

Eco^N
an ecological nutrient system



adapt-N

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- Set the standard for nitrogen modeling
- Built on 10+ years of land-grant research
- Demonstrated to improve grower profit while reducing N loss
- 100% independent, unbiased, and transparent
- Designed for agronomists, recognized by the industry



A Systems Approach

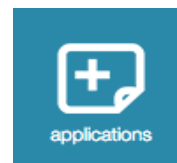
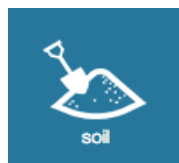


an ecological nutrient system

- Nitrogen Modeling
- Nitrogen Stabilizers
- Plant Tissue Sampling/nutrient balancing
- Imagery
- Soil Health
- EC
- Zone Management

Adaptive N Management

User
Inputs:



Adapt-N
Simulations:

High-Resolution Climate Data
(Precip, Temp, Solar Radiation)

Multiple Interrelated Software Models

- Crop growth, N uptake, N loss, manure, etc.
- 2,000+ proprietary soil dictionary records



Results for
every field:



RECOMMENDATION

- Daily recommendations
- PDF reports
- Shapefile + agX export
- Interactive graphs
- N-Alerts
- Prior-season analysis

Soil and Agronomic inputs

- Soil Type/Texture/Rooting depth (based on NRCS databases)
- Slope
- Soil Organic Matter
- Prior crop info
- Planting info, expected yield
- Tillage method and details
- Existing and expected applications:
 - Nitrogen rate, type, placement, date, stabilizer
 - Manure type, rate, incorporation, and analysis
 - Irrigation

PNM model: The core of the *Adapt-N* tool

- Based on long-term modeling efforts at leading international institutions (Cornell, USDA-ARS, Rothamstead) going back to the 1980's
- Includes comprehensive literature knowledge
- Calibrated and tested with extensive field studies
- Accesses high-resolution weather data and extensive soil databases

Hutson, J.L., R.J. Wagenet, and M.E. Niederhofer. 2003. Leaching Estimation And Chemistry Model: a process-based model of water and solute movement, transformations, plant uptake, and chemical reactions in the unsaturated zone. Version 4. Dept of Crop and Soil Sciences. Research Series No. R03-1. Cornell University, Ithaca, NY, USA.

Sinclair, T.R., and R.C. Muchow. 1995. Effect of nitrogen supply on maize yield: I. modeling physiological responses. *Agronomy Journal* 87:632-641.

summary

land

soil

crop

applications

settings

RECOMMENDATION

Created for 2015-Jul-27.

60 lbs N/Acre
Sidedress N Recommendation

58 - 65
Rec Range (lbs N/Acre)

30 lbs N/Acre
N Fertilizer Already Applied

Recommendation based on 2015's configuration and the simulation year's supporting estimates, and assumptions:

164 lbs N/Acre Expected N in crop at harvest	24 lbs N/Acre N mineralization so far	36 lbs N/Acre N loss so far
0 lbs N/Acre Partial credit from soybeans	86 lbs N/Acre N in crop now	2 lbs N/Acre Expected Future Fertilizer Loss
9 lbs N/Acre Future Net N Credits	3 lbs N/Acre N in soil now	16.5"/21.9" Rainfall since planting / since 01/01/15
1 lbs N/Acre Current Nitrate N top 12" Virtual PSNT: 0.2 ppm	6.6"/6.6" Water in root zone / field capacity	3 lbs N/Acre Root zone inorganic N

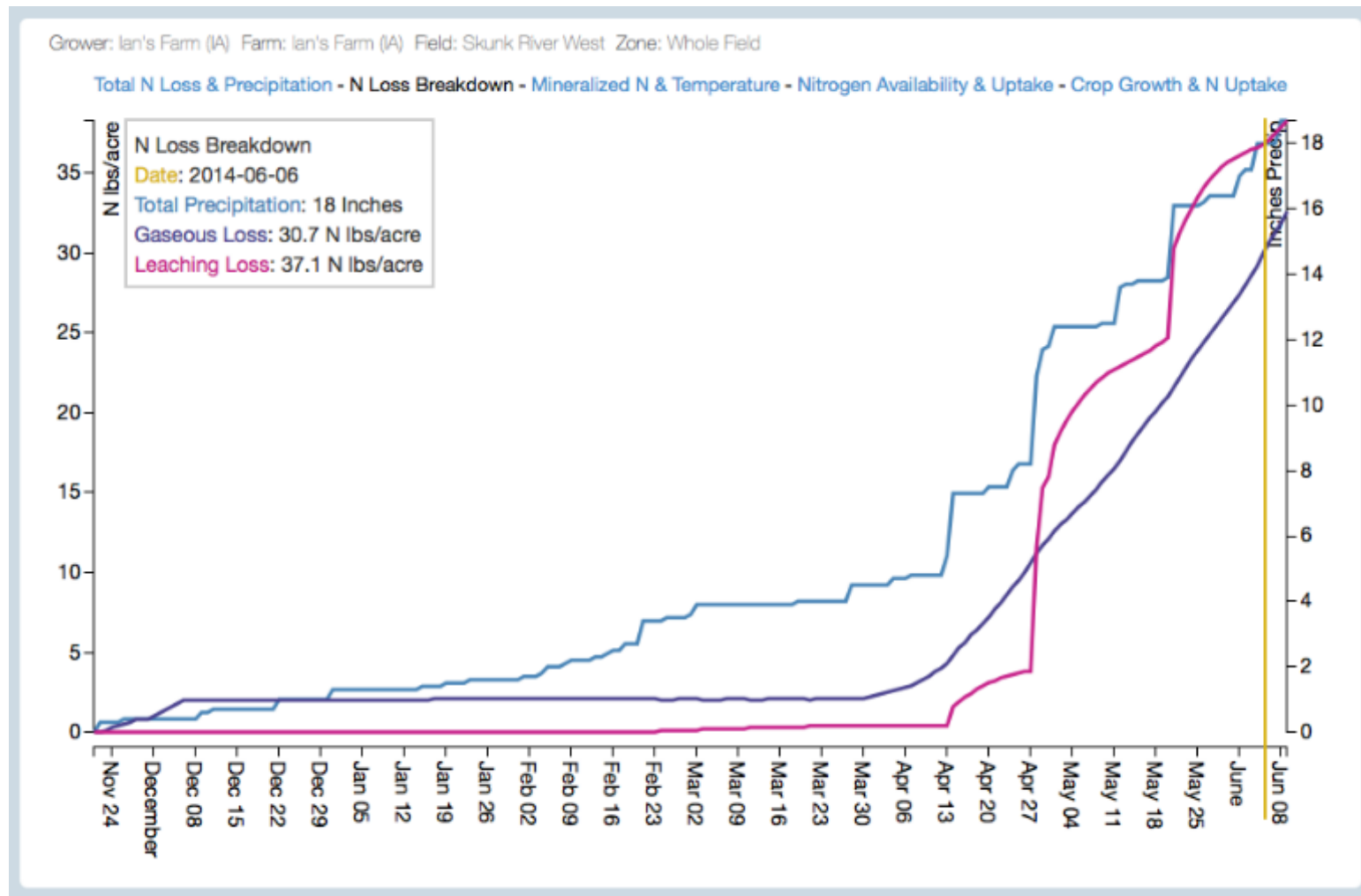
Farm: FIPS 125 - Marion
 Field: Knoxville
 Zone: vrt148 (2015)

Soil Type: Ladoga
 Planted: 2015-05-05
 Growth Stage: V18

Google Map Data Terms of Use

Detailed support for all recommendations gives users key insights into our modeling results so ground observations and other tools can be used in complement.

Graphs for detailed insight



The screenshot displays the EcoN web application interface. On the left is a vertical navigation menu with icons for 'summary', 'land', 'soil', and 'crop'. The main content area is titled 'FIELD RECOMMENDATION' and shows a recommendation for 07/28/2015: **0 / 41 / 95 / 1,100** lbs N/acre (min/avg/max/total). Below this, field details are listed: Grower FIPS 19 - Iowa, Farm FIPS 125 - Marion, Field Knoxville, and Acres 34. A 'FIELD CONFIGURATION' section at the bottom shows the 'Planting Date' as 05/05/2015. A calendar for July 2015 is open, showing the date 07/28 selected. To the right of the calendar is a satellite map of the field with a grid overlay, and a Google Maps interface with navigation controls.

FIELD RECOMMENDATION

Recommendation for 07/28/2015
0 / 41 / 95 / 1,100
lbs N/acre (min/avg/max/total)

Grower FIPS 19 - Iowa
Farm FIPS 125 - Marion
Field Knoxville
Acres 34

FIELD CONFIGURATION

Planting Date 05/05/2015

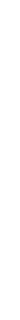
Calendar: July 2015

Su	Mo	Tu	We	Th	Fr	Sa
28	29	30	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1
2	3	4	5	6	7	8

Select from historical weather years to compare recommendations under different scenarios

Adapt-N Strip Trials

Validating and Improving the Tool



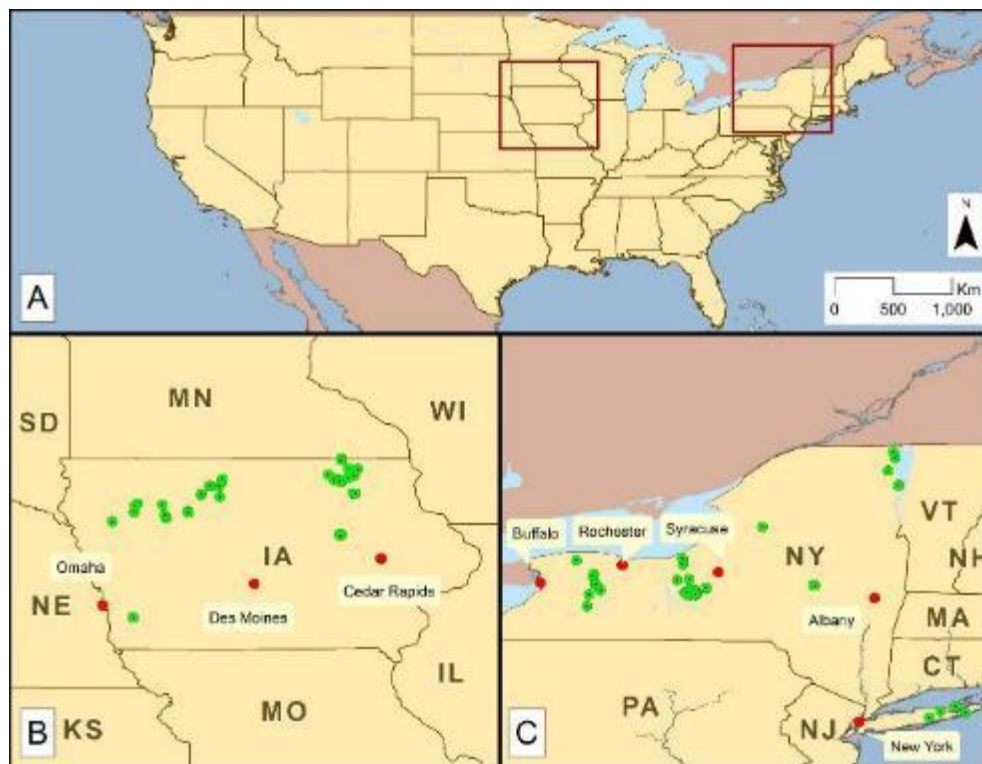
Adapt-N Model Calibration and Testing

- 200+ Cornell University-coordinated replicated strip trials in 10 states (Midwest, Northeast, Mid-Atlantic, Southeast)
- In collaboration with researchers and consultants
- Adapt-N vs. Grower rates or Multi-rate N response trials
- Additional “informal” testing
- Funded by many organizations



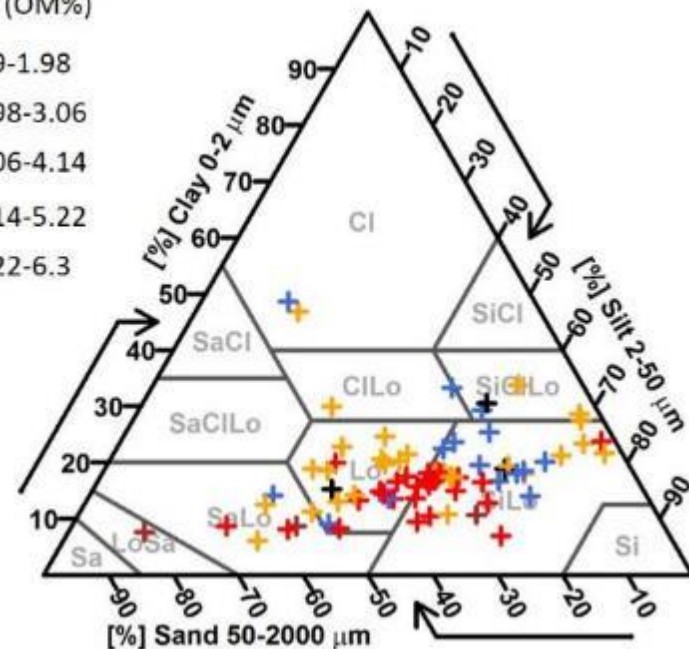
2011-14 Grower vs Adapt-N Strip Trials

Iowa and New York (n=115)



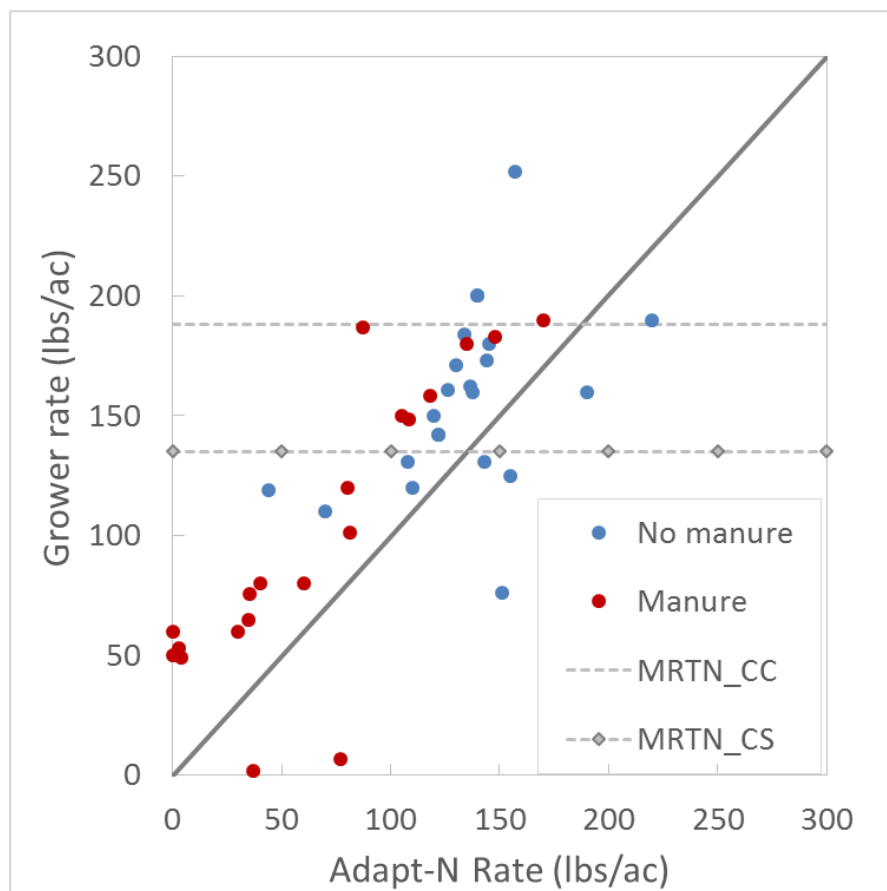
Legend (OM%)

- 0.9-1.98
- 1.98-3.06
- 3.06-4.14
- 4.14-5.22
- 5.22-6.3

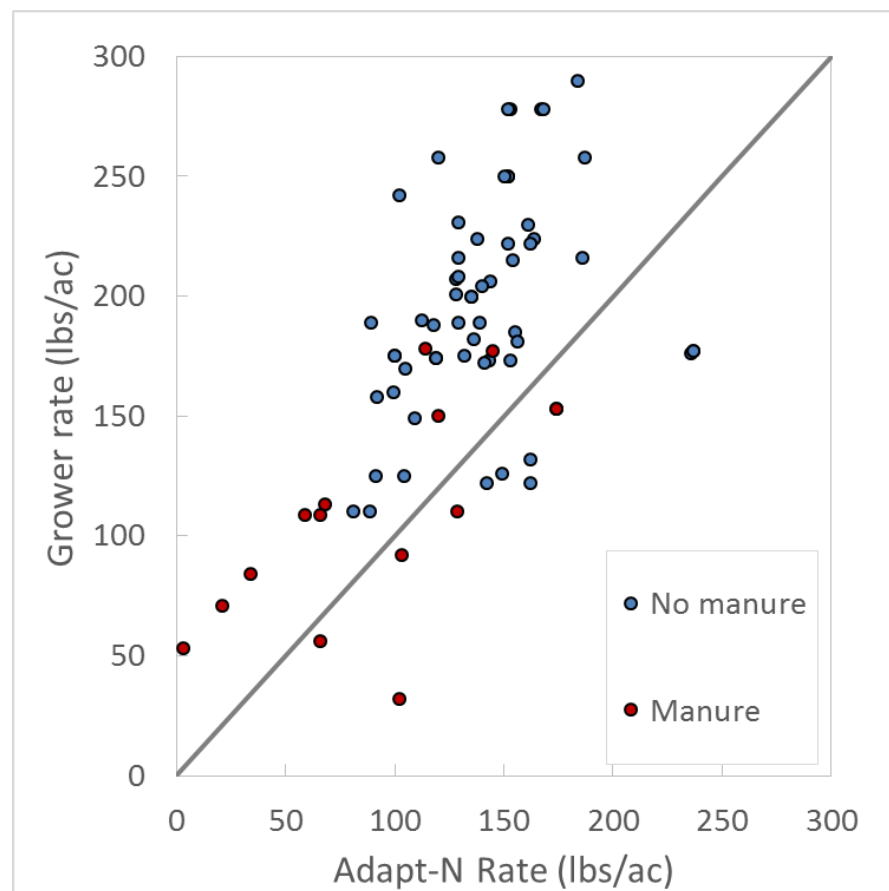


Grower vs Adapt-N Rates

Iowa

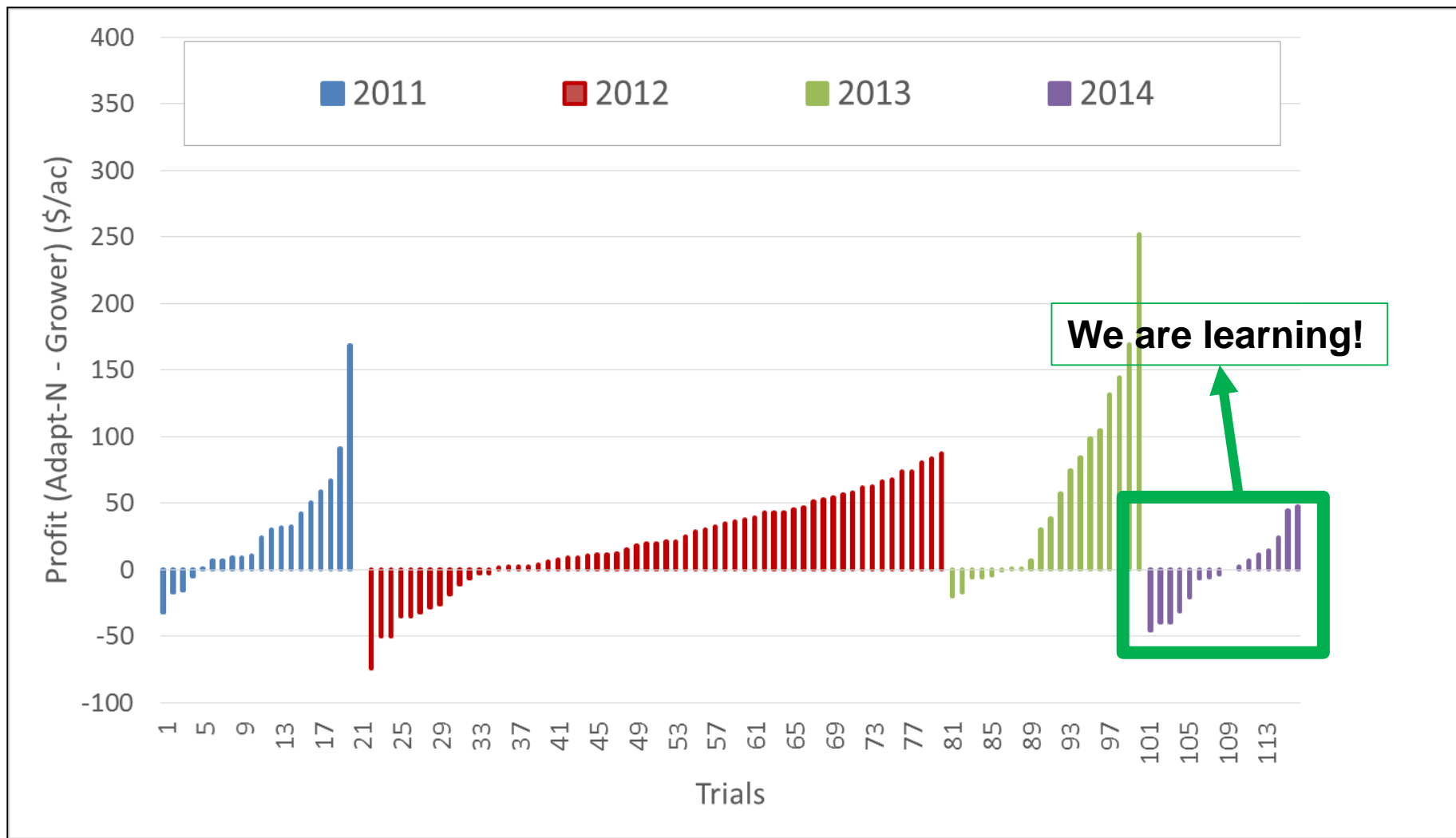


New York



Profit differences for 2011-2014 strip trials in NY and IA

Comparing Adapt-N rate recommendations with Grower rates



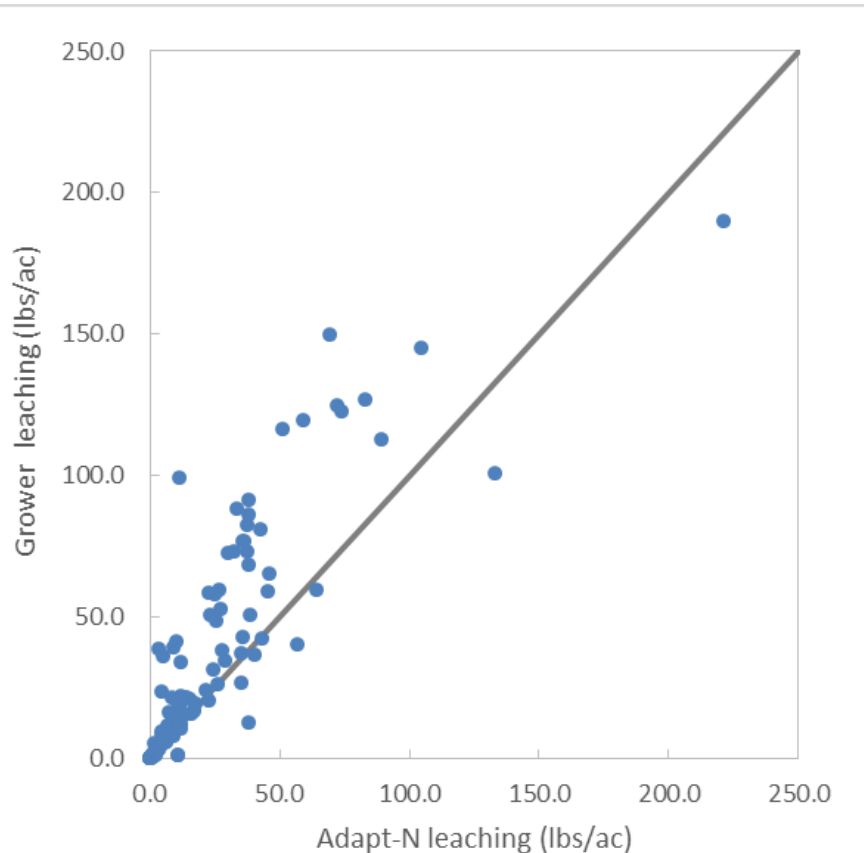
Comparison of Adapt-N and Grower N rates

2011-14 on-farm strip trials in Iowa and New York

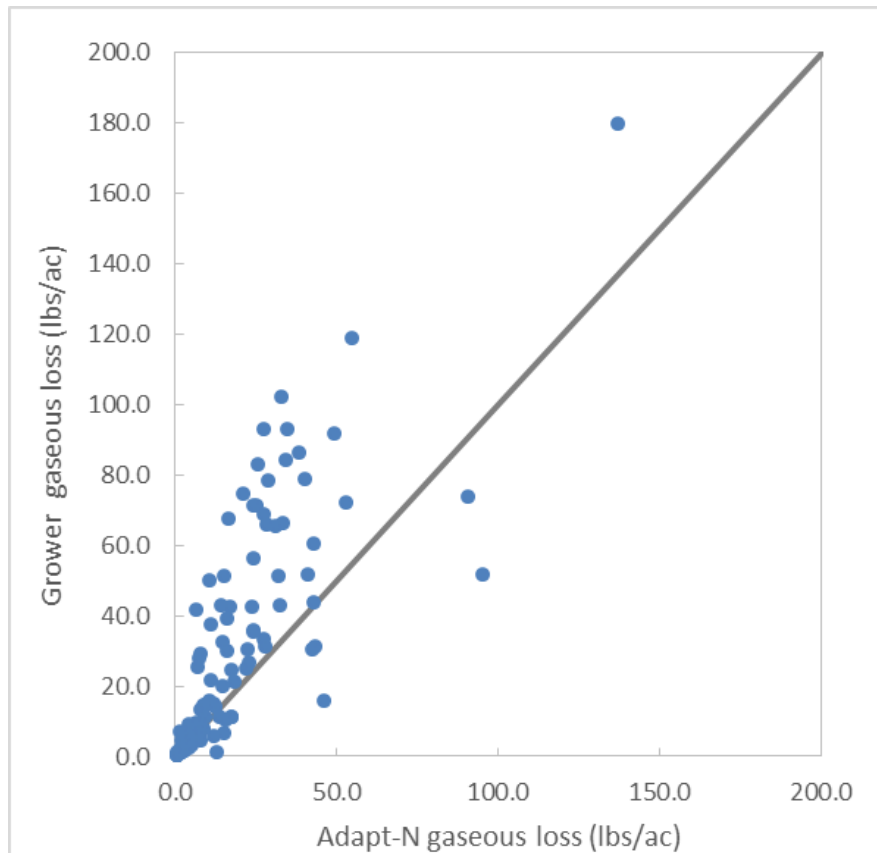
State-Year	NY2011	NY2012	NY2013	NY2014	IA2011	IA2012	IA2013	Mean
N input diff (lbs/ac)	-62.7	-66	19.1	-32.6	-16.7	-27.6	-19.3	-29.4
Yield diff (bu/ac)	-0.05	-1.85	20.60	-3.20	1.90	-0.45	0.50	2.49
Profit diff (\$/ac)	\$34.1	\$23.93	\$93.63	\$0.95	\$21.6	\$14.35	\$12.2	\$28.68

Comparison of Adapt-N and Grower N rates: Simulated environmental losses from applications Iowa and New York Trials 2011-14

Leaching losses reduced by 35%



Gaseous losses reduced by 40%



A Systems Approach



Adapt-N-Recommendation Methodology

$$\begin{aligned} \text{N Rate} = & \\ & \text{Expected N in Crop} \\ & - \text{N in Crop Now} - \text{N in Soil Now} \\ & - \text{Prior Crop Credit} \\ & - \text{Net N Future N Losses and Gains} \\ & - \text{Price-Profit-Risk Factor} \end{aligned}$$

Input: Expected Yield

Simulation based on actual real-time weather

Partial simulation, partial fixed credit

Probabilistic simulations based on historical weather

Probability-uncertainty simulations