A Climate-Based Tool for Agricultural Nitrogen Management Decisions

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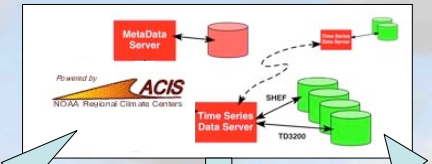
Farmer's Decision

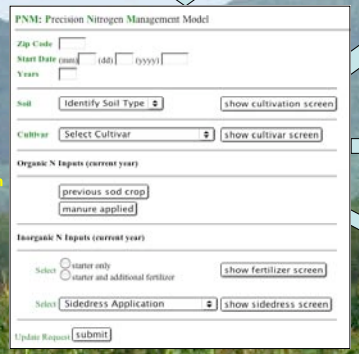
Do I need to apply side-dress nitrogen to my corn?

Side-dress nitrogen is typically applied to maize in mid- to late June. This inorganic fertilizer application assures the plant is supplied with ample nitrogen as it begins its exponential growth phase



ACIS is an internet based system designed to provide directed access for user specified queries to climate data archives. It has been developed by the NOAA Regional Climate Centers (RCCs) in collaboration with the National Climatic Data Center (NCDC). ACIS is a distributed and synchronized system that provides consistent and timely climatic products. The implementation of the system at multiple centers provides redundancy and ensures timely availability. The synchronization and standardization ensures that users will receive the same information regardless of the point of contact. The system was designed with layers of independent modules interconnected by Common Object Request Broker Architecture (CORBA) to ensure flexibility in both the location and programming language of the modules. ACIS was designed to allow access through three interfaces that provide a different balance of detail, customization, and ease: 1) low-level CORBA, 2) mid-level XML-RPC and 3) high-level web-based interfaces (html).

The ACIS system is now available to the public. Links to the ACIS system can be found at http://rcc-acis.org. These links take the user to the interface where it is possible to view sample products and use ACIS to set up "individualized" requests on-line, although you will not be able to receive the actual summaries until you become a subscriber. This approach gives you the opportunity to try out the system and see what stations and years are available, as well as see samples of the product/summary before subscribing.



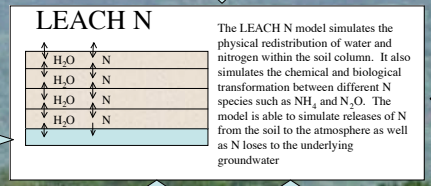
These inputs allow ACIS to access the relevant climate data from a NOAA weather station nearest the field.

Soil type, information on field slope, tillage date and tillage depth and input on corn variety, planting date and plant density are required by LEACH N and the maize model.

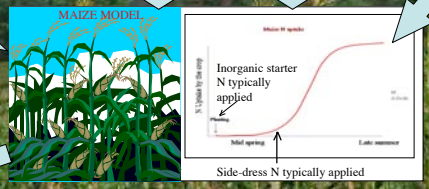
Information about sources of organic nitrogen. Sod crop specifies % of legume in sod, plow date and plow depth. Date, rate and if applicable incorporation depth are requested if manure has been applied.

Information specific to previous applications of inorganic fertilizer including type, date, rate and if applicable incorporation depth.

Web page delivers necessary input variables to ACIS, LEACH N and maize model.



The LEACH N model simulates the physical redistribution of water and nitrogen within the soil column. It also simulates the chemical and biological transformation between different N species such as NH_4 and N_2O. The model is able to simulate releases of N from the soil to the atmosphere as well as N loses to the underlying groundwater



Policy Maker's Decision

What nitrogen management practices are appropriate in a watershed to limit the concentration of nitrates in the groundwater given the prevailing historical climate conditions and maintain crop productivity?

Using model simulations driven by many years of historical climate data (available via ACIS' low level CORBA interface) and various soil, crop and management scenarios it is possible to make management recommendations that are appropriate under "typical" climatological conditions.

This historical analysis provides the basis for a nitrogen leaching index (NLI). The NLI can be used to guide nitrogen management decisions through the year. For example, a farmer may wish to apply nitrogen as manure. The NLI would provide a recommended application time (spring or fall) and rate that balances the need to maintain soil N levels with the potential for N leaching.

Recommendation

Application of nitrogen at the specified rate is indicated based on the weather conditions experienced during recent weeks

When side-dress applications are used, the initial application of spring fertilizer (usually at planting) is typically at a reduced rate. During dry years, the recommended side-dress application would likely be less than the climatological "average" rate since less of the early spring soil N present is lost. Higher side-dress application rates would be indicated during wet springs, due to enhanced losses (leaching and denitrification) of the early spring N. By splitting N inputs into early (planting) and late (side-dress) spring applications, these N losses are reduced resulting in more efficient N use by the crop.

Optimal corn yield requires that adequate N is available to the crop. Supplemental N must be supplied in the spring since, by late June, farmers cannot enter the field with equipment due to rapid crop growth. If a single N application is used in the early spring (typically at planting) when crop demand for N is low, the potential exists for significant amounts of N to be lost to the environment through leaching and denitrification during wet seasons. This N is then unavailable for the crop as it begins its rapid growth stage in June and crop demand for N is high. The application of side-dress N at this time provides the N necessary for optimal crop growth. The potential for leaching is also reduced since evapotranspiration typically leaves the soil sub-saturated, greatly reducing the potential for N losses.

Future Plans

We are in the process of developing high-resolution (1 km^2) gridded climate data sets. Temperature data will be based on Rapid Update Cycle (RUC) model analyses, that have been adjusted using independent Cooperative Network station data and topographic features. These values will then statistically downscaled to 1 km. A similar procedure will be used for rainfall using daily NEXRAD precipitation estimates. We anticipate that these gridded data will be available through ACIS.