nd+} year corn. Our 2005-2007 results show the challenges with taking an accurate PSNT in extreme growing conditions (wet in 2005 and 2006, dry in 2007).

Chlorophyll at PSNT Time

The new procedure for chlorophyll testing to predict the need for sidedress N fertilizer developed by Penn State (Beegle and Piekielek) recommends no additional N if the first reading at the 6 leave stage is 46.0 or greater. For sites with readings below 42.0, sidedress N is recommended and for sites between 42.0 and 45.9, a second reading is recommended 4-7 days later for corn at the 7-8 leaf stage. If for this second reading, values are 43.0 or greater, no additional N is needed. It was not feasible to do repeated measurements but based on the one time reading, the test was incorrect at 3 of 4 sites (Table 5). Data from 2005-2007 showed a very low accuracy for this test across all sites and we conclude a one-time chlorophyll measurement is not a valid option for NY.

Stalk Nitrate Test

Based on work in NY in 2005 and 2006 a site would have benefited from additional N if the Stalk N value is <250 ppm while if the value is >2000 ppm then the site had excess N. The four NNY sites showed a wide range of stalk N values (Table 5); however, at all sites there was a clear trend with increasing stalk N values as side-dress rates increased. This test is a very clear indicator in N management for corn in the 2nd year and beyond but should be used over multiple years as year specific conditions such as weather affect the value.

Table 5: Pre-sidedress nitrate test (PSNT), chlorophyll at sidedress and harvest time, end-of-season soil nitrate (12 inches), and stalk nitrate test data for the 4 NNY trials.

N Rate	PSNT (ppm)			
	St Lawrence	Lewis	Jefferson	Essex 3
	3rd year corn	4th year corn	2nd year corn	2nd year corn
	Non-responsive	Responsive	Non-responsive	Responsive
No N				9.9 a
Starter N only	10.5 a	13.8 a	10.0 a	9.5 a
Starter + 50 lbs N	9.5 a	12.1 a	15.5 a	9.5 a
Starter +100 lbs N	10.1 a	13.4 a	10.4 a	9.0 a
Starter +150 lbs N	11.4 a	12.3 a	11.1 a	8.4 a
	Chlorophyll at PSNT time			
No N				35 a
Starter N only	41 a	48 a	42 a	35 a
Starter + 50 lbs N	47 a	44 b	41 a	35 a
Starter +100 lbs N	39 a	47 ab	41 a	33 a
Starter +150 lbs N	37 a	48 ab	41 a	32 a
	Stalk nitrate test (ppm)			
No N				67 b
Starter N only	1252 b	104 b	80 c	75 b
Starter + 50 lbs N	2615 ab	54 b	85 c	118 b
Starter +100 lbs N	4245 ab	304 b	852 b	1960 a
Starter +150 lbs N	5907 a	2127 a	1607 a	2292 a
	End-of-season soil nitrate test (ppm)			
No N				0.0 a
Starter N only	2.7 a	0.0 a	0.0 a	0.0 a
Starter + 50 lbs N	0.0 a	0.0 a	0.0 a	0.0 a
Starter +100 lbs N	2.9 a	0.0 a	0.0 a	0.0 a
Starter +150 lbs N	4.5 a	0.0 a	2.7 a	1.8 a
	Chlorophyll at harvest			
No N				21 b
Starter N only	41 b	30 c	11 a	19 b
Starter + 50 lbs N	42 b	44 b	22 a	20 b
Starter +100 lbs N	44 ab	54 a	30 a	26 ab
Starter +150 lbs N	50 a	57 a	31 a	35 a

†Average values with different letters (a,b,c) are statistically different ($\alpha = 0.05$)

Chlorophyll at Harvest Time

The chlorophyll test results increased as the sidedress N rates increased (Table 5) but the End-of-season Stalk N test is a much more reliable indicator of the crops N status at the end of the year.

End of Season Soil Nitrate Test
End-of-season nitrate levels were very low (Table 5). This is an indication even in a dry year any fertilizer N not taken up by the plant will be lost to the environment.

Forage Quality

Crude and Soluble Protein
Slight drops in crude and soluble protein at these sites are consistent with the work done in 2005 and 2006 (Table 6). However, it is clear that is does not significantly affect the overall forage quality based on the values for milk per ton (Table 8) and economic analysis performed using a common Northeast USA TMR dairy ration showed the if there was no yield response it was much more costly and had had greater environmental impacts to sidedress N as a method to gain crude protein than to supplement the ration with soybean meal to make gain the crude protein lost by not sidedressing.

Table 6: Impact of N application on crude protein and soluble protein for the 4 Northern New York trials in 2007.

	St. Lawrence	Lewis	Jefferson	Essex 3
	3rd year corn	4th year corn	2nd year corn	2nd year corn
	Non-responsive	Responsive	Non-responsive	Responsive
	Crude Protein (% of DM)			
No Starter			.	5.2 c
0	7.0 b	5.4 c	.	5.1 c
50	7.3 b	6.2 b	.	6.2 b
100	7.4 b	7.4 a	.	6.7 ab
150	8.2 a	8.0 a	.	7.1 a
	Soluble Protein (% of DM)			
No Starter			.	1.3 b
0	1.8 a	1.6 b	.	1.3 b
50	1.9 a	1.8 b	.	1.5 ab
100	1.9 a	2.1 a	.	1.5 ab
150	2.0 a	2.2 a	.	1.8 a

† Forage data was not analyzed for Jefferson County site due to weed pressure and poor yields.

Other Forage Quality Parameters
Neutral detergent fiber (NDF), digestible NDF (dNDF), lignin and starch were also analyzed and no significant differences between N application rates were observed with any of these parameters (Table 7).

Milk per Ton and Milk per Acre
Milk per ton is a measure of lbs of milk per ton of silage measured by the U. of Wisconsin's milk2006 program. Despite the yield response at two sites there was no significant change in overall forage quality across the N application rates (Table 8). Milk per acre is a combination of forage quality and yield measured by the U. of Wisconsin's milk2006 program. Significant differences at Essex 1 indicate the decrease in yield at lower N application rates.

Table 7: Impact of N application on NDF, dNDF, lignin and starch for the 4 Northern New York trials in 2007.

	St. Lawrence	Lewis	Jefferson	Essex 3
	3rd year corn	4th year corn	2nd year corn	2nd year corn
	Non-responsive	Responsive	Non-responsive	Responsive
	NDF (% of DM)			
No Starter			.	53.2 a
0	43.8 a	47.5 a	.	51.8 a
50	42.6 a	47.2 a	.	51.8 a
100	45.2 a	45.8 a	.	52.0 a
150	44.1 a	45.1 a	.	48.5 a
	dNDF (% of DM)			
No Starter			.	63.8 a
0	64.9 a	68.5 a	.	61.7 a
50	64.8 a	67.0 a	.	62.7 a
100	63.9 a	67.7 a	.	63.9 a
150	63.4 a	67.1 a	.	64.0 a
	Lignin (% of DM)			
No Starter			.	3.8 a
0	3.3 a	3.3 a	.	3.7 a
50	3.3 a	3.4 a	.	3.9 a
100	3.5 a	3.4 a	.	4.0 a
150	3.5 a	3.4 a	.	3.6 a
	Starch (% of DM)			
No Starter			.	27.0 a
0	32.3 a	30.2 a	.	28.1 a
50	32.9 a	29.8 a	.	26.6 a
100	30.4 a	29.9 a	.	26.4 a
150	30.8 a	29.7 a	.	29.4 a

† Average values with different letters (a,b,c) are statistically different ($\alpha = 0.05$).

†† Forage data was not analyzed for Jefferson County site due to weed pressure and poor yields.

Table 8: Impact of N application on estimated milk per ton and milk per acre for the 4 Northern New York trials in 2007.

	Milk per ton (lbs/ton)			
	St. Lawrence	Lewis	Jefferson	Essex 3
	3rd year corn	4th year corn	2nd year corn	2nd year corn
	Non-responsive	Responsive	Non-responsive	Responsive
No Starter			.	3098 a
0	3308 a	3320 a	.	3069 a
50	3331 a	3310 a	.	3084 a
100	3247 a	3380 a	.	3098 a
150	3264 a	3381 a	.	3219 a
	Milk per acre (lbs/acre)			
No Starter			.	17273 c
0	26082 a	20938 b	.	18948 bc
50	27714 a	23794 b	.	21117 ab
100	27626 a	27224 a	.	20846 ab
150	26620 a	27449 a	.	23735 a

† Forage data was not analyzed for Jefferson County site due to weed pressure and poor yields.

Combined Results from 2005 and 2006

First Year Corn

Six 1st year corn trials were conducted in NNY in 2005 and 2006. These trials combined with ten others from around NYS showed no yield or forage quality response to additional N beyond a small starter application (Table 9). From the research station trials that included a 0 N treatment, we concluded that 1st year corn will benefit from a small starter N application (~30 lbs N/acre). If we combine all 1st year trials, we concluded that first year corn does not require any additional N beyond the starter. Furthermore, since 1st year corn fields do not require additional N there is no need to use any N management tools such as the PSNT, chlorophyll, or ISNT.

Table 9: Overall yield and quality of 1st year corn.

	On-farm sites		Research farm sites	
N sidedress rate	Corn silage yield (35% DM)	Milk per ton	Corn silage yield (35% DM)	Milk per ton
lbs N/acre	tons/acre	lbs/ton	tons/acre	lbs/ton
No Starter	.	.	19.6 b	3199 a
0	21.7 a	3193 a	21.1 ab	3195 a
50	22.2 a	3234 a	21.5 a	3257 a
100	22.4 a	3214 a	22.6 a	3194 a
150	22.4 a	3211 a	22.1 a	3168 a

†Average values with different letters (a,b,c) are statistically different ($\alpha = 0.05$)

Corn after corn or soybeans (2005-2007):

In NNY, seven 2nd year, one 3rd year and one 4th year corn trial were conducted of which five were responsive to additional N. If we combine this with 8 others from around NYS, we have a total of 9 non-response and 8 responsive sites. The range of responsive 2nd year site and the difference in the calculated recommended N rate vs. the optimum economic N rate (Table 10) makes it clear that we need to utilized tools such as the ISNT, End-of-season stalk nitrate and PSNT to better identify which sites are likely to be responsive when it comes to 2nd year corn or greater.

Table 10: Reported yield potential and N needs vs. actual yield and optimum economic N rate.

	Required N[1]	Optimum Economic N Rate[2]	Yield Potential[3] (35% DM)	Actual Yield[4] (35% DM)
	lbs N/acre	lbs N/acre	tons/acre	tons/acre
St. Lawrence 1 (2006)	102	0	21.3	21.2
St. Lawrence 1 (2007)	123	0	21.3	23.4
St. Lawrence 2 (2006)	102	0	21.3	21.7
Jefferson 1 (2006)	91	.	23.0	16.4
Jefferson 2 (2007)	?	0	?	14.3
Essex 1 (2006)	74	135	18.7	17.6
Essex 2 (2005)	74	140	18.7	25.0
Essex 3 (2007)	74	136	18.7	19.4
Lewis (2007)	133	147	23.8	23.0

[1] Required N based on N rate (lbs/acre) = [(Yield Potential*1.2) – Soil N – Sod N] / (N efficiency/100).
[2] Optimum Economic N Rate based on a forage value of \$30 per ton and \$0.54 N cost.
[3] Yield potential is based on soil type and drainage.
[4] Actual yield is averaged for non-responsive sites and the yield at the optimum economic N rate for the responsive sites.

ISNTxLOI

The ISNT x LOI OM critical value curve worked very well in predicting the N needs of 2nd + year corn, accurately predicting 7 of 9 NNY and 15 out of 18 2nd + year and corn after soybean sites state wide, with the one incorrect site having hail damage (Jefferson 2006) which may have lead to its sidedress response, a corn

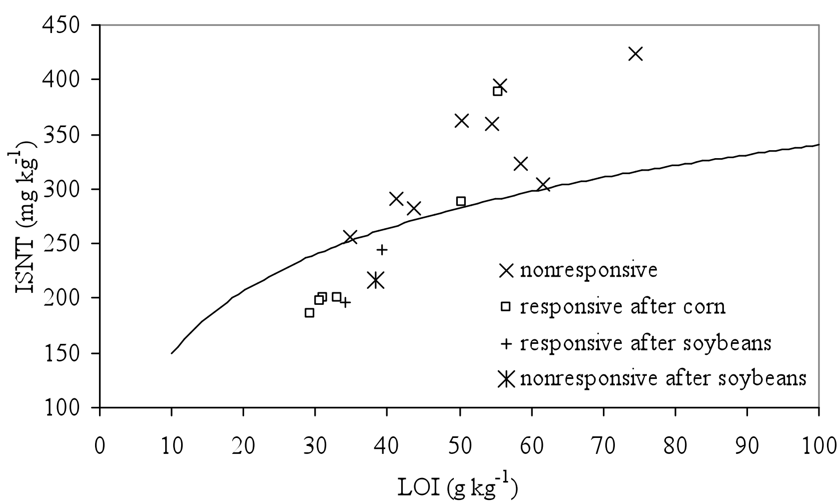

Figure 2: ISNT values of 18 corn sites in New York.

after soybean site which was statically non-responsive but had large variability in the data and a responsive site (Lewis 2007) that was responsive but predicted to be non-responsive. This is very encouraging for the potential of adopting the ISNT x LOI OM for predicting N response in corn sites that are in their 2nd year or beyond. The ISNT was more accurate than the PSNT in predicting a response to sidedressing for 2nd + year corn which indicates the benefit of measuring a much more stable fraction of N with the ISNT that is not affected by precipitation around the time of sampling.

Conclusions/Outcomes/Impacts to Date:

- As shown through the work in 2005 and 2006 corn in the 1st year after sod does not benefit from additional N beyond a small starter application and no tools are need for predicting N needs.
- When corn follows corn in the rotation the response to N is variable and it is in these fields that we have the most opportunity to reduce N use by predicting whether or not a field will respond to N fertilizer.
- Though the PSNT is still used, this work showed that weather conditions, particularly wet weather in the spring, provide challenges with the test. In addition, PSNT sampling protocols (12 inch cores within a narrow soil sampling window) limits its adoption.
- The ISNT showed much greater accuracy and carries the benefit of only requiring an 8" soil sampling and having more flexibility regarding the time of year the sample is taken. To assure that the ISNT is only measuring the soil N supply and not measuring N supplied by other sources such as manure or sod, avoid taking samples for the ISNT within 5 weeks after sod plowdown or manure application.
- The End-of-season Stalk Nitrate test proved to be a very useful indicator of the N management on a field for a given season; however, using this tool to guide changes in N management requires 2+ years of data from the same field as year to year variability (such as weather conditions) affect the values.
- The End-of-season Stalk Nitrate test was released for use in NY in the fall of 2007. The ISNT will be released for use in NY in January 2008.

Outreach:

Results were presented in the form of extension articles (What's Cropping Up? and Northeast Dairy Business articles as well as fact sheets and newsletter articles) and through extension presentations (Corn Congress at the Miner Institute; Winter Meetings in Jefferson and St Lawrence Counties). In addition, talks about the project were given at the 2007 Field Crop Dealer Meetings (237 people). Fact sheets on the Late Season Stalk Nitrate Test, Nitrogen Guidelines for Corn, and ISNT were developed and posted on the NMSP website (http://nmsp.css.cornell.edu/publications/factsheets.asp). For further information: NNY extension projects: http://nmsp.css.cornell.edu/projects/nny.asp.

Next steps:

We proposed the following nitrogen project activities for 2008:

(1) ISNT and stalk nitrate assessment: Farms will be selected in five of six NNY counties. All corn fields on the farm will be sampled and analyzed for ISNT, standard soil fertility, and stalk nitrate at the Cornell Nutrient Analysis Laboratory. Farm records will be used to determine field histories. Assessments for ISNT and stalk

nitrate distribution on the farm will be done for each of the farms (whole farm assessment).

(2) Field trial with protected N sources: We will compare ESN and Nutrisphere-N in their effectiveness to reduce N losses and enhance yields for corn production.

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Reports:

Articles in newsletters and popular farm press:

Publication	Article	Author	Issue
Farming	Forages	Ev Thomas	January 2007 (Vol. 10, No.1)
Country Folks	NYFVI-Funded Project Evaluates Economic and Environmental Benefits of Reducing Nitrogen Use on Corn Crop	Kara Dunn	October 16, 2006 (Vol. 32, No.50)
CCE of Jefferson County Ag and Natural Resources	NYFVI-Funded Project Evaluates Economic and Environmental Benefits of Reducing Nitrogen Use on Corn Crop	Kara Dunn	November 2006 (Vol. 8, No.11)
CCE Lewis County Ag Digest	NYFVI-Funded Project Evaluates Economic and Environmental Benefits of Reducing Nitrogen Use on Corn Crop	Kara Dunn	November 2006 (Vol. 12, No.11)
Northeast Dairy Business	Save on Nitrogen Cost	Joe Lawrence and others	February 2007 (Vol. 9, No. 2)
What's Cropping Up	Nitrogen Savings for 1st Year Corn	Joe Lawrence and others	Jan-Feb 2007 (Vol. 17, No. 1)
CCE of Jefferson County Ag and Natural Resources	Nitrogen Needs of 1st Year Corn	Agronomy Factsheet #21	Feb. 2007 (Vol. 9, No. 2)
Dairy and Field Crops News (CNY CCE team)	Nitrogen Savings for 1st Year Corn	Joe Lawrence and others	March 2007 (Vol. 14, No. 1)
Seneca County Ag Alert	Nitrogen on 1st Year Corn.	Mike Dennis	March 2007
CCE Lewis County Ag Digest	Looking to Cut Fertilizer Cost on Corn?	Joe Lawrence	April 2007 (Vol. 13, No. 4)
Ag News (Steuben)	Nitrogen Savings for 1st Year Corn	Joe Lawrence and others	
Country Folks	Nitrogen Needs of 1st Year Corn	Agronomy Factsheet #21	May 2007 (Vol. 33, No. 27)
Country Folks	Looking to Cut Fertilizer Cost on Corn?	Joe Lawrence	May 2007 (Vol. 33, No. 27)

Country Folks	NNY Farmer Happy to Save Money on Not Overfertilizing Corn	NNY	May 2007 (Vol. 33, No. 29)
Empire State Farmer	NNY Farmer Happy to Save Money on Not Overfertilizing Corn	NNY	May 2007 (Vol. 30, No. 10)
Country Folks	On-farm Research Shows Farmers Can Use Less N to Save Money and Reduce Environmental Impact	Eleanor Jacobs and Kara Dunn	August 2007
Cornell Chronicle	On-farm Research Shows Farmers Can Use Less N to Save Money and Reduce Environmental Impact	Eleanor Jacobs and Kara Dunn	June 2007

Scientific Publications:

Lawrence J.R., Q.M. Ketterings, and J.H. Cherney. 2008. Effect of nitrogen application on yield and quality of silage corn after forage legume-grass. Agron. J. 100:73-79.

Agronomy Fact Sheets:

- # 31: Late Season Stalk Nitrate Test (7/21/2007)
- # 21: Nitrogen Needs for First Year Corn (12/18/2006)
- # 35: Nitrogen Guidelines for Corn (12/03/2007)
- # 36: Illinois Soil Nitrogen Test (1/8/2007)

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