Pre-sidedress Soil Nitrate Test for Corn

Nitrogen and Corn Production

Nitrogen (N) is important for optimum corn production. The total N requirement can be met in a number of ways. First, soils supply N by organic matter decay. In Pennsylvania, manure and N added to the soil by legumes like alfalfa are also important sources of N. Finally, N can be supplied in fertilizers. In most situations the total N requirement of the corn crop is supplied by a combination of these sources. When the only sources of N are the soil and fertilizer, N fertilizer recommendations have been successfully estimated by basing them on realistic expected crop yield. However, the contributions of manure and legume N are variable and difficult to estimate reliably. Thus, it is difficult to make economically and environmentally sound N recommendations on many farms in Pennsylvania.

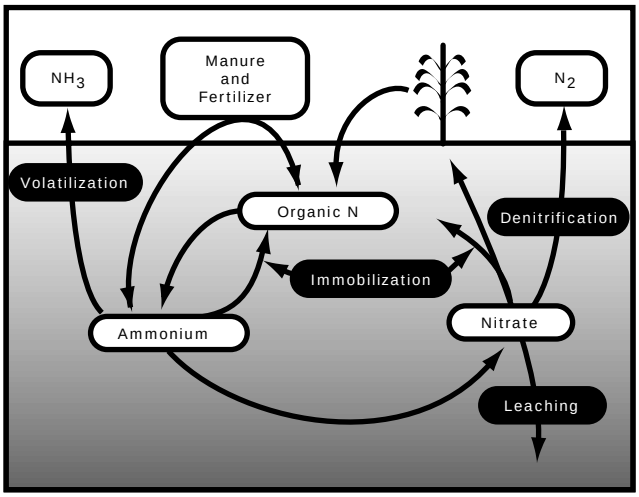
Nitrogen Behavior and Soil Testing

Soil testing has been used effectively for years to determine the availability of phosphorus (P) and potassium (K) in agricultural soils and for determining fertilizer recommendations for these nutrients. Unfortunately, due to the complex behavior of N in the soil, development of a reliable soil test for N availability has been more difficult.

As is evident in the N cycle diagram, N behavior in soil is very complex. More than 98 percent is relatively unavailable because it is tied up in soil organic matter. However, regardless of the form of N originally in the soil or added to it, soil N undergoes many changes that determine whether it becomes available to the corn crop primarily as nitrate N, or is lost to the environment. Most of these changes are carried out by microorganisms in the soil and thus are very sensitive to rainfall, temperature, soil drainage, and soil organic matter levels. Because of this sensitivity to environmental factors, changes in N availability and losses of N are generally highest during the spring and fall of the year—seasons when the crop is not actively taking up N. The result is greater potential for leaching and denitrification.

This behavior has several important implications for managing N for optimum corn production and for determining availability of soil N. Corn has the greatest need for N in the spring, starting about 30 to 45 days after plant emergence, following the period of greatest change in soil N availability.

Efficiency of N utilization can be improved if the N is applied after the spring wet season and near to the time of greatest need by the crop. A soil test at that time should more accurately reflect the actual availability of soil N for the corn crop. Sidedressing N in June, when the corn is 10 to 20 inches tall, has become a common practice for Pennsylvania corn growers.



Nitrogen Soil Test

A new approach to N soil testing whereby samples are taken during the growing season has been under study by researchers across the country, including a major effort in Pennsylvania. This test is called the Pre-sidedress Soil Nitrate Test (PSNT). The basis for this new N soil testing approach is taking soil samples just before sidedressing—after the spring wet period but before the period of major N demand by corn—and determining the nitrate-N available in the soil at that time. The results are then used to make sidedress N recommendations.

Research has shown that when the soil nitrate-N level is above 21 ppm, there is little chance of an economic response to adding additional N to the field. At soil nitrate-N levels below 21 ppm, sidedress N will be required to achieve optimum economic yield. The table below can be used to estimate an appropriate N recommendation in this situation.

A similar test, called the chlorophyll meter test, is used to estimate the nitrogen status of the growing corn crop based on the color of the corn leaves. This test is also a pre-sidedress test, run at the critical time just before the major demand by the crop. The color of the leaves is read directly on the plant in the field with a handheld meter. Thus, no samples need to be collected and analyzed and the results are available immediately. However, it is necessary to have a high-N fertilized check area in the field to calibrate the meter. This area must be established well ahead of when the meter readings will be made. Details on using the chlorophyll meter test and making recommendations based on the readings can be found in *Agronomy Facts #53, The Early Season Chlorophyll Meter Test for Corn.*

Both of these tests are recommended for use primarily on fields where there are significant organic N contributions, such as a history of manure applications or a use of forage legumes in the crop rotation cycle. These tests have limited value on most fields without organic N contributions, because these fields generally have low N levels and thus the standard recommendations are suitable.

Nitrogen Soil Test Sampling Procedure

1. Apply only a minimum of fertilizer N in the spring (starter fertilizer and/or N used as an herbicide carrier).
2. Apply manure based on the history of the field, a manure analysis, how the manure will be handled, and on crop requirements for N estimated from the expected yield and crop history.
3. Take soil samples when the corn is 12 inches tall or at least a week before planned sidedressing.
4. Sample the fields by taking 10 to 20 cores to a 12-inch depth if possible. If that depth is not possible, sample as deeply as you can. Avoid starter bands and other atypical areas. Because of sampling problems, this test cannot be used on fields that received injected fertilizer or manure.
5. Combine, crumble, and dry the cores as quickly as possible. Spread and dry the samples in the sun, or under a heat lamp in a well-ventilated area.
6. Send the sample to a reputable soil-testing lab for soil nitrate-N analysis, or use a reliable field test kit for soil nitrate-N to determine the nitrate-N level in the sample.
7. Calculate the adjusted N recommendation from the accompanying worksheet.

Calculation to Obtain Pre-sidedress Soil Nitrate Test Recommendation

Soil nitrate-N _____ ppm (1)

>>>If the soil nitrate level is ≥ 21 ppm, the N recommendation is zero, otherwise continue the calculations below.

Yield factor: _____ (2)
Expected yield (bu/A)

History factor: _____ + _____ + _____ = _____ (3)

Manure since last harvest	Previous crop	Manure history (past 3 years)
None = 0.75	Corn = 0	None = 0
Any = 3.5	Soybeans = 1.0	Any = 1.75
	Forage Legume = 3.5	
	Other = 0	

Recommendation: _____ — [_____ X _____] = _____ lb/acre [a]

(2) Yield factor — (3) History factor — (1) Soil nitrate-N

[a] If the calculated recommendation is less than 30 lb/A, a zero recommendation is suggested.

Prepared by: Douglas Beegle, professor of agronomy; Richard Fox, professor of soil science; Gregory Roth, associate professor of agronomy; and William Piekielek, research support associate.

Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

Where trade names appear, no discrimination is intended, and no endorsement by Penn State Cooperative Extension is implied.

Issued in furtherance of Cooperative Extension Work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and the Pennsylvania Legislature. T. R. Alter, Director of Cooperative Extension, The Pennsylvania State University.

This publication is available in alternative media on request.

The Pennsylvania State University is committed to the policy that all persons shall have equal access to programs, facilities, admission, and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. The Pennsylvania State University does not discriminate against any person because of age, ancestry, color, disability or handicap, national origin, race, religious creed, sex, sexual orientation, or veteran status. Direct all inquiries regarding the nondiscrimination policy to the Affirmative Action Director, The Pennsylvania State University, 201 Willard Building, University Park, PA 16802-2801: Tel. (814) 865-4700/V, (814) 863-1150/TTY.

© The Pennsylvania State University 1999 R2M299ps