Annual Report to the International Plant Nutrition Institute for Funds Provided for

Beta-testing the Adapt-N tool in On-farm Strip Trials

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Since the spring of 2013, we have made significant progress in gathering a third year of data for calibration and validation through on-farm beta-test trials, and improving the Adapt-N tool. We have also made tremendous progress in educating stakeholders about the importance of adapting N inputs in corn systems to weather impacts by moving to dynamic N rate decisions made at sidedress time. At this point it appears that Adapt-N can save growers money: $20 - $30 per acre in dry years can be expected, but potentially much more in a wet year when the profit gains come from avoiding yield loss. In 2011-12 growers prevented excessive N inputs (on average 54 lb per acre), while in 2013 growers learned hard lessons about their poor N timing practices such as applying the bulk of their N as pre-plant or as starter fertilizer. In many cases, growers who applied most of their N early had significant losses, and needed to apply further N to avoid yield loss. Many such growers are now rethinking their strategy, as these findings provide strong incentive for growers to move to more sidedress applications of nitrogen, and thus manage the risk and actual needs better. Progress is summarized below.

BETA-TESTING RESULTS:

2012 NY data analysis was completed in May 2013 and published (linked here), and 2011-2012 results summary was published as well (linked here) here, as well as in the Vol. 97, 2013, No. 4 issue of IPNI's *Better Crops* publication. Data from eighty-four on-farm trials between 2011 and 2012 were analyzed, including 56 trials in NY (implemented in part with IPNI support) and 28 in IA. Results showed that in dry and normal weather conditions, Adapt-N can decrease N inputs without causing yield losses. Over the two years, Adapt-N application rates were reduced on average by 66 lb/ac in NY and 32 lb/ac in IA in comparison to current grower practice, while average yield losses with Adapt-N were only -1 bu/ac (not statistically significant). Adapt-N thus increased profits in 79% of trials (80% in NY and 75% in IA), with average increases of about $31/ac in NY ($20/ac in IA) due to fertilizer cost savings. The lower Adapt-N sidedress rates also significantly reduced N loss to the environment, with end-of-season simulated leaching losses decreasing by 10 lbs N/ac, and simulated total N losses decreasing by 34 lbs N/ac on average. Highlights in 2012 included the case study (linked here) at Donald and Sons Farm in Moravia, NY, where N reductions of 67,000 lb in 2012 saved the farm over $30,000. The

Donalds continue to use Adapt-N recommendations across their fields, and implemented 9 trials in 2013. We plan to collect their yield monitor information this winter.

On-farm testing of Adapt-N continued in 2013, and we expect to receive data from at least 100 trials from this season. After relatively dry or average weather conditions throughout most of the user area in 2011 and 2012, 2013 provided a stark contrast. This spring was extremely wet in most of our user area, causing large losses of early-applied N through both leaching and denitrification. Particularly first-time Adapt-N users, who sought out the tool to try to account for the impact on their preplant applications, were shocked to find, in many cases, that most of their investment in N had been lost by early- to mid-June. In a wet year like this, the benefit of Adapt-N to farmers comes from increasing N rates where needed in order to avoid major yield losses. The long-term value comes from Adapt-N instigating paradigm shifts as farmers recognize the high risk for loss of early-applied N, and rethink their management systems to consider sidedress applications.

Preliminary 2013 results are generally positive. Of 14 NY trials preliminarily analyzed to date, Adapt-N performed well in 9, with average yield increase of 12 bu/ac and profit increase of $52/acre due to the tool (five silage yields are reported as grain equivalent). Adapt-N sidedress rates were higher than the grower's normal practice in 8 NY trials, all of which resulted in yield and profit increase (from +4 to 58 bu/ac and +$12 to $246/ac.) The five NY trials that resulted in profit loss (three silage and two grain) indicate two things: 1) potential opportunities for further refinement of the simulation model with consideration of soil health characteristics: losses were found in small long-term tillage experiments in continuous corn, 2) the need for more precise user inputs, especially related to manure applications, and probably an adjustment of the risk factor used for the higher uncertainty inherent in manured scenarios, as affected by uneven or imperfectly calibrated manure spreading and not-ideally-representative testing, 3) the need for user-ability to indicate drainage characteristics of the field – losses were found in several fields that were observed to be rather wet during the spring.

Since Adapt-N currently assumes good drainage, and this is not the case for all fields, this can cause Adapt-N to underrecommend. The silage trial with the highest yield loss was a volunteer trial using a single-check-strip with no replication. In reviewing background information on this trial, we found that one of the manure applications used likely had only been applied to part of the field (indicating yet more practical reasons for greater variability in manured fields), that the grass sod had been entered as 1-25% legume, when legume content was probably insignificant, and that the farmer had observed long-lasting wetness in the field. Adjustments are currently being made to Adapt-N based on this information.

Without this trial, average benefit in NY rises to a 16 bu/ac yield increase and $73/ac profit increase with an increase of only 12lb/ac of N on average, indicating that N inputs are generally reduced or increased respectively, as justified by weather impacts for actual needs. In Iowa, Adapt-N caused profit increase in 2 of 4 cases received so far, with average N rate reduction of

23 lb/ac, yield decrease of 3 bu/ac and profit loss of less than $1/acre. All trials are being reviewed for accuracy, and we are awaiting information on further trials.

Some highlights among the 2013 trials have come from Keith Severson at Cayuga County Cooperative Extension, whose collaboration in the project was supported by IPNI. Keith worked with grower Arnold Richardson (see Impacts section, below) to establish Adapt-N trials in three of Richardson's fields. Due to N loss from early spring wetness, Adapt-N recommended sidedress N rates that were 20, 30, and 40 lbs/ac higher than Richardson's normal practice. The higher rates resulted in yield gains of 23, 23, and 30 bu/ac, and profit gains of $102, $95, and $128 per acre, respectively. Additional highlights come from volunteer collaborator Dave DeGolyer at Western NY Crop Management Association, who established several trials with grower Donn Branton (see Impacts section, below). By applying 60 lb N/ac at sidedress because Adapt-N indicated that preplant applied N had largely been lost, Branton saw increases of 25, 42, and 58 bu/ac in three trials and profit gains of approximately $79, $164, and $246/ac due to avoided yield loss.

These results preliminarily suggest that Adapt-N is equally useful as a tool for calculating needed N increases during wet years, as it is for avoiding excess N in normal years, and can result in large economic benefits to farmers through avoided yield loss. While there are no immediate environmental benefits of Adapt-N recommending higher rates in a wet year, we anticipate that the impact of this reality on farmers will be to encourage many more farmers to shift their N applications to sidedress time and acquire high clearance equipment. This will then have significant positive environmental impact in future years (both wet and dry) on timing and rates of application. We look forward to analyzing the majority of the 2013 data that have not yet come in, and using results to further refine the model's ability to account for the impact of weather on N availability.

EDUCATION:

There is more interest in Adapt-N by the week both at the state as well as the regional and national level. We have presented at a number of conferences, field days, workshops and other trainings since last February. Notably, with increasing interest from service providers and growers across the Northeast and Midwest, we provided a multi-location webinar training on March 21, 2013 that drew well over 200 people. In total we have provided almost 30 hours of instruction to about 3500 people for over 2800 person-hours of training. A table of presentations is provided in Appendix 1. Western NY Crop Management Association just published their January newsletter, which reaches 400 farmers, 30 consultants, and selected Cornell researchers – it includes a feature story on weather impacts on N, the successes of Adapt-N in WNY this year, and encouragement for growers to move to sidedressing with high clearance equipment, using Adapt-N recommendations.

Additionally we have been maintaining the blog on our website and we are close to completion on the Adapt-N Training Manual we have been developing. It will be posted at http://adapt-n.cals.cornell.edu/manual/index.html as soon as it is ready.

ADAPT-N TOOL IMPROVEMENTS:

Geographic Range: As of April 2013, the geographic range for the tool has been significantly expanded beyond last year's states of IA, MN, WI, IL, IN, and the 13 Northeast states. The tool can now also be used in beta-mode in the following areas: Eastern parts of KS, NE, SD, and ND; and all of MO, MI, KY, OH, VA, WV, and NC. The tool now covers the vast majority of rain-fed corn production in the US. For the new states, data is entered through the interface by using the Adapt-N version for a neighboring state, and generic soil textural classes are used instead of the soil series names. We had planned to offer full featured capabilities in those regions, but our funding was tied up in the federal budget sequester.

Batch Upload: Adapt-N now has batch upload capability under the "Manage Locations" tab for advanced users who are familiar with standard use of the interface. This is an attractive feature for consultants or large farms who would like to rapidly enter information from large numbers of fields from their own software or spreadsheets. Basically, this involves importing the data through specifically-formatted comma-separated-value (csv) files under the "Upload File" feature. Detailed instructions and examples are included on our website.

Model Adjustments: In some cases during 2013, users were concerned that the tool was not adequately accounting for excessive leaching and denitrification losses, resulting in very low PSNT-LSNT levels and leaf yellowing from the extreme wet conditions encountered in much of the user area this season. We provided some explanations and guidance on how to deal with this.

The Adapt-N interface was updated during and after the growing season in response to feedback and data from collaborators on how the model was dealing with the extremely wet conditions.

We provided guidance and then made adjustments as follows:

1. Weather data had lagged 3 days, because more recent weather data were not sufficiently accurate. Additionally, leaching and denitrification play out over an additional 4 to 5 days (both in the real world and in Adapt-N). Thus when a large recent rainfall event occurs, it could take the Adapt-N tool up to 6 days to fully account for it, and changes in the recommendations occur over several days, thus resulting in an underprediction of losses on the day the tool is run.

- UPDATE made August 9: With improvements in climate data acquisition and processing, the quality of previous-days' weather data has improved considerably, so that the high resolution weather data are now more rapidly available in error-corrected form, thanks to the Earth and Atmospheric Sciences Team. There is

now only a 1-day lag. We are further considering running the model several days into the future with current temperature conditions, and possibly predicted rainfall, in order to give recommendations for "today" and "anticipated recommendation" for several days later, in order to allow for the dynamic processes that have to do with the development of anoxic conditions over several days and resultant denitrification. We will announce to users when further upgrades have been made.

2. The current model assumes that fields are adequately drained. I.e., they are either naturally well-drained, or have tile installed. Locations that are either poorly drained, compacted, or receive run-on from adjacent areas may have greater losses than estimated by Adapt-N. N rates for inadequately drained and compacted soils in extremely wet years may thus need an upward adjustment.

- UPDATE: We are currently working on a drainage option in the tool, and also are reexamining over-winter processes. A new NRCS agreement will allow us to accomplish this this winter.

3. Corn may look yellow because it is impacted by short term nitrate losses from leaching and denitrification from the surface layer, where the roots are concentrated in the early season. But if, for example, a lot of manure has been applied, there may be considerable amounts of ammonium and potentially mineralizable nitrogen in the profile (see graphical output titled "Inorganic Nitrogen (urea, ammonium, nitrate) in the Root Zone"). The field symptoms may therefore be visually exaggerated by the temporary lack of available nitrate in the root zone. Another consideration is visual bias: Sometimes, a field observation is heavily influenced by a few small poorly drained areas (or headlands along the road) where the problems are most pronounced, while the majority of the field actually shows much less of a problem.

4. The tool has not been extensively tested for extreme wetness, as we have not experienced such conditions in the testing area over the past years. When extreme conditions occur (and they were truly extreme is some areas – parts of Iowa have set new records for spring rainfall), the tool may not be able to predict quite as well compared to more average conditions. It is possible that N losses from very high and/or continuous precipitation are under-predicted. Some model adjustments may need to be considered for the future.

5. Suggestions made for how to make adjustments: Run the tool as normal, but adjust for possible high losses as evidenced from field observations or a PSNT-LSNT test. For example, if the model output suggests that the surface 12 inches has 100 lbs per acre nitrate (see the fifth graph in the PDF report), but the soil test indicates only 40 lbs/ac (PSNT-LSNT value of 10 ppm), then add 60 lbs/ac to the recommendation. Extreme leaf yellowing could suggest a similar adjustment. This way, you can correct for excessive short-term losses while still accounting for all other factors.

- UPDATE: Based on results of spring soil nitrate samples collected by Adapt-N users, we made a June 26 adjustment in the PNM model to better account for denitrification losses. We reviewed the data, compared them with model results, and concluded that such losses were underestimated for medium and fine-textured soils in cases of persistent wetness, as was experienced in several parts of the Adapt-N user area. We adjusted the denitrification rate coefficients, which appears to address the concern. Coarse-textured soils appeared to not be impacted by this, since they have low denitrification rates and mostly lose N through leaching. We provided additional details on this to users: The denitrification process involves the reduction of nitrate to gaseous forms (N_2 and N_2O), which is especially pronounced in very wet soils. In extreme wet years, the lack of oxygen is persistent and can temporarily deplete all nitrate in the soil. This process is modeled in Adapt-N through a Michaelis-Menten type equation, where the substrate conversion rate (nitrate to N gases) is controlled by a factor, the denitrification rate coefficient. This coefficient is in turn impacted by the moisture and temperature conditions, and soil characteristics (texture, organic materials, etc.). The denitrification rate coefficients used by the model were based on several multi-year field studies that included fertilizer and manure additions, but never involved an extreme wet year as experienced in some areas in 2013. The journal articles that discuss the research are listed on our web site. We will be reviewing these updates once we have 2013 data available.

Future Improvements: We are currently working on several feature improvements for spring 2014:

- A beta cover crops module. This will put in place a way that users can start to account for the impacts of cover crops. The planned version will include inputs for cover crop species (including mixes), growth stage and biomass at termination, C:N ratio at termination, method and date of termination, and several of these will have defaults and guidance on choices available.
- Improvements to the way the model handles over-winter processes and drainage characteristics of soils
- Improvements to the way soils are handled in the model, and soil dictionaries for additional states
- Nitrous oxide emissions estimations
- Improvements to the price ratio and risk correction factors used for scenarios with different risk or price ratio.

IMPACT:

There's a continually growing 'buzz' around Adapt-N, with several fairly high-profile articles out in the agricultural literature. While there are too many to give an exhaustive list here, several articles are linked as follows: Corn & Soybean Digest, May 2013; Farm and Dairy, 2013; Empire State Farming Blog, May 2013; New York Ag Connection, May 2013; Corn & Soybean Digest, July 2013; New York Farm Viability Institute, September 2013.

Adapt-N has close to 1,000 registered users, approximately 350 of these users have one or more fully configured fields (i.e. actually used the tool to complete a simulation that is still present in the interface at this time). About 300 users are located in the Northeast and Midatlantic, about 500 users in the Midwest, and about 200 elsewhere. There are approximately 50 users who each have more than 10 fields fully configured, and the top two most active users have 142 and 106 fields configured, respectively. Based on these users and average field sizes in their areas, we estimate that there are roughly 135,000 acres in the Midwest and 20,000 acres in the Northeast fully configured and simulating in Adapt-N. We do not know how many acres implemented recommended rates in 2013, but we can conservatively estimate at least 15,000 acres total for 2013, and probably this many combined between 2011-2012.

Adapt-N provides strong incentives to sidedress to growers, because the increased profits during dry or normal years can only be realized when waiting until sidedress time to apply the majority of the needed fertilizer, as it is only at this time that the amount can be estimated well. With average profit gains of about $27/acre and average N reductions of 54lb/ac over 2011-2012, a rough estimate of actual impact on the approximately 15,000 acres of implemented rates in the user area would be profit increases of >$400,000, and N savings of about >800,000 lb in total. Increased profits of well over half a million dollars can be estimated for 2013.

We will be conducting a case study interview with Arnold Richardson (see discussion of his trials above) in Cayuga County in the next months. He has been aware of Adapt-N for several years, was one of the earliest growers to request an account, and had run a few simulations before 2013. However, he did not start using the tool with any seriousness until this year, because its recommended rates had generally seemed too low for him, and he did not feel he knew enough about the tool. He was impressed with the results this year, and we are looking forward to learning about his perspectives and plans for 2014, which include further use of Adapt-N.

A specific example of impact on farm-management practices that we know about now is taking place in Western NY, based on Donn Branton's trials above. Donn's standard N management for years has been to place all N fertilizer in a deep slot at planting. He has not been sidedressing. However, this year it became very evident that such fertilizer is in fact very vulnerable to losses during heavy rains, and thus more N was needed at sidedress time despite the fact that enough would have been available in a normal year. The Brantons are now rethinking their N

management and are considering making sidedressing a standard practice. They are likely to decrease their preplant N applications significantly, and apply N using Adapt-N recommendations as one of their decision tools.

Dave Degolyer and colleagues have sampled about 600 acres (about 30 fields) of Donn Branton's fields in the next days. They submitted soil health test samples to both Cornell and Ward Lab (for the new Haney Soil Health Tool). They sent composites of whole fields for each field for soil health analysis, but also took split samples (by soil type and yield map) for nutrient and organic matter analysis. Of these fields about 300 acres will go into corn grain next year. They plan to run Adapt-N by management unit within fields, basing their expected yields on past yield history from their yield monitors. They sent us splits of the by-management-unit samples as well so that we can run these through our new N-dynamics-related soil health indicators (respiration and proteins). Donn and his son Chad have expressed interest in providing data for calibrating the beta soil health module for Adapt-N that we have some funding for so far. They plan to leave us short 0-N sections, implement Adapt-N and Grower N rates, and report on yields across the fields. Some cover cropped fields will be included in this set, so will also help us with calibrating our beta cover crops module.

Appendix 1: Educational Events

Group or Event	Sponsoring Agent	Speaker	Title or Subject	Duration of Adapt-N material	Date	Location	# in Audience (approximate in some cases)	Notes
Midwest regional NAICC meeting	NAICC	Harold van Es	Adapt-N Tool for Precision Nitrogen Management in Corn	45	2/19-20/2013	Des Moines, IA	70	Invited Update on Adapt-N.
Triple Bottom Line Grower Group Meeting	Vela Environmental	Harold van Es	Adapt-N Tool for Precision Nitrogen Management in Corn	60	2/21/2013	Kansas	8	8 top notch growers representing at least 60,000 acres, participating in a project to improve input decisions etc. one of them has already switched from fall anhydrous to spring application due to using adapt-N and seeing losses.
NNY ADP stakeholder meeting	NNY ADP	Bianca Moebius-Clune	Update on Adapt-N: A Tool for Precision Nitrogen Management in Corn	15	2/26/2013	Watertown, NY	20	
NNY ADP stakeholder meeting	NNY ADP	Bianca Moebius-Clune	Update on Adapt-N: A Tool for Precision Nitrogen Management in Corn	15	3/8/2013	Chazy, NY	25	
Presentations to Coop participants		Troy Jenkins				IN		Secondary Impact - Adapt-N user integrating information into his outreach: Troy Jenkins is an agronomist with North Central Coop in Rochester, Indiana
		Michael McNeill	Using the Adapt-N Tool			Riverside, IA	110	mostly farmers were in attendance at this meeting, also some consultants and ag professionals. Interest in the Adapt N concept was high. Main question: "why haven't we heard of this before?"
		Michael McNeill	Using the Adapt-N Tool			Stewartville, MN	95	mostly farmers were in attendance at this meeting, also some consultants and ag professionals. Interest in the Adapt N concept was high. Main question: "why haven't we heard of this before?"
Crop Management Seminars	Pioneer	Jake Vossenkemper	Crop Management Seminars		Feb and March	Multiple locations in Illinois	500	Secondary Impact - Adapt-N user integrating information into his outreach to Pioneer customers

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Intensive Adapt-N Training Webinar	Adapt-N Team	Bianca Moebius-Clune, Harold van Es	Cornell Adapt-N Intensive Workshop by Webinar: Precision Nitrogen Management in Corn using the Adapt-N Tool	240	3/21/2013	Webinar Broadcast to Personal Computers and Multiple Host Locations in Northeast and Midwest		Number of attendees registered and attending via personal computer (had 175 people register, ~135 attendees logged into webinar (some repeatedly, so this number accounts for that)), host sites with many attendees that were not all logged in. > 200 total is a good guess.
Intensive Adapt-N Training Webinar host site	Shannon Gomes, MGT Envirotec	"	"			Borlaug Learning Center at Iowa State Research Farm, 3327 290th Street, Nashua, IA 50658	21	
Intensive Adapt-N Training Webinar host site	Hal Tucker, MGT Envirotec	"	"			Iowa Central Community College, 916 N Russel Street, Storm Lake, IA	22	We received a lot to positive comments on the presentations and the potential of the Adapt-N tool
Intensive Adapt-N Training Webinar host site	Michael McNeil, MGT Envirotec	"	"			Iowa Lakes Community College, 2111 Highway 169 N., Room 16, Algona, IA 50511	20	
Intensive Adapt-N Training Webinar host site	Jim Cambarato, Purdue University	"	"			Beck Agricultural Center, Purdue University, 4540 U.S. 52 West. West Lafayette, IN 47906		
Intensive Adapt-N Training Webinar host site	Scott Gabbard, AgNR Educator, Purdue Extension, Shelby County	"	"			Shelby County Extension, IN	3	
Intensive Adapt-N Training Webinar host site	Crop-Tech Consulting, Inc.	"	"			Crop-Tech Consulting, Inc., 9051 Bucks Road, Heyworth, IL 61745	20	

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Intensive Adapt-N Training Webinar host site	CCE Suffolk county	"	"			423 Griffing Ave, Riverhead, NY 11901	2	
Intensive Adapt-N Training Webinar host site	Clinton County CCE	"	"			Clinton CCE, 6064 State Route 22 Plattsburgh NY 12901	7	They had a good group that stayed after, talking more. Kitty O'Neil starting in May as CCE Regional Agronomist in 4 counties in northern NY - said she enjoyed the morning portion of the Adapt-N webinar yesterday, unable to attend latter parts.
Intensive Adapt-N Training Webinar host site	Cornell Hudson Valley Lab	"	"			Cornell Hudson Valley Lab 3357 US Rt. 9W, Highland, NY 12528	4	We had 3 growers attend (a 4th called in sick) representing about 1500 cares of sweet corn. They both showed interest in trailing Adapt-N and at least one grower directly said they were going to trial it this year. The content and presentation was outstanding; the only thing I would add is a break in the middle of each of the AM and PM sessions. It was a long time to sit and be receptive, even for someone who does as much computer work as me. The growers that came are key growers in the area, so I think if they find Adapt-N to be beneficial to them, I think there is a good chance that other growers in the area will give it a shot too (i.e. thier endorsement will hold a lot of weight with other area growers).
Intensive Adapt-N Training Webinar host site	Erie County Soil & Water and USDA-NRCS office	"	"			SWCD, 50 Commerce Way, East Aurora, NY 14052		
Intensive Adapt-N Training Webinar host site	Cayuga CCE	"	"			248 Grant Ave in Auburn, NY	8	all brought a laptop or an I pad I was so impressed most were able to connect within our building some had trouble I think they all went home educated inspired and wanting to connect in the 13 cropping year
Intensive Adapt-N Training Webinar host site	CCE Rennselaer County	"	"			61 State Street, Troy, NY 12180	4	
Intensive Adapt-N Training Webinar host site	CCE Oneida County	"	"			Oriskany, NY	5	

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Intensive Adapt-N Training Webinar host site	Agricultural Consulting Services	"	"			Ithaca, NY	3	they found the program to be very good, and hope to run some fields this year to build experience, and explore how they can integrate this into their recommendations.
Intensive Adapt-N Training Webinar host site	Stuart & John's Sugarhouse, UNH extension Cheshire County	"	"			Stuart & John's Sugarhouse, 31 NH Rte. 63, Westmoreland, NH	7	
Intensive Adapt-N Training Webinar host site	UVM Middlebury Extension	"	"			23 Pond Ln, Middlebury, VT	4	
Intensive Adapt-N Training Webinar host site	UVM St Johnsbury Extension	"	"			374 Emerson Falls Road, St. Johnsbury, VT	3	
Intensive Adapt-N Training Webinar host site	UVM St Albans Extension	"	"			Conference Room at Church of the Rock, 1091 Fairfax Road St. Albans, VT 05478	12	
Intensive Adapt-N Training Webinar host site	various organizations/individuals	"	"			Webinar viewed on personal computer	96	96 registered as personal computer… not sure how many total in end were on. ~135 attendees logged into webinar (some repeatedly, so this number accounts for that.)
CSS Seminar	Department of Crop and Soil Sciences	Bianca Moebius-Clune	Adapt-N On-Line Tool for Site-Specific and Weather-Adjusted Nitrogen Management in Corn: On-farm Strip Trial Results	50	4/18/2013	Ithaca, NY	40	

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Beck's Hybrids large grower meeting and workshop	Beck's Hybrids	Harold van Es	Adapt-N, a tool for precision N management in corn systems	120	4/30/2013	Atlanta, IN	30	Invited presentation to group of large growers who are asking their consultants to provide Adapt-N for N recommendations, invited by Beck's Hybrids, which is a seed company that does high-end consulting with very large growers in Indiana and surrounding states. These growers are managing somewhere between 3000 and 20,000 acres of corn.
Informal meeting	G&K Concepts and others	Harold van Es			7/16/2013	Fort Wayne, IN and region	10	Harold van Es paid an informal visit to collaborators Jordan Seger and Greg Kneubuhler, and visited several of the trial sites. Good Adapt-N discussion was had.
InfoAg Conference		Harold van Es	Precision N Management with Adapt-N: Updates and Results	50	7/16/2013	Springfield, IL	250	good questions and discussion; lots of interest in Adapt-N. Many have heard from others about the tool. Interested by GIS companies, etc
InfoAg Conference		Harold van Es	Workshop: Adapt-N	50	7/17/2013	Springfield, IL	30	
Musgrave Research Farm Field Day	Cornell College of Ag and Life Sciences and Cooperative Extension	Bianca Moebius-Clune, Bob Schindelbeck, Dan Moebius-Clune, Matt Ryan, Paul Salon	Soil Health, Adapt-N and Cover Crop Interseeding for Adaptation and Resilience	25	7/18/2013	Musgrave Research Farm	100	engaged audience, good questions, efficient overview of all those topics. Handouts provided.
Nitrogen Use Efficiency Conference	Soil Science Society of America (SSSA)	Harold van Es	Precision Nitrogen Management In Corn Production Using Models and Weather Data	120	8/14/2013	Kansas City, MO	150	
Informal meeting	La Coop Federee	Harold van Es	Adapt-N, a tool for precision N management	30	9/5/2013	St Hyacinth, QC	4	presentation to cooperative interested in adopting Adapt-N
Northeast Iowa farmer field day	Cedar Basin Crop Consulting	Harold van Es	Adapt-N, a tool for precision N management	30	9/18/2013	LaPorte, IA	30	Part of nutrient reduction farmer meeting

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Department al seminar	Iowa State University- Dept of Agronomy	Harold van Es	Adapt-N: Employing Cloud Computing Technology for Corn Nitrogen Management	60	9/19/2013	Ames, IA	60	Invited speaker for departmental seminar
Conference on Preserving Water Quality in a Changing Climate	Cornell Cooperativ e Extension Onondaga County, NY	Harold van Es	Agriculture and Climate Change: Adaptation and Mitigation	30	9/26/2013	Skaneateles, NY	25	focus on adapration and mitigation of climate change
NY Interagency Soil Health Initiative	NY NRCS	Bianca Moebius -Clune	NY-CIG Project: Soil Health Training and Quantifying Benefits for Precision N Management	30	10/18/201 3	Morrisville State College, Morrisville, NY	20	
Tile Drainage Conference	Miner Institute	Bianca Moebius -Clune	Adapt-N for Site-Specific and Weather-Adjusted Nitrogen Management in Corn: A Tool to Minimize Nitrogen Leaching to Tile Drainage Water … and More	45	10/24/201 3	Miner Institute, Chazy, NY	90	
ASA-CSSA-SSSA Annual Meetings	ASA-CSSA-SSSA	Bianca Moebius -Clune	Site-Specific and Weather-Adjusted Nitrogen Management in Maize: Adapt-N Increased Grower Profits and Decreased Nitrogen Inputs in Two Seasons of On-Farm Strip Trials	120	11/4/2013	Tampa, FL	50	

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ASA-CSSA-SSSA Annual Meetings, Symposium on adaptive N management and optical sensor	ASA-CSSA-SSSA	Harold van Es	Can Models and Weather Databases Enhance the Use of Sensor-Based Nitrogen Management?	20	11/5 & 11/6/2013	Tampa, FL	90	CCA credits via live-streaming were offered to national remote audience on 11/5
CCE Inservice Training	Cornell Cooperative Extension	Harold van Es	Adapt-N Update	45	11/20/2013	Ithaca, NY	22	Cornell Cooperative Extension
NC State University, Murphy Brown meeting	NCSU	Harold van Es	Adapt-N, a cloud based tool for precison nitrogen management	60	12/5/2013	Raleigh, NC	11	in-depth discussions on Adapt-N