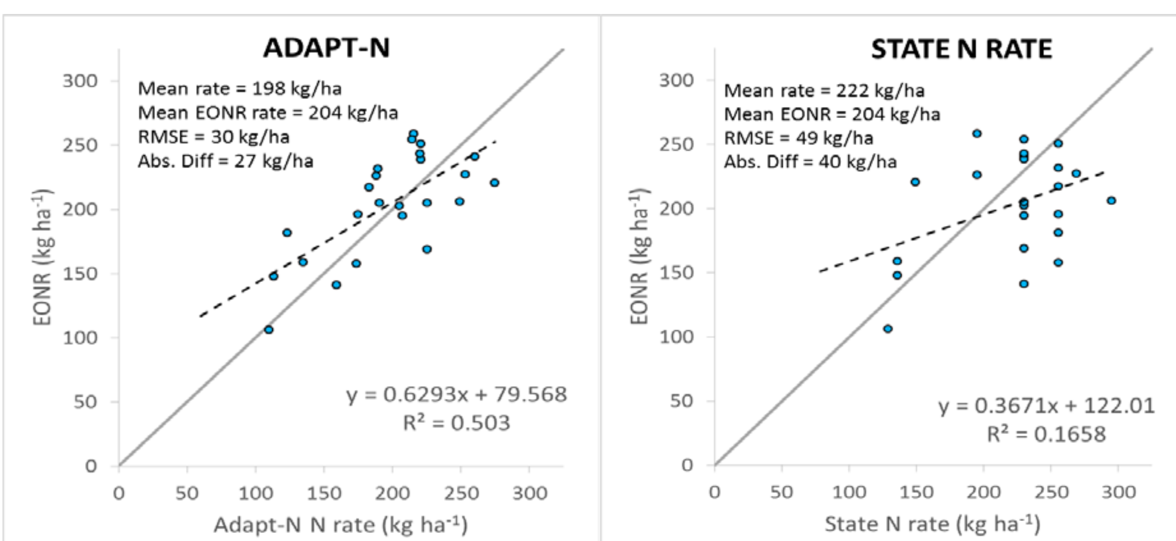
Adapt-N Updates

(Adapt-N.com)

Harold van Es, Shai Sela, Becky Marjerison, Jeff Melkonian, Lindsay Fennel, Aaron Ristow

- Software Updates:
  - VRT utility; integration with other software platforms
  - Enhanced efficiency products
  - Field observations
  - Cover crop version available this fall
- **A**pproved and recommended by NutrientStar program
- Adapt-N vs Grower on-farm strip trials in NY show (WCU 25, 5)
  - Average $26 higher profits with 38% less N applied
  - Average 39% reduced leaching and gaseous N losses
- Adapt-N vs. conventional Cornell N recommendations (CNC) on-farm multi-rate strip trials (WCU 26, 3)
  - CNC under-recommends EONR by 39 lbs/ac with database yield assumptions ($44/ac profit loss); CNC over-recommends by 70 lbs/ac with realistic yield assumption ($38/ac profit loss)
  - Adapt-N under-recommends EONR by 6 lbs/ac ($9/ac profit loss)
- Adapt-N vs. conventional Cornell N recommendations (CNC) lysimeter studies (WCU 26, 2)
  - $34/ac higher profit for Adapt-N; 28% reduction in leaching losses
- Midwest studies (IN, OH, WI), comparing Adapt-N vs. State N rates: 39% improved precision (RMSE):



Use of Adapt-N Results in Better Agronomic and Environmental Outcomes than the Corn N Calculator

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Nitrogen (N) management is important in corn production systems because of the high cost of N fertilization and public concerns over environmental impacts. Corn response to N is highly variable, so determining the optimum N rate is challenging. The economically optimal N rate (EONR) can often range from 0 to as much as 250 lb/acre for a field depending on many soil and management factors, as well as the weather. This variability leads to uncertainty which often results in excessive application of N fertilizer to reduce yield risks, thus adding unnecessary fertilizer costs and increasing the potential for environmental losses.

Several tools are available for growers to determine optimal fertilizer N requirements. These approaches can be categorized as either static or dynamic. Static tools offer generalized recommendations that do not consider seasonal conditions of weather and variation in crop management, while dynamic approaches account for the variable and site-specific nature of soil N dynamics.

This study focuses on two New York nitrogen recommendation tools: the dynamic Adapt-N simulation model and the static Cornell Corn Nitrogen Calculator. We evaluated whether accounting for weather effects and site-specific conditions improves N recommendation rates. The study had two objectives:

a) To compare the N recommendations of the Cornell Corn Nitrogen Calculator and the Adapt-N tools relative to the optimum rate, and

b) To compare the environmental losses resulting from these recommended N rates.

Methods

The Corn N Calculator

The Cornell University Corn Nitrogen Calculator (CNC) is a static approach that includes a calculation of N demand (yield-driven crop uptake) and N supply (soil organic matter, manure, previous crops), combined with efficiency factors. The CNC has been the conventional approach to corn N rate calculations in New York for several decades and estimates can be derived from a spreadsheet downloaded from http://nmsp.cals.cornell.edu/software/calculators.html.

The CNC tool allows the use of either a default yield potential from an embedded database, or a manually entered value for yield potential entered by the user. The CNC default yield potential depends on field soil type and drainage status. For this analysis we generated N recommendations using both the default yield potential and a manually entered realistic yield potential based on grower-estimates from historical yield performance.

The Adapt-N tool

Adapt-N (Adapt-N.com) is a web-based dynamic simulation tool that combines soil, crop and management information with near real-time high resolution weather data to estimate optimum N application rates for corn. It is intended primarily as an in-season tool to provide recommendations for sidedressing. To generate N recommendations, the tool requires user inputs such as achievable yield, soil texture class or soil series name, organic matter content, crop variety, information on previous crops, manure or pre-plant N applications (if applicable), and the field tillage practice. Combining this information with early season weather data was expected to improve the precision of N recommendations and thus maximize farm profits while minimizing environmental N losses.

Data from 16 replicated field trials from multiple locations in New York between 2011 and 2015 were used to compare the sidedress N recommendations generated by the CNC and Adapt-N tools. The CNC tool generates a total N recommendation for the field conditions regardless of the timing of the N application. Therefore, in the case of the CNC tool, if the grower in the experiment opted to apply some of the N rate as a starter or pre-plant, this rate was subtracted from the total N recommendation and the rest was used as sidedress. For the case of Adapt-N, these early applied N rates were included in the simulations used to generate the sidedress recommendations.

Field data

In each of the field trials, multiple N rate applications were used, allowing the EONR of each trial to be calculated

Nutrient Management

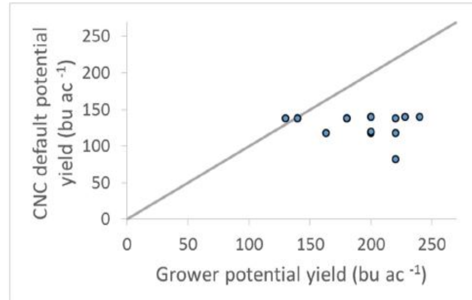

Fig.1 Potential yields estimated by the Grower and those extracted from the CNC database for each field trial.

using quadratic function curve fitting. The economic losses from the EONR resulting from the CNC and the Adapt-N rates were calculated based on a price of $0.50 per lb of N fertilizer and $4.95 per bushel of corn. It should be emphasized that the EONR represents the optimum nitrogen rate that is determined at the end of the growing season. It is therefore a reference point made in hindsight for evaluation of N recommendation tools that are used early in the season when fertilizer needs to be applied.

Estimation of environmental losses

Leaching losses from the bottom of the root zone and gaseous losses to the atmosphere due to denitrification and ammonia volatilization were simulated by the Adapt-N tool. The trials used for the analysis had different N management approaches, depending on collaborator preferences, such as pre-plant N or manure applications in different quantities. While these management decisions might have led to high simulated N losses prior to sidedress time, these losses would have been the same for the Adapt-N and the CNC tools. Therefore, to compare the simulated environmental losses resulting from the Adapt-N or the CNC sidedress recommendations, only the environmental fluxes that occurred after the application of sidedress N and until the end of the year (Dec 31st) are reported.

Results and discussion

Potential yields and N recommendations

Figure 1 presents a CNC comparison between the default potential yields derived for each field and the realistic estimated yields supplied by the grower (Note: the 1:1 line indicates equal values, and data points below the line indicate lower values for the variable on the Y-axis, and vice versa). The potential yields supplied by the CNC tool were significantly lower (130 bu/ac) than the grower estimates (192 bu/ac), which were generally close to the actual achieved yields recorded at the end of the season (189 bu/ac). This indicates that growers generally have a good sense of a field's yield potential and that the default potential yields in the CNC tool are well below the actual yields.

Choosing between Grower-estimated and default potential yield was found to have a strong effect on

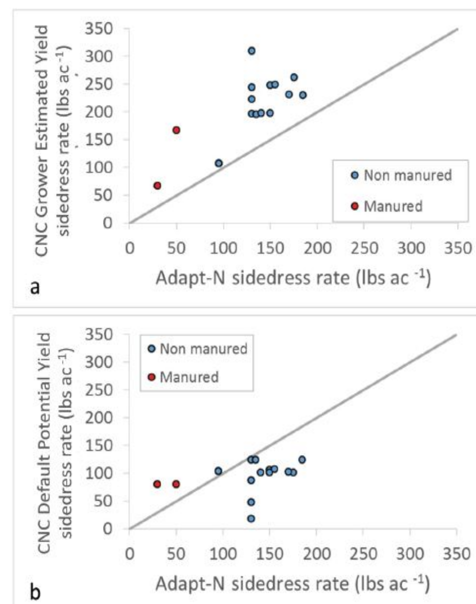

Fig.2 Comparison of sidedress N rate recommended by the Adapt-N and CNC tools. The Adapt-N rate was calculated in both panels using potential yield supplied by the grower. The CNC rate was calculated either using the potential yield supplied by the grower (a) or the default potential yield from the CNC database (b).

the N rates recommended by the CNC, especially comparing both to the Adapt-N rate. Using the realistic, grower-estimated potential yield (Figure 2a), the CNC recommended on average 213 lb N/ac for non-manured trials and 117 lb N/ac for manured trials. The average recommendation rate for Adapt-N, which is driven by the grower-estimated potential yield, was 141 lb N/ac and 40 lb N/ac for the non-manured and manured trials, respectively, a substantial decrease of 72 lb N/ac (51%) and 77 lb N/ac (65%) from the CNC rate.

Using the default potential yield (Figure 2b), the CNC recommended on average 97 lb N/ac for the non-manured trials, a 44 lb N/ac (31%) decrease over the respective Adapt-N rate. For the manured trials the CNC tool recommendation remained higher than Adapt-N's recommendation, with an 80 lb N/ac (100% increase). However, as the CNC sidedress N recommendations result from a possibly outdated potential yield, these rates could be insufficient in fulfilling the actual crop needs, despite the higher recommendation.

Economic analysis

The CNC tool with the default potential yield considerably under-estimated the optimum N rate calculated from the quadratic function response curve, with an average rate of 120 lb N/ac compared with 159 lb N/ac for the EONR (Figure 3a). The lower recommendations lead to an average profit loss from the EONR of $44/ac. Conversely, when the CNC tool was supplied with a more realistic grower-estimated potential yield, the CNC recommendations were found to substantially overestimate the optimum rate, with an average of 229 lb N/ac, or 70 lb N/ac above the EONR (Figure 3b), leading to an average profit loss from the EONR of $38/ac.

Figure 3c presents the relation between the Adapt-N rates and the EONR, and shows that it accurately predicted the EONR with an average N rate of 153 lb N/ac, only slightly below the 159 lb N/ac calculated average value of the EONR. Consequently, the average loss from the EONR was $9/ac for Adapt-N, a significant improvement over the losses from the CNC rates. By basing recommendations on local conditions, Adapt-N improved the accuracy and precision of the N

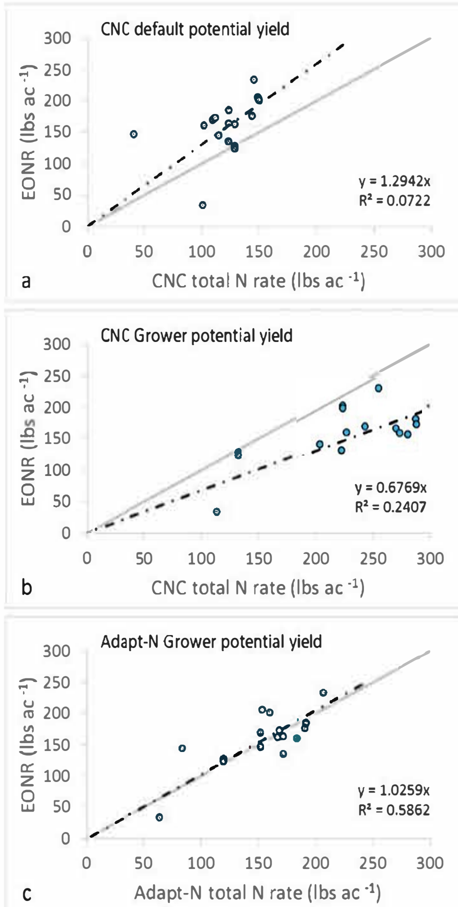

Fig.3 Comparison between the EONR and (a) CNC recommendations based on the default potential yields, (b) CNC recommendations based on the Grower potential yields, and (c) Adapt-N recommended rates.

recommendations in these trials.

Environmental N losses

Simulated environmental losses that occurred following the application of the CNC and Adapt-N sidedress rates were divided almost evenly between leaching and gaseous losses for either tool (Figure 4), which reflects the medium texture of the soil at most sites. Adapt-N rates reduced on average 26 lb N/ac of

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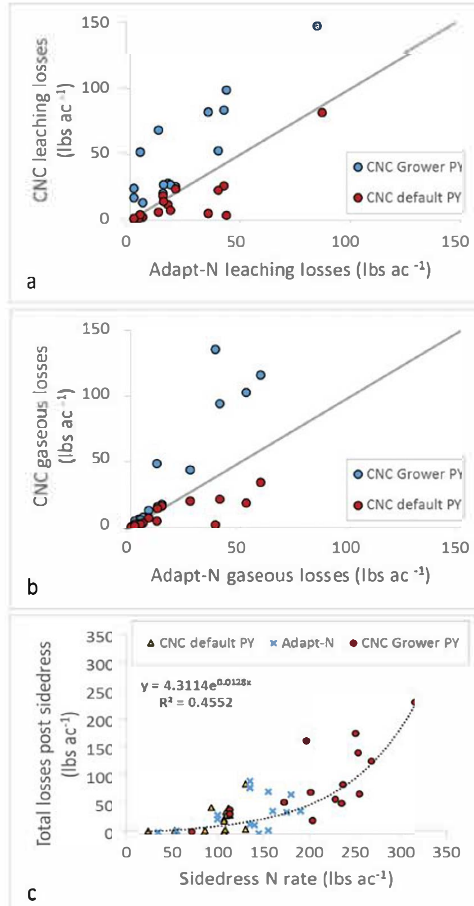

Fig.3 Comparison between the Adapt-N and the CNC simulated leaching (a) and gaseous (b) losses. For the CNC tool, the losses from both the default potential yields and the grower-estimated potential yields are presented. Panel (c) presents the relationship between the total simulated losses post sidedress and the sidedress rate for the two tools.

leaching losses (Figure 4a, 53% reduction) and 21 lb N/ac of gaseous losses (Figure 4b, 54% reduction) compared to the CNC rates with realistic (Grower-estimated) yields. Conversely, when potential yields were derived from the CNC database, the lower CNC N recommendations only marginally reduced the environmental losses compared to the Adapt-N based recommendations (Figure 4a and b, 8 lb/acre, on average).

The relation between total environmental N losses occurring post sidedress and the sidedress rate showed an exponential relationship between application amount and the simulated N losses (Figure 4c). This demonstrates that the relative amount of N lost to the environment is much larger when excessive N rates are applied. Apparently, under-fertilization does not accrue substantial environmental gains while reducing farmer profitability, while over-fertilization increases environmental losses without gaining profitability advantages. The Adapt-N tool was close to the EONR and mostly achieved both objectives.

Conclusions

This study presents a comparison between two N recommendation tools for corn nutrient management: CNC, which uses a static approach, and Adapt-N, which employs a fully dynamic simulation-based approach. Adapt-N recommendations were found to better account for the different production environments and weather effects, and were therefore superior to those of the CNC in terms of profitability and reconstructing the experimental EONR under the different management scenarios. The CNC default potential yield estimates were found to be unrealistically low compared with both the grower-estimated potential yields and the actual achieved yields in the experimental sites. However, using the CNC tool with more realistic grower-estimated yield estimates resulted in a substantial overestimation of the EONR and increased environmental losses. Our results suggest that adoption of a dynamic N recommendation tool in New York can significantly increase farmers' profits while reducing environmental N losses.

A full manuscript of this article titled "Dynamic model improves agronomic and environmental outcomes for Corn N management over static approach" is currently under review by the Journal of Environmental Quality.

Water Quality Impacts Reduced with Adapt-N Recommendations

Nutrient Management

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Soil nitrogen (N) is both spatially and temporally variable, challenging farmers to meet optimal nitrogen (N) needs and minimize N deficiency risk. N typically is a large monetary input for corn production in part due to farmer tendency to over-apply N fertilizer and/or manure to maximize their returns to N applications in the presence of high uncertainty around the optimum N rate. This excessive N maybe be readily lost to the environment through volatilization, runoff and leaching. Not only do N losses negatively impact yield, we know a significant percentage of total N load is carried by ground water or discharged to streams, causing environmental costs. Therefore, a top priority should be the estimation of the optimum N rate that meets crop production needs while minimizing environmental impacts.

The optimum N rate depends on numerous factors including the timing and amounts of early season precipitation events, previous organic and inorganic N applications, soil organic matter, carry-over N from previous cropping seasons, soil texture, rotations, etc. There are several approaches to optimizing N rates and minimize N losses. These can be generally categorized as (i) static and (ii) adaptive. Static tools offer generalized recommendations that do not consider seasonal conditions of weather and soil/crop management, while adaptive approaches account for the variable and site-specific nature of soil N dynamics, including the effects of weather. Using data from two seasons of corn silage grown at the Cornell University research farm at Willsboro, NY, we compared the economic and environmental impacts of N rate recommendations from a conventional static approach (the *Cornell Corn Nitrogen Calculator; CNC*) with the adaptive *Adapt-N* approach (adapt-n.com).

Adapt-N and the Cornell Corn Nitrogen Calculator

The Cornell University Corn Nitrogen Calculator (CNC) is a static approach that includes a basic mass balance calculation of N demand (yield-driven crop uptake) and N supply (soil organic matter, manure, previous crops), combined with efficiency factors. The CNC approach has been the established corn N recommendation approach for several decades, and estimates can be derived from a spreadsheet downloaded from http://nmsp.cals.cornell.edu/software/calculators.html.

Adapt-N is a dynamic simulation tool that combines soil, crop and management information with weather data to estimate optimum N application rates for corn. Originally developed at Cornell University, the tool has been licensed for commercial use and is currently calibrated for use on about 95% of the US corn production area. When using the tool to inform in-season N application rates, early season weather effects and site-specific attainable yield can be incorporated into the recommendation, allowing N management precision to be improved.

The Adapt-N tool was compared to CNC recommendations in a spatially-balanced complete block design (4 replications) on two paired experimental sites for the 2014 and 2015 growing seasons. In each trial, the treatments were defined by the total amount of N applied, where the rates were:

(i) the total N rate based on Adapt-N recommendations (including a 15 lbs/ac starter) for the date of sidedress, and

(ii) the total recommended rate of the Cornell Corn Nitrogen Calculator (including a 15 lbs/ac starter), using realistic yield goals (rather than the database yield goals, which would have underestimated real yields for these sites).

The treatments were implemented on 16 plots, each on a Cosad loamy fine sand and a Muskellunge clay loam, in continuous corn (silage), under no-till and plow-till management. Drainage water samples were collected from the lysimeters at key time points in the spring (April 7th and April 23rd) and fall (October 1st, October 29th, and December 3rd). The lysimeters include drainage lines routed to a utility hole to allow for drain water samples to be collected. Nitrate (NO3) and Nitrite (NO2) concentration was quantified from the samples to allow us to assess differences in water quality in Adapt-N vs CNC plots. In this article, we will refer to NO3+NO2 concentrations simply as NO3 or "nitrate", as the NO2 fraction is typically very small.

At the end of the 2014 and 2015 seasons, we measured

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corn yields and calculated associated partial profit differences for the two treatments. Corn yields were assessed by representative sampling (four 15 ft long row sections per plot). Partial profit differences between the Adapt-N and CNC practices were estimated using prices of $0.50/lb N and $50/T silage.

Results

Yield and Profit: The measured agronomic and leaching losses of the two recommendation approaches are presented in Table 1. Adapt-N recommended N rates were substantially lower than the CNC rates with an average reduction of 55 lbs/ac (183 vs 126 lbs/ac), while the average yields did not differ significantly (13.0 vs 13.1 T/ac; p=0.74). Reducing N rates without compromising yields resulted in $34/ac higher partial profit from the Adapt-N treatment. The economic and agronomic benefits of Adapt-N are similar to those from a larger study conducted in IA and NY using data from 113 on-farm trials (Sela et al., 2016).

Lysimeter measured nitrate concentrations: In addition to the economic benefits, substantial environmental advantages were found with Adapt-N. When both seasons and soil textures were combined, the average NO3 concentration from the grab samples collected from the lysimeters indicated significantly lower water quality impacts under Adapt-N management vs CNC (11.0 and 15.3 mg/L, respectively; p<0.01). On average there was a 28% reduction in NO3 concentration from the Adapt-N treatments. When analyzing the clay loam and loamy sand plots separately but still combining the two seasons, NO3 concentration was significantly higher in the CNC loamy sand treatments (20.1 vs 13.7 for Adapt-N; p<0.01) and they trended toward higher concentrations in the clay loam treatments (10.0 vs 8.0 for Adapt-N; p=0.09).

Figure 1 shows nitrate concentrations for each drain water sample. Generally, there was a large range of losses throughout the year, but they trended up with more applied N. As could be expected, we saw that the loamy sand plots had higher losses, regardless of treatment, due to the lower water holding capacity of the coarse textured soil. Similarly, NO3 concentrations from the clay loam plots were less responsive to the amount of applied N compared to the sandy plots, but there were still substantial losses, especially at the higher rates. We conclude that the lower applied N rate in the Adapt-N treatments resulted in an overall lower concentration of NO3 in leachate from the lysimeters.

Conclusions

This study proves both economic and environmental gains from using Adapt-N's adaptive approach to estimating in-season N rates across two distinct soil types in Northern New York. In all, the Adapt-N recommended rates were lower than the CNC rates but maintained the same yield and showed greater profits. Overall, the use of Adapt-N can significantly contribute to nitrogen reduction goals by reducing overall inputs, minimizing environmental losses, and improving farmer profits.

Acknowledgements

This work was supported by funding from the USDA-NRCS, New York Farm Viability Institute, USDA-NIFA, and USDA-Sustainable Agriculture Research and Extension, and the Northern New York Agricultural Development Program.

Table 1 2014 and 2015 growing season comparison of N application rates, yield, partial profits, and NO3 concentration. Water quality samples were taken in the spring and fall of 2015 (after the 2014 and 2015 growing seasons, respectively).

Texture	#	Total N Applied (lb/ac)			Yield (T/ac)				Profit ($/ac)			NO_3 Concentration (mg/L)			
	n	Adapt-N	CNC	Diff (A-CNC)	Adapt-N	CNC	p-value	Diff (A-CNC)	Partial profit Adapt-N	Partial profit CNC	Diff (A-CNC)	Adapt-N	CNC	p-value	Diff (A-CNC)
Clay Loam	*22*	134	194	-60	12.5	11.9	0.29	0.6	656	643	12	8.0	10.0	0.09	-1.9
Loamy Sand	*30*	123	175	-52	13.3	14.0	0.12	-0.7	608	552	56	13.7	20.1	<0.01	-6.4
Clay and Sand	*52*	128	183	-55	13.0	13.1	0.74	-0.1	632	598	34	11.0	15.3	<0.01	-4.3

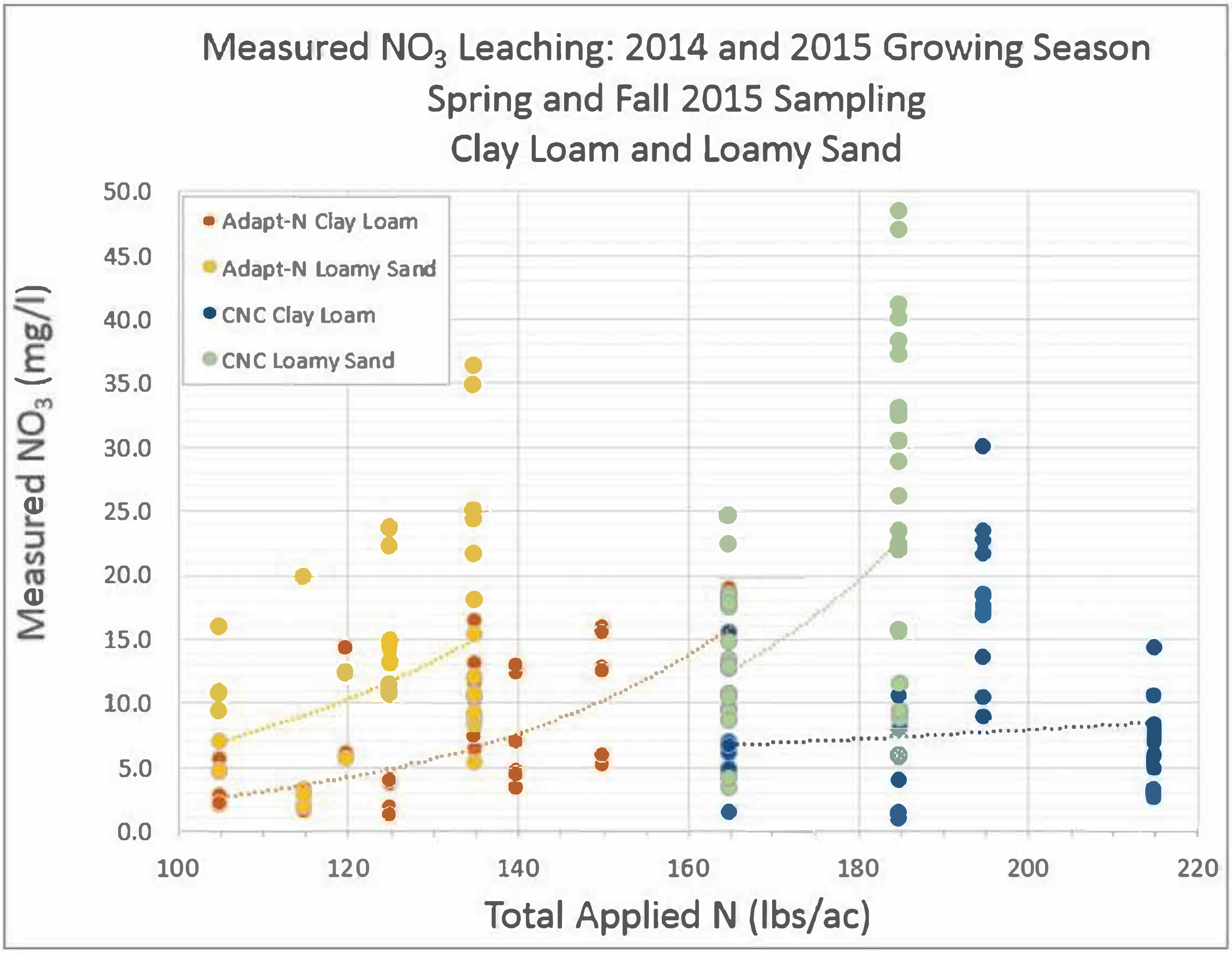

Fig. 1 Total Applied N recommended from two tools (Adapt-N and CNC) compared with measured NO3 leaching concentrations over two seasons from two soil textures. In general the Adapt-N recommended lower N applications resulted in lower average NO3 concentrations, and the loamy sand showed greater leaching losses with increasing N rates than the clay loam.

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Cornell Soil Health Lab Updates

(http://soilhealth.cals.cornell.edu/)

Bob Schindelbeck, Aaron Ristow, Kirsten Kurtz, and Harold van Es

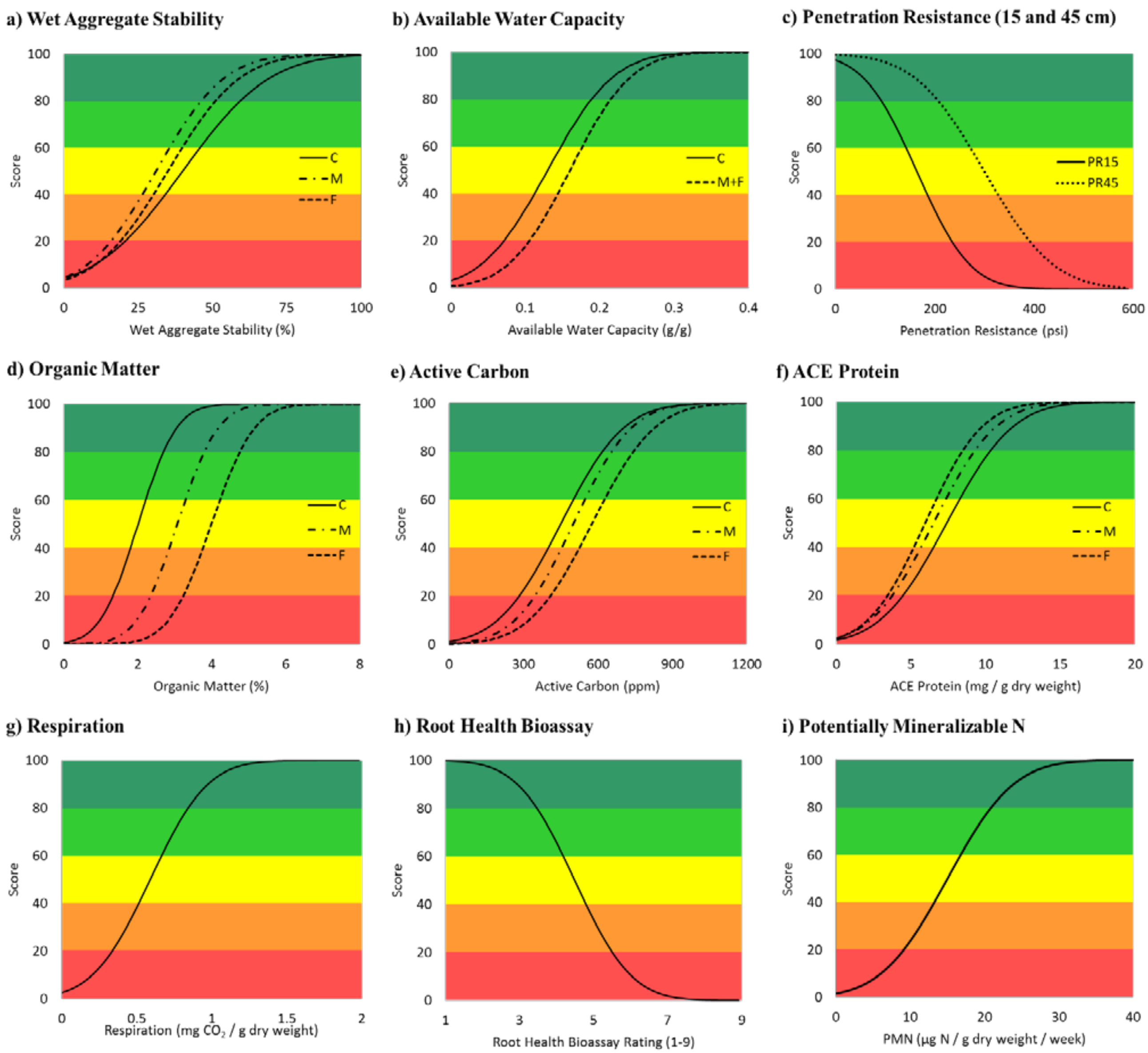
- New soil health training manual available on-line.
- New web-based software for sample submission and reporting
- New report format
- Updated scoring functions based on data analysis from ~7,000 samples.
- New scoring functions for different Major Land Resource Areas (Northeast, Midwest, Mid Atlantic).
- Newly created Soil Health Institute works with NRCS, Cornell University and other research scientists to develop a national soil health test, mostly based on the Cornell framework.

Mean and standard deviation for soil health indicators, based on analysis of ~7,000 samples. Soil health score equals 50 for mean value (Fine et al., 2016).

	Texture		
Soil Health Indicator	**Coarse**	**Medium**	**Fine**
Aggregate Stability (%)	52.2 (23.8)	42.2 (24.7)	41.8 (20.0)
Available Water Capacity (g g^{-1})	0.152 (0.068)	0.208 (0.068)	0.219 (0.060)
Penetration $Resistance_{15}$ (psi)	168 (96)	161 (90)	161 (95)
Penetration $Resistance_{45}$ (psi)	319 (93)	296 (108)	297 (138)
Organic Matter (%)	3.26 (1.89)	3.75 (1.52)	4.42 (1.36)
Active Carbon (mg kg^{-1})	486.7 (243.0)	531.2 (182.2)	608.7 (168.4)
Protein (mg g^{-1})	10.2 (5.7)	7.0 (4.4)	5.7 (2.4)
Respiration (mg CO_2 g^{-1})	0.64 (0.39)	0.62 (0.31)	0.61 (0.27)
Root Health Bioassay (1-9)	4.5 (1.2)	4.4 (1.2)	4.3 (1.2)
Pot Mineralizable N (μg N g^{-1})	14.2 (16.2)	17.2 (20.7)	19.5 (15.2)

Updated Soil Health Scoring Curves

(Fine et al., 2016)



Previous Format

2016 Format

Cornell Soil Health Assessment

Corey Corn
123 Horizon Rd
New Iowa, NY, 13026

Agricultural Service Provider:
Doe, John
Assessments Inc.
john@doe.com

Sample ID:	S_1
Field/Treatment:	West Upper
Tillage:	7-9 inches
Crops Crown:	COG, COG, COG
Date Sampled:	5/1/2015
Given Soil Type:	Lima
Given Soil Texture:	Silt Loam
Coordinates:	42.44790 °N; 76.47570 °W

Measured Soil Textural Class: Silt Loam **Sand: 37%** **Silt: 53%** **Clay: 10%**

Test Results

	Indicator	Value	Rating	Constraint
Physical	Available Water Capacity	0.15	42	
Physical	Surface Hardness	87	84	
Physical	Subsurface Hardness	290	50	
Physical	Aggregate Stability	22.0	22	Aeration, Infiltration, Rooting, Crusting, Sealing, Erosion, Runoff
Biological	Organic Matter	2.9	32	
Biological	ACE Soil Protein Index	4.5	26	Organic Matter Quality, Organic N Storage, N Mineralization
Biological	Respiration	0.39	23	Soil Microbial Abundance and Activity
Biological	Active Carbon	450	27	Energy Source for Soil Biota
Chemical	pH	6.9	100	
Chemical	Phosphorus	4.5	100	
Chemical	Potassium	67.8	93	
Chemical	Minor Elements Mg: 419 Fe: 1.1 Mn: 12.9 Zn: 1.9		100	

Overall Quality Score 58 Medium

Comprehensive Assessment of Soil Health

From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. http://soilhealth.cals.cornell.edu

Grower:
Corey Corn
123 Horizon Rd
New Iowa, NY 13026

Agricultural Service Provider:
John Doe
Assessments, Inc.
john@doe.com

Sample ID:	S1
Field ID:	West Upper
Date Sampled:	05/01/2015
Crops Grown:	COG/COG/COG
Tillage:	7-9 inches

Measured Soil Textural Class: **silt loam**

Sand: **37%** - Silt: **53%** - Clay: **10%**

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.15	43	
physical	Surface Hardness	87	81	
physical	Subsurface Hardness	290	53	
physical	Aggregate Stability	22.0	30	
biological	Organic Matter	2.9	45	
biological	ACE Soil Protein Index	4.5	27	
biological	Soil Respiration	0.4	24	
biological	Active Carbon	450	39	
chemical	Soil pH	6.9	100	
chemical	Extractable Phosphorus	4.5	100	
chemical	Extractable Potassium	67.8	93	
chemical	Minor Elements Mg: 419.0 / Fe: 1.1 / Mn: 12.9 / Zn: 1.9		100	

Overall Quality Score: **61** / Excellent

As part of the CASH Report Summary indicator scores are assigned a color rating. (Left) The assessment traditionally used a three color system (red, yellow, green for low (0-30), medium (30-70), and high (70-100), respectively). In 2016 the report began using a five-color system – red (0-20), orange (20-40), yellow (40-60), light green (60-80), and dark green (80-100) for very low, low, medium, high, and very high, respectively.

Musgrave Farm- Field E

Lima silt loam soil
Long-term tillage trial
COG/COG/COG

- **Moldboard PLOW**
- Chisel till
- Ridge till
- **ZONE till**

2012-15 Tillage effects on grain yields (bu/A)

	2012	2013	2014	2015	AVG.
PLOW till	**147.7**	**173.4**	**178.5**	**93.6**	**148.3**
ZONE tlll	**167.2**	**197.1**	**174.5**	**105.7**	**161.1**

2015 Nitrogen response grain yields (bu/A)
140 bu/A yield target, planted 6-20-15

		Adapt-N	NCALC
	0#N	**75# N**	**125# N**
PLOW till	**84.5**	**109**	**113.9**
ZONE till	**97.5**	**111.5**	**109.2**

Cover crop interseeding exp.

- Split-plot design, sown at sidedress
- Cocktail mix- vetch, clover, ryegrass
- Soil health parameters effect on soil N response and yield
  - Increasing water holding capacity, aggregate stability
  - Increasing organic matter- active carbon, soil protein, soil respiration

- Cover crop effects on soil nitrogen and yield (Adapt-N calib.)

	NO cover crop			WITH cover crop		
		Adapt-N	NCALC		Adapt-N	NCALC
	0#N	**75# N**	**125# N**	**0#N**	**75# N**	**125# N**
PLOW till	**84.5**	**109**	**113.9**	**91.7**	**119.2**	**126.2**
ZONE till	**97.5**	**111.5**	**109.2**	**114.3**	**120**	**126**

School of Integrative Plant Science
Soil and Crop Science section

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Comprehensive Assessment of Soil Health

From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. http://soilhealth.cals.cornell.edu

Grower:
Bob Schindelbeck
1004 Bradfield Hall
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Sample ID:	NN2190
Field ID:	Aur E PLOW TILL NO COVER CROP
Date Sampled:	05/25/2016
Given Soil Type:	Lima
Crops Grown:	COG/COG/COG
Tillage:	7-9 inches

Long term moldboard plow
NO cover crop

Measured Soil Textural Class: **loam**
Sand: **40%** - Silt: **38%** - Clay: **21%**

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.13	32	
physical	Surface Hardness	270	10	Rooting, Water Transmission
physical	Subsurface Hardness	350	32	
physical	Aggregate Stability	17.0	21	
biological	Organic Matter	2.5	28	
biological	ACE Soil Protein Index	3.5	18	Organic Matter Quality, Organic N Storage, N Mineralization
biological	Soil Respiration	0.4	30	
biological	Active Carbon	310	15	Energy Source for Soil Biota
chemical	Soil pH	7.9	0	High pH: Toxicity, Nutrient Availability
chemical	Extractable Phosphorus	6.9	100	
chemical	Extractable Potassium	91.2	100	
chemical	Minor Elements Mg: 349.9 / Fe: 0.8 / Mn: 5.6 / Zn: 0.4		100	

Overall Quality Score: **41** / Medium

Musgrave Farm
Field E
Sampled 5-25-16
Lima silt loam soil
COG/COG/COG

Increasing:
Soil water storage
Aggregate stability

Increasing:
Organic matter
Soil protein
Active carbon
Respiration

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Grower:
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Sample ID:	NN2193
Field ID:	Aur E ZONE TILL WITH COVER CROP
Date Sampled:	05/25/2016
Given Soil Type:	Lima
Crops Grown:	COG/COG/COG
Tillage:	no till

Zone till
WITH interseeded cover crop 2013-15

Measured Soil Textural Class: **loam**
Sand: **42%** - Silt: **38%** - Clay: **18%**

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.18	60	
physical	Surface Hardness	280	8	Rooting, Water Transmission
physical	Subsurface Hardness	350	32	
physical	Aggregate Stability	57.6	93	
biological	Organic Matter	2.9	44	
biological	ACE Soil Protein Index	4.6	28	
biological	Soil Respiration	0.6	47	
biological	Active Carbon	520	54	
chemical	Soil pH	7.7	0	
chemical	Extractable Phosphorus	8.8	100	
chemical	Extractable Potassium	77.8	100	
chemical	Minor Elements Mg: 337.8 / Fe: 0.6 / Mn: 4.4 / Zn: 0.3		100	

Overall Quality Score: **56** / Medium

Precision Agriculture Plan for NYS

Harold van Es, Joshua Woodard and Michael Glos

- PA defined as "the use of advanced technologies to precisely match agricultural inputs with needs". This applies to crop and animal systems, and reflects an approach that moves from generalized (field, herd, annual, etc.) towards more specific, individualized, and real-time management.
- Full day workshop in December, 2015 in Geneva and all day session at the 2016 New York Farm Show
- Discussion of PA technologies on different farm types
- Current state of PA in New York; survey of NY farmers
- Technological and socio-economic barriers
- Recommendations for advancing PA in New York

Selected results of online survey of NY producers about their use of Precision agriculture, based on 182 useable responses.

- Corn and soybean producers are the largest adopter of high-precision GPS services (RTK, DGPS etc.) among other agricultural goods producers with nearly 40% of the respondents using it.
- Within the corn and soybean producers, access to high speed internet on the farm is high, nearly 90% among the 38 respondents while over 94% of the other row cop producers have high speed internet.
- Use of Yield monitors, with or without GPS, is high among the corn and soybean producers compared to the other producers, almost 34% compared to 9% among all other respondents.
- 32% of corn/ soybean producers use field imagery from satellite, planes or UAVs, while juice and wine grape producers are the most prolific users (47%)
- 32% of juice and wine grape producers use soil maps created by grid soil tests or electrical conductivity measurements with GPS compared to only 18% of corn and soybean producers.
- Corn and soybean producers are, by far, the largest users of variable rate chemical applicators with GPS, auto steer technology and soil mapping using soil tests with 29%, 34% and 47% respectively answering positively.
- Corn and soybean producers adopt PA for higher profits (81%), reduced environmental impacts (60%) and personal time savings (58 %)