Adapt-N: A New Nitrogen Management Tool for Sweet Corn?

Authors: Bianca Moebius-Clune, Harold van Es, Jeff Melkonian, Laura Joseph.
Contact Info: Bianca Moebius-Clune, bnm5@cornell.edu , 1001 Bradfield Hall, Department of Crop and Soil Sciences, Cornell University, Ithaca, NY 14853

Try Adapt-N

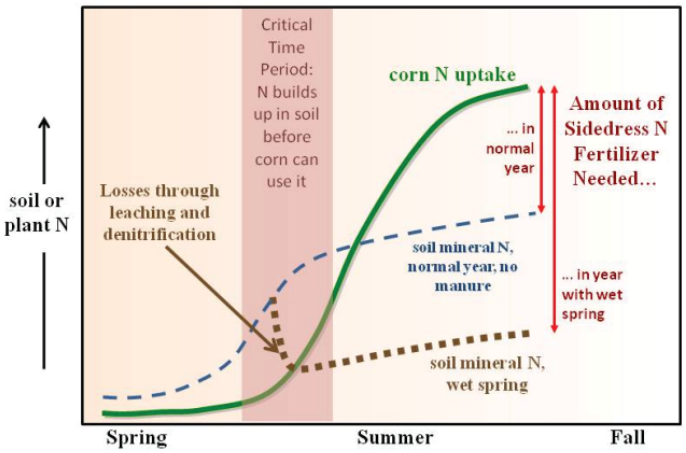
Adapt-N is an online decision support tool (http://adapt-n.cals.cornell.edu) that we are currently beta-testing in on-farm trials in New York and Iowa. The tool was designed to help precisely manage N inputs for grain, silage, as well as sweet corn. It uses a well-calibrated computer model and incorporates high resolution weather information to develop recommendations that are specific to your farm. It was designed to help you do the following:

- Predict corn N needs more precisely based on field-specific conditions
- Adjust N applications based on weather on your farm
- Reduce fertilizer rates, costs and losses in the long-term, while maintaining yield
- Fine-tune sidedress N rates
- Determine whether manured fields need additional fertilizer N
- Determine whether you need rescue N after heavy spring rains
- After the growing season – is there excess N?
- Explore this learning tool and evaluate alternatives: "What if I had…?"
- Use it on your smartphone, iPad, or tablet computer – Adapt-N is mobile enabled.

Our website has detailed information about why (environmentally and economically) adaptive N management is important, how it relates to climate change, how to get an Adapt-N account, how to use the Adapt-N tool and how it works. We also have a blog you can sign up for, and a long list of factsheets, articles, and peer-reviewed publications with more in-depth information about the model that's at the core of the tool.

Background

Nitrogen management is of key importance in corn production systems because of the relatively large N inputs that are used inefficiently (N recovery in the plant is usually lower than 50%), the high cost of N fertilizer, weather impacts on available N, and public concerns over N pollution of the environment. Our studies have shown that early season weather, particularly rainfall, contributes to the well-documented variability in economic optimum corn N rates. In other words, it's because of weather variability that the amount of fertilizer N needs in one year could differ by about 100 lb N from what is needed in another year! Why? … In warm weather nitrogen mineralizes faster from the organic matter in the soil to become available to the crop, but this occurs slower in colder weather. In a normal or dry spring, nitrogen mineralizes to nitrate form and remains in the root zone where the crop can take it up later, when it needs it (see the green vs. blue line in the graph). However, in a wet spring (see the brown dotted line in



the graph), nitrogen can be leached out of the crop's reach or denitrified during the "Critical Time Period" when nitrates build up but have not been used by the crop yet.

This means that it is not possible to accurately determine how much N fertilizer will be needed at the beginning of the growing season. Therefore, many growers currently pay for "insurance fertilizer" – they apply in excess of what is needed in most years, and still come up short in some years. This reduces farm profits and causes potentially high environmental losses to both surface and ground water and to the atmosphere. Nitrate leaching to water bodies can cause excessive nitrate levels in estuaries such as the Great Bay, Chesapeake Bay and the Gulf of Mexico, resulting in algae build-up, dead zones and fish kills. Also, denitrification of nitrate to N_2O, which is a potent greenhouse gas with a warming potential about 300 times greater than CO_2, is contributing the largest chunk to agricultural greenhouse gas emissions. For reference, agricultural N_2O emissions make a larger yearly contribution than all of U.S. aviation.

Adaptive N Management: Benefits of Incorporating the Weather Component

The Adapt-N tool encourages lower N application at planting, and then, at sidedress time, provides more precise N recommendations for corn, based on site-specific management and weather-related dynamics. *Economic and logistical benefits:* More accurately estimating N needs will allow you to spend less money on fertilizer in the average year (about 3 out of 4 years) by adjusting fertilizer rates downward based on weather conditions in the spring, but will allow you to maintain yields in wet years by applying additional N as needed. Using the tool saves time, as there is no need for in-season soil sampling or waiting for test results. There is currently no cost for using this online tool, and you will receive the N-recommendation instantaneously. *Environmental benefits:* 1) Less nitrate leaching and denitrification because less nitrate is subject to losses in the Critical Time Period and in the fall when soils tend to be wetter. There is a win-win opportunity here: it has been shown that leaching and denitrification losses increase exponentially when over-fertilizing above corn N demand. So farmer profits and environment are satisfied by the same goal – applying as much N as is needed and not more. Remember: N lost to the environment is N you paid for (or got "for free" from your organic matter), that your crop cannot use.

How does Adapt-N work?

Adapt-N is accessed through a web interface (http://adapt-n.cals.cornell.edu) 'wrapped' around the Precision Nitrogen Management (PNM) model. This interface allows users to input crop, soil, and N management information to get a nitrogen recommendation. There are three key components of this model-based N management decision support tool:

1) Well-calibrated and tested dynamic simulation model: composed of a corn growth and N uptake model, linked to a soil process model. It simulates 1) water and N transport, 2) chemical and biological N transformations in the soil and 3) N uptake, growth and yield of the corn crop. All these processes are heavily impacted by rainfall and temperature. The model has been extensively tested for experimental applications in the Northeast, and is currently being beta-tested for on-farm use in New York and Iowa. We will make this season's results available on our webpage this winter.!

2) Model access to weather data: at the appropriate scale for farm-level applications. Weather is a key driver of soil/crop processes: The conventional weather station network is not sufficiently dense to pick up local variation in temperature and precipitation. The Northeast Regional Climate Center (NRCC) and the Cornell University Center for Advanced Computing

(CAC) have collaborated to produce and distribute near real-time daily high resolution temperature data and precipitation data (3 x 3 mile gridded) for the Northeast U.S. These data are updated daily and can be automatically accessed by Adapt-N through the web.

3) A user-friendly interface: Adapt-N is designed for easy data entry, and uses information that is part of routine record keeping. Generating a nitrogen recommendation generally requires only several minutes once the needed information (see our manual online) has been gathered, and requires less time with repeated use and experience. N recommendations can be generated at any time and the tool therefore allows for continuous monitoring of N availability as the crop progresses in the growing season. We are planning on an email alert service for next spring. Adapt-N also provides a large, valuable set of information, including graphs of the location's precipitation and temperature, mineralization of N from OM, soil inorganic N content, a graph showing daily PSNT values, and leaching losses, among others, on a daily time step.

How do I begin using the tool?

To register to access Adapt-N, please contact Jeff Melkonian (jjm11@cornell.edu) for your user ID and password. Then, go to the Adapt-N website at http://adapt-n.cals.cornell.edu/, read the directions provided in the manual section, and click on the 'Adapt-N Sign in' button. You will be able to enter any number of fields, and receive weather- and input-adjusted information about N dynamics, including an in-season nitrogen recommendation. You can even test scenarios: for example – what if you had applied the same amount of N at sidedress instead of at planting in 2011?

What info do I need to run a field in Adapt-N?

- Latitude and longitude for the field location (link provided online, if needed).
- Soils: coarse, medium, or fine texture, field slope, % organic matter
- Tillage: fall plowing, spring plowing (date and depth), or conservation tillage (25, 50, 75, or 100% residue cover)
- Manure applications for current and past two growing seasons: date, rate, N content (dry matter, lbs ammonium-N and organic-N/1000 gals), surface applied or incorporated.
- Sod in last 3 years: % legume in the sod, surface kill or incorporation date
- Rotating out of soybean?
- Starter/additional N fertilizer: type, date of application, depth and rate of each application
- Crop: planting date, cultivar (silage/grain/sweet corn and maturity class), expected harvest population, expected yield in that field that year.

What's the current status of beta-testing the Adapt-N tool?

The model is well calibrated through about 20 years of experimental work. With funding from a National Conservation Innovation Grant from the NRCS and a grant from New York Farm Viability Institute we are beta testing it with replicated strip trials on over 40 farms. We are comparing each collaborating grower's standard practice with the Adapt-N recommendation. This year, Adapt-N recommendations in NY trials were between 15 and 130lb N lower than what growers are currently applying. We will be analyzing this year's yields, plant N uptake and soils data, and adjusting the tool.