

Soil Amino Sugar Test for Corn

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Nitrogen application for corn production is often based on yield goal and sometimes is adjusted for other N inputs such as manure, crop residues, and legume cover crops. Since in many cases N availability is not taken into account, under or over fertilization occurs in some growing seasons. While excessive N application increases the risk of environmental pollution as well as production costs, insufficient application of N may cause severe yield reduction.

Soil $\text{NO}_3\text{-N}$ testing is currently practiced in many regions and for various crops. However, the results of soil N measurements in humid areas, such as in Massachusetts, where considerable rainfall in the period between planting time and rapid phase of plant growth may occur, is not trustworthy unless done close to the time of N need. In the northeast the Pre-Sidedress Nitrate-N Test (PSNT) is recommended. It is a late-spring nitrogen management tool developed by Fred Magdoff (Univ. of Vermont) for use in corn production. The test is especially appropriate for corn on dairy farms where producers are utilizing animal manure. This is because the availability of nitrogen from manure varies due to several interacting factors. For example, there can be a high variability in time and method of manure application, accuracy in rate of spreading, uniformity in application, variability in manure analysis, rate of decomposition and other factors such as variable weather. The PSNT is taken to determine the amount of $\text{NO}_3\text{-N}$ in the top 12 inches of soil just prior to sidedress time, usually when corn is 12 inches tall. This takes into account soil N mineralization and expectation of soil N release. However, PSNT is not always accurate and convenient since:

- Soil samples need to be collected during the early growing season when farmers are very busy with many other tasks on their farm, and N application must be postponed until after testing. This may be problematic if adverse weather conditions delay sidedressing and corn gets too tall.
- The soil test may not be accurate in fields where nitrogen fertilizer or manure have been applied in a band application.
- PSNT may be much less accurate when used on sandy soils or on soils with poor drainage.
- The results may not be as accurate if the weather condition is cold and therefore, N release processes are slow.

Attempts have been made to introduce an alternative technique for determination of N sufficiency in soil for corn. One characteristic of the new approach should be to reduce variability in the soil N content caused by the processes including mineralization, immobilization, nitrification, denitrification, leaching, and plant uptake, processes that affect soil nitrate concentration. Ideally, a soil test for N would estimate the supply of organic N that gradually but continuously releases nitrate. This approach however, would be effective only if the organic N compound is readily mineralized and highly correlated to fertilizer-N responsiveness.

Recently, reports from researchers in Illinois indicate that among various organic fractions in the soil, concentrations of amino sugar N were considerably higher (33 to 1000%) in non-responsive than in responsive soils to fertilizer-N. In other words, accumulation of amino sugar N in soil reduces the yield response of corn to N fertilization. In these studies, soil concentrations of amino sugar N showed a very high correlation with both yield and fertilizer-N response. Soils were then classified as responsive and non-responsive to N fertilization when amino sugar N concentration was less than 200 mg kg⁻¹ or greater than 250 mg kg⁻¹, respectively. This method has potential economic implications for production agriculture, and also should be of value for controlling NO₃-N pollution of ground and surface water. It would make the time of soil sampling much less critical than with PSNT, so that soil N availability could potentially be predicted on the basis of a one-time test prior to the growing season using samples collected for evaluation of P and K and other nutrients.

In order to validate the above mentioned technique in determination of responsiveness of sites to N fertilization, experiments are being conducted by three farmers in different locations of Massachusetts and several more in Connecticut. In each location, two treatments one with adequate N application in spring and one without any form of nitrogen source are being evaluated. Each treatment is replicated 3 times in each field. Each experimental plot (strip) consist of 4 rows of planted corn with a length of 200 feet.

Soil samples from each strip have been taken in the fall (sometime between harvest and freezing) and also in the early spring for calculation of amino sugar N content. The comparison between the soil samples taken in two seasons will show if the level of amino sugar N stays relatively constant during the winter, which would give the farmer the flexibility of taking soil samples when he/she is less busy with many other tasks at the farm. In these experiments, the correlation of corn silage yield with the concentration of soil amino sugar N will also be investigated to find if the fall soil test predicted yield or N needs adequately. The results will also be compared with two other methods; PSNT and End-of-Season Corn Stalk Test, for examining the accuracy of each technique in these farms.

These on-farm studies are being conducted by farmers participating in one of the Farmer Research Group projects being coordinated by the University of Connecticut and the University of Massachusetts. SARE funding has been obtained for the larger Farmer Research Group/Network project. Contacts include Sue Ellen Johnson at 413-245-5857, Tom Morris at 860-486-0637 and Stephen Herbert at 413-545-2250.