

# Adapt-N Trial Implementation Protocols

(v.2 4/16/15)

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## Goals and Objectives

*To enhance N management, by accounting for weather interacting with other soil and management factors, while also increasing the adoption of cover crop and soil health management practices in corn production.*

Specifically our objectives are to:

- 1) continue to calibrate and validate Adapt-N, and incorporate cover crop and soil health test model inputs,
- 2) educate growers and their advisors about
  - a. the benefits of incorporating weather information with a modeling approach,
  - b. using cover crops and other soil health management practices to improve N dynamics and long-term sustainability,
  - c. methods for using multiple technologies for more sustainable N management in corn, including Adapt-N, high-clearance equipment and variable rate technology for more timely and flexible sidedressing, and establishment of cover crops in standing corn
- 3) increase broad-scale adoption of Adapt-N through encouraging low-risk implementation.

*Performance Target: By 2015, users in the Northeast will simulate locations representing at least 100,000 corn acres in Adapt-N, and at least 100 growers will implement recommendations on at least 25,000 acres.*

## Summary Timeline 2015

Date	Activity	Materials to submit (see details starting on page 4)
<b>Apr-May</b>		
>	Identify & plan trial fields	<ul style="list-style-type: none"> <li>Locate fields, record soil and management info (Excel Template, "Basic Field Info" tab, "A" and "B")</li> </ul>
>	Spring soil sampling (if applicable)	<ul style="list-style-type: none"> <li>0-6" <a href="#">Standard Soil Health Analysis Package</a>: Submit online</li> <li>0-12" ammonium, nitrate, OM: use Form S (at cover crop termination if applicable)</li> </ul>
>	Create locations for simulation in Adapt-N	<ul style="list-style-type: none"> <li>Make sure your <a href="#">Adapt-N account</a> is active and you can <a href="#">login</a>; use research version for cover cropped trials. Contact Aaron if you need help with getting a new account or accessing an existing account</li> </ul>
>	Corn planting (if applicable in May)	<ul style="list-style-type: none"> <li>Record date and any preplant/starter N ("Basic Field Info" tab, "B")</li> </ul>
<b>June</b>		
>	Corn planting (if not done in May)	<ul style="list-style-type: none"> <li>Record date and any preplant/starter N ("Basic Field Info" tab, "B")</li> </ul>
>	Run Adapt-N simulations	<ul style="list-style-type: none"> <li>Send Aaron FULL Adapt-N pdf reports run on sidedress day</li> </ul>
>	Establish sidedress treatments	<ul style="list-style-type: none"> <li>Record sidedressing date, date Adapt-N was run for recs., expected yield, all treatment fertilizer rates (A, G, zero-N, more treatments optional; 3+ reps) (Basic Field Info tab, "C")</li> <li>Record fertilizer type ("C").</li> <li>Email photos and comments to Aaron</li> </ul>
<b>July-Nov</b>		
>	Trial monitoring	<ul style="list-style-type: none"> <li>Send Aaron photos of noteworthy fields, events, activities</li> </ul>
>	Field meetings, one-on-one meetings with farmers	<ul style="list-style-type: none"> <li>Please tell Aaron when you include info on N dynamics, Adapt-N, Soil Health in any outreach events. (Excel, "Outreach" tab).</li> <li>We can provide materials. If you prefer, please invite member of Adapt-N &amp; Soil Health campus team</li> </ul>
>	Corn Stalk Nitrate and Late Season Soil Nitrate sampling (if applicable)	<ul style="list-style-type: none"> <li>We are not requesting you to sample this year for our project but if you are gathering this info for your own purposes, please share (Excel, "ByPlotInfo2015" tab, "F")</li> <li>If applicable: 0-12" soil samples for nitrate, from each plot: use Form S</li> <li>If applicable: Stalk samples from each plot: use Form SN</li> </ul>
>	Harvest and Yield measurements	<ul style="list-style-type: none"> <li>Measure yield and record for each strip (Excel "By Plot Info2015" tab, "E" and "G"), email to Aaron</li> <li>Send yield monitor files if applicable</li> </ul>
<b>Nov-Jan</b>		
>	Provide feedback	<ul style="list-style-type: none"> <li>Trial implementation suggestions, model or interface suggestions, Adapt-N manual, other ideas</li> </ul>
>	Adapt-N outreach in meetings and workshops	<ul style="list-style-type: none"> <li>Please tell Aaron when you include info on N dynamics, Adapt-N, Soil Health in any outreach events. (Excel, "Outreach" tab).</li> <li>We can provide materials. If you prefer, please invite member of Adapt-N &amp; Soil Health campus team</li> <li>Report number of additional retrospective simulations run with growers and/or implementation acres/stories.</li> </ul>

## General Deliverables

### Grower Involvement & Collaborator skills development:

- Involve growers to implement trials and/or to simulate additional fields in Adapt-N (Aaron can provide trial and simulation number deliverables if needed).
- Become comfortable with using Adapt-N, interpreting its output, providing adaptive N management recommendations and guidance to growers to help them understand their N dynamics and needs.
- Provide us with feedback for tool & program improvement.

### Strip Trials:

- Collect Adapt-N input data for each trial and run simulation
- Help growers establish and maintain strip trials
- Provide simple field histories, sample soil (if applicable) and yield data from strip trials, report with observations

### Outreach:

- Organize field days, meetings, workshops, etc to include info on Precision N Management using Adapt-N, record attendance numbers and other relevant info, report to Aaron (date, speaker, event, location, length of Adapt-N material, other notes).
- Help recruit consultants, government and/or non-profit personnel, extension staff, as well as further growers for trying out Adapt-N, and to provide feedback (see low-risk implementation suggestion below).
- Remain in close contact with growers regarding any issues, challenges, questions, they may have, and gather feedback from them.

### Reporting/Evaluation:

- Email data, observations, progress info, photos, and other info to Aaron.
- Participate in project evaluation/reporting.

## Detailed Instructions

### April-May 2015

#### Identify Trial Fields:

- Provide grower names, GPS locations, etc. to Aaron in excel template (Basic Field Info “A” and “B”).
- Guidelines for choosing fields:
  - **N status:** Aim for fields with low initial N input so that additional N need is anticipated, and the grower plans to sidedress.
  - **Cover Crops:** For NY, where possible, pick fields that currently have a growing cover crop that will be terminated before corn planting (for cover crop module testing). For other Northeast trials no cover crop preference.
  - **Field Variability:** Aim to conduct trial on typical part of field with uniform cropping history and minimal slope/soil-type/etc. variability. Incorporate variability that is present into length of strips (See Figure 2, page 5).

#### Spring Soil Sampling (where applicable):

*Certain project collaborators will be asked to soil sample for ammonium, nitrate and OM and soil health testing. If you have not been directly asked, skip to “Planning trial set-up” below.*

Sample prior to tillage/fertilization/planting. Avoid sampling in injection rows if fertilizer has already been applied. Send Aaron a note if either of these may be an issue.

- **0-12 inch: for ammonium, nitrate and OM** – one composite sample (standard size) per field trial, using Form S (can use one form for multiple trials). Rapidly dry or refrigerate immediately (do NOT freeze), and promptly submit with blue ice along with soil health samples. (If cover crop module is being used, ideally take this sample at same time as cover crop sampling. Note that N concentrations change rapidly with improper sample handling.)
- **0-6 inch: for Standard Soil Health Assessment package** – one composite  $\geq 8$  cup sample per field trial, using the online submission form:  
(<http://soilhealth.cals.cornell.edu/extension/test.htm#packages>).  
Refrigerate, pack with blue ice, and use bulk USPS box to send to Cornell for testing. Sampling directions can be found at <http://soilhealth.cals.cornell.edu/extension/test.htm>.

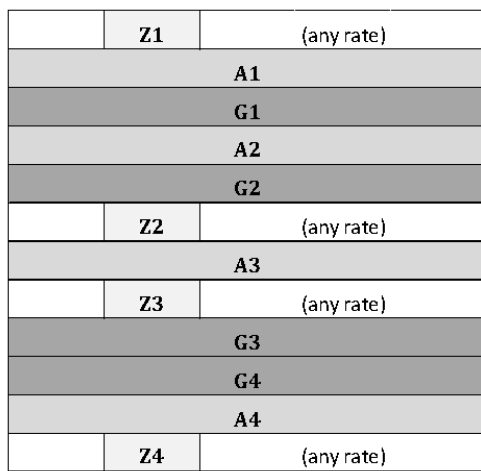
#### Planning trial set-up:

Include at least 3 N treatments (A, G, Z) and at least 3 (ideally 4) replications of each (Figure 1, page 5). More treatments or reps are great. If using a different number of treatments/reps, see info on spatially balanced complete block designs in Appendix, page 9. We strongly encourage one treatment to be Zero-N.

#### **Why Zero-N?**

- To help us assess model accuracy in determining N mineralization and losses from soil organic matter from various sources
- To assess new soil biological tests and their contribution to this prediction

Figure 1. Standard Trial Design



G = Conventional/current Grower N sidedress rate (note decision method)  
 A = Adapt-N recommended sidedress rate as determined on sidedress day.  
 Z = Zero-N at sidedress (starter and/or some manure is ok, must be deficient in N)

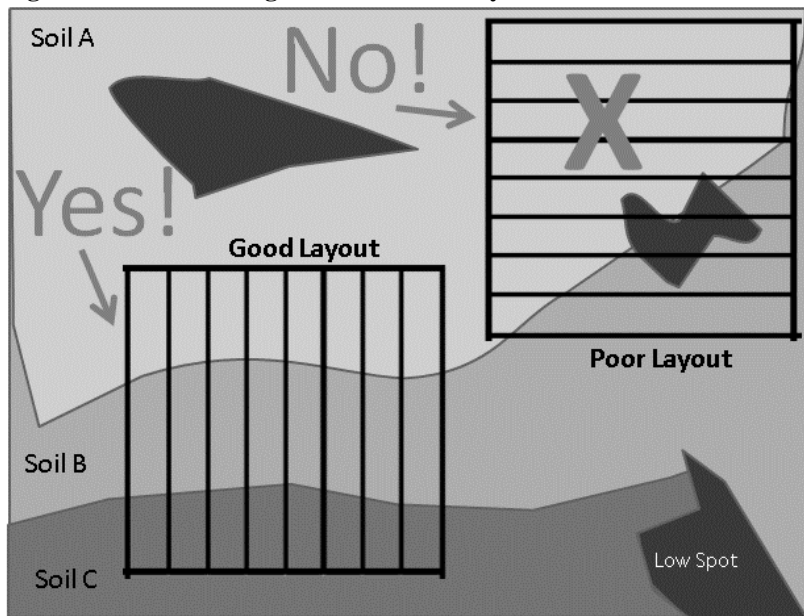
Width of strips: same as, or multiples of, grower's sidedress and harvest equipment for easy management. At least 6 rows (8 or more is preferred).

Length of Z strips: > 50 feet for hand harvest; > 200 ft for yield monitor assessment

Length of A and G strips: at least 50 feet, up to whole length of field

**Trial design should incorporate in-field variability.** Although minimizing extreme variability is the goal, there will still be some variability in the field. Aim to incorporate this into the design so that treatment comparisons will be minimally affected.

Figure 2. How to manage in-field variability



- If no more uniform field can be found, choose part of field with minimal variability
- Include the variation equally across all treatments
- For example, run field strips perpendicular to variation in slope, soil type, drainage, etc. as in the example on the left.

## April-May 2015 continued

### Planting:

Growers plant their crop as usual in trial field. Record date and any preplant/starter N in excel (“Basic Field Info tab, “B”)

### Create locations for simulation in Adapt-N:

- Help growers gather and enter info into Adapt-N for trial field and several additional fields (target numbers differ by collaborator, see letter of commitment)
- Become comfortable, and help growers become comfortable using Adapt- N interface. Make sure your [Adapt-N account](#) is active and you can [login](#); Contact Aaron if you need help with getting a new account or accessing an existing account. Also contact Aaron about using the beta version of Adapt-N if you have any cover cropped trials.

## June 2015

If planting in June, see instructions above. Make sure that the planting date and preplant/starter N is recorded in the Excel tab (Basic Field Info, “B”).

### Run Adapt-N simulations:

- Determine Adapt-N recommendations for trial fields **on day of sidedress**. Ensure accurate model inputs, especially GPS location (“B” in Excel spreadsheet), soil type choice (“B”), OM% (“B”), fertilizer inputs (“B”), manure (“B”, yes or no) and expected yield (“C”). It is very important to closely estimate the expected yield. We recommend using the highest or second highest historical yield for the site. Reassess whether any inputs should be adjusted based on early season weather until then (such as expected yield, rooting depth...)
- Email Aaron the FULL Adapt-N pdf reports for each trial, showing inputs, recommendation on sidedress day, graphs. To download the report go to the “Land” option on the left, select the field of interest, select “View” and, in the dropdown menu, choose “N-Rec”. On the following screen you will see a map. Below the map, toward the left-hand side there will be an option of downloading the “short” or “full” pdf. Select “full”. Download and email to Aaron.

### Establish sidedress treatments:

- Help growers calibrate their sidedress equipment if necessary, so that appropriate N rates are applied.
- See Figures 1&2, above for appropriate trial layout
- Determine Conventional/Grower sidedress practice for each trial field, and record method grower uses to make N rate decisions (Basic Field Info tab, “C”).
- ***Ensure at least 20 lb N/ac difference between Adapt-N and Grower sidedress rates, to make comparisons meaningful. The Adapt-N rate should be implemented as recommended.*** If the chosen Grower rate is too similar to Adapt- N, please adjust Grower rate up or down for 20 lb difference, and make a note.
- ***Sidedress ideally not earlier than V6 stage.*** Predictability increases rapidly during this time.
- Take digital photos of the progress of corn from the trials and email to Aaron.
- Provide requested info to Aaron in excel template. At this point the “Basic Field Info” tab should have sections A, B, C, and D completed. The “Outreach” tab may or may not have information, depending on whether or not you have conducted any outreach to this point. The “ByPlotInfo2015” tab will be completed at harvest.

## July - Nov 2015

### Trial monitoring:

- Enter sidedress applications into Adapt-N, if you haven't done so already, and monitor recommendations
- Email Aaron observations as necessary
- Take digital photos of field trials that are particularly noteworthy, events, etc. and email to Aaron. Please record any outreach events in the excel spreadsheet.

### Field meetings & one-on-one meetings with farmers:

- Report to Aaron about and/or involve Aaron in field meetings at on-farm trial sites
- Follow up with growers on simulations if this seems useful, such as if there are post-sidedress losses and Adapt-N suggests applying more N

### Late Season Soil and Corn Stalk sampling:

- *NOTE: We are not requesting you to sample this year for our project but if you are gathering this info for your own purposes, please share (Excel, "ByPlotInfo2015" tab, "F").*

### Harvest & Yield measurements:

Collect yield data by either weigh wagon (or wagon and pad scales), yield monitor, or by hand (as a last resort). **PLEASE send yield info for Zero-N strips also** (same protocol)! Zero-N strips are particularly valuable for testing Adapt-N model performance.

- **Weigh wagon:** Help growers calibrate equipment. Harvest each strip individually and weigh. Report:
  - Harvest date
  - Total yield of each strip
  - Total area of each strip (length x width)
  - Moisture content of each strip (or moisture corrected yield if that's easier)
  - Record this information in the Excel spreadsheet (ByPlotInfo2015, "G")
- **Yield monitor:** Help growers calibrate equipment, following manufacturer's directions. Hopefully the grower has an established way to calibrate already. Sensors for grain flow, moisture, ground speed, and header all need to be properly calibrated for data to be useful. A description of this process from Iowa Soybean Association is at [http://isafarmnet.com/2008OFNConf/Managing%20Your%20Operation/Calibrate\\_Yield\\_Monitor\\_McGuire.pdf](http://isafarmnet.com/2008OFNConf/Managing%20Your%20Operation/Calibrate_Yield_Monitor_McGuire.pdf)

Harvest each strip, monitoring yield. Report:

- Harvest date
- Average moisture corrected yield/acre, for each strip
- Send shapefiles of trial yield maps, and of N as applied maps.
- Also send pdf or jpg images.



- **Hand harvest** (if above options not available):
  - Within each plot mark two representative harvest sections: each should be at least 20ft-long and at least 2 rows wide (with at least one buffer row from the plot edge, keeping in mind that the plants in each section should represent the average for the plot). Alternatively, 4 representative 20ft long sections of 1 row are fine, too.
  - Harvest and report each section separately in the excel file (for example, in our standard trial with three treatments and 4 reps, you will harvest 24 sections total from 2 sections/plot x 12 plots).
  - Report in excel template (ByPlotInfo2015 “G”):
    - Harvest date
    - Total yield of each section
    - Total area of each section (length x width of harvested area)
    - Moisture content of each section: weigh 2 representative fresh plants from each section (wet weight), chop, oven dry, and measure dry wt.
    - Or, report standard moisture corrected yield/acre if that’s easier (15.5% for grain corn, 65% for silage corn)
- Please also gather grower feedback, info on additional fields simulated if applicable, notes, take pictures and email to Aaron.

## Nov 2015 – Jan 2016

### Provide feedback:

Please send suggestions on trial implementation, Adapt-N model or interface, Adapt-N manual, other ideas

### Outreach in meetings & workshops:

- Please tell Aaron about presentations you give that include info on N dynamics, Adapt-N, Soil Health. We can provide materials. You may be presenting yourself in most cases, or there’s the option to invite a member of the Adapt-N and Soil Health campus team. Please record any of these in the Excel template (“Outreach” tab).
- Share significant stories on how farmers are using Adapt-N and/or new understanding of N and soil health dynamics so that this can be included in project reporting.



## Appendix

### Spatially Balanced Complete Block Design (van Es et al., 2007):

If you are implementing your trial with more or less than the standard number of treatments and reps, please use the following to plan trial layout.

# TRTS ↓	# REPLICATIONS				
	2	3	4	5	6
2	ba ab	ab ba ba	ba ab ab ba	ab ba ab ba ab	ba ab ab ba ba ab
3	bca cab	cba bac acb	bac acb abc cab	bac acb cba bca cba	acb cba bac acb cba bac
4	dcab cbda	cdab dbca dabc	abcd cdab dabc bcda	cbda dcab acbd badc bdca	dcba bcda bdac abcd cadb dabc
5	debac bdcea	cebad eadcb dceba	edacb dbcea acdbe baedc	cdefb dabce aecdb ebdac bcaed	caedb dbaec bcdac becad aebcd edcba
6	cabfed becdaf	facedb cbadef efbacd	bcedfa cafedb efbacd fdcbae	beacdf afbdec fceabd cbdfae dacefb	feadbc baecdf edcbfa cfbead acdfef dbface
7	gbcdeaf dagfbec	bcgadef gedcbfa caefgbd	fdcbage bgfced afbecdg cagfdeb	cdgfeab fbdagce gabcdef deagfbc acfebdg	eafdbcg fcgaebd gbaecdf cebfdga dgecfab adcbgfe

**Directions:** Assign treatments randomly to letter indicators for the desired number of treatments and replications. For split-plot designs, use two-steps: main plots are first identified laid out. Then for each block, split plots are defined where each main plots is assumed as a replication.

From: van Es, H.M., C.P. Gomes, M. Sellmann and C.L. van Es. 2007. Spatially-balanced complete block designs for field experiments. *Geoderma* 140: 346-352. doi:10.1016/j.geoderma.2007.04.017.