

## LATE-VEGETATIVE CORN STAGE SOIL SAMPLING FOR NITRATE-N

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Interest in monitoring and applying nitrogen (N) to corn at mid- to late-vegetative growth stages has gained interest in recent years due to wet spring conditions and equipment available to move through tall corn. Also, some farmers and crop advisers have been monitoring soil nitrate-N concentrations throughout the growing season. The question that has come up is what do soil nitrate-N concentrations mean when sampled at mid- to late-vegetative growth stages?

### Soil Nitrate Sampling/Testing

The only soil nitrate test calibrated in Iowa is the late spring soil nitrate test (LSNT, also called the pre-sidedress nitrate test or PSNT in other states). Soil samples for that test are collected when corn is six to twelve inches in height. So, a very specific timing of soil sampling for the LSNT test (typically occurs late May through early June). Sampling before and after that timing invalidates use of the LSNT soil concentration calibration (critical value at 20 to 25 ppm nitrate-N). Also, the LSNT is calibrated for a one-foot sample depth, not with concentrations for a second or third foot. Research when the LSNT was developed looked at including the second foot, but the assessment of N sufficiency for corn was not improved significantly – so calibration was not developed for a two-foot depth (also, few farmers or crop advisers like a sampling requirement of two feet). Soil nitrate testing, like phosphorus and potassium, must have a calibration, with standard timing and depth of sampling – otherwise interpretation of test results will be incorrect.

### Banded Fertilizer and Manure

For soil nitrate testing when manure or fertilizer has been applied, a complication is injected/band applications. The manure or fertilizer band will have high concentrations compared to the between-band soil. Therefore, if soil cores are not pulled representative from within and between the bands, incorrect interpretation will occur. For example, if soil cores are only collected from between the N bands, then measured nitrate-N concentrations will be at background levels. Nitrate will not move laterally across the topsoil, so sampling between bands will not include nitrate remaining from banded N applications. Conversely, if soil cores are only pulled from within the band, then soil nitrate-N concentrations will be inflated. Iowa State University Extension and Outreach publication PM 1714 (Nitrogen Fertilizer Recommendations for Corn in Iowa) gives a suggested soil sampling protocol when N has been band applied. Simply, it is tough to get representative samples with banded fertilizer and manure. Add in soil sampling in tall corn, and the potential for poorly represented samples could easily increase.

### Soil Nitrate-N Across Vegetative Growth Stages

As corn grows, and is rapidly taking up large amounts of nitrate-N (as the plant takes up water), soil nitrate-N concentrations will decline and will change rapidly. The rapid uptake and change in concentration would make calibration of a soil nitrate test at mid- to late-vegetative growth stages difficult. Soil nitrate-N concentrations will be lower at later vegetative stages than present at the LSNT sample timing. And, by beginning of reproductive stages (VT/R1), soil nitrate-N concentrations in the top foot or two of soil will be quite low when N is applied at an economic

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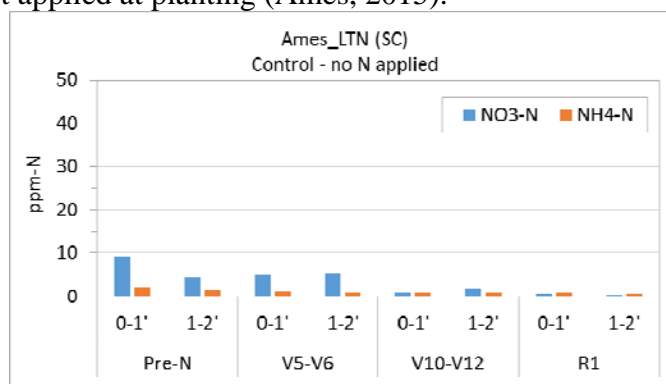
optimal rate. As an example, Figures 1 and 2 show soil nitrate-N results from preplant until the R1 corn growth stage in two studies conducted in 2015 near Ames with corn following soybean. The graphs in Figure 1 give the soil nitrate-N concentrations in the top two feet of soil with N (SuperU) broadcast applied at planting at a rate near the optimum that year (120 lb N/acre), double that rate (240 lb N/acre), and with no N applied. The graph in Figure 2 gives the soil nitrate-N concentrations in another study where anhydrous ammonia was applied preplant at 145 lb N/acre. In both studies soil nitrate-N concentrations decreased rapidly after the V5/V6 corn stage.

Therefore, I'm concerned that people believe that high soil nitrate-N concentrations should be present throughout the growing season, including late vegetative and grain fill. That is not the case, and it has been shown many times that post-harvest nitrate-N within the soil profile is elevated when more than needed N has been applied. This infers that soil nitrate-N concentrations within the soil profile should not be high across the reproductive stages. Remember, that soil mineralization/N cycling continues throughout the growing season when soils are moist, deep rooting ensures uptake from the soil profile, and N remobilization takes place within the plant. At the R1 (silking) growth stage, corn will have approximately 70-75% of the total N taken up by maturity (R6). At optimal N rates, and for high N use efficiency, the soil profile and corn plant stalk should not have high nitrate-N concentrations at seasons end.

## Late Nitrogen Applications

Nitrogen applications at late vegetative growth stages, by themselves, are not needed for high corn yields. If there is adequate N available to the plant (nitrate in the soil profile or inorganic-N being produced from on-going mineralization), more N will not increase yield. If N supply is short (due to say inadequate N application or losses), then corn can respond to late application, and as long as the applied N is within the active root system where water is being taken up. In Iowa's rainfed system, rainfall is typically needed to achieve good response to late applied N. If the corn crop does not utilize the applied N, then potential for loss of residual nitrate to water systems will increase.

Figure 1. Three graphs with soil nitrate-N and ammonium-N concentrations with no N and two rates of urea broadcast applied at planting (Ames, 2015).



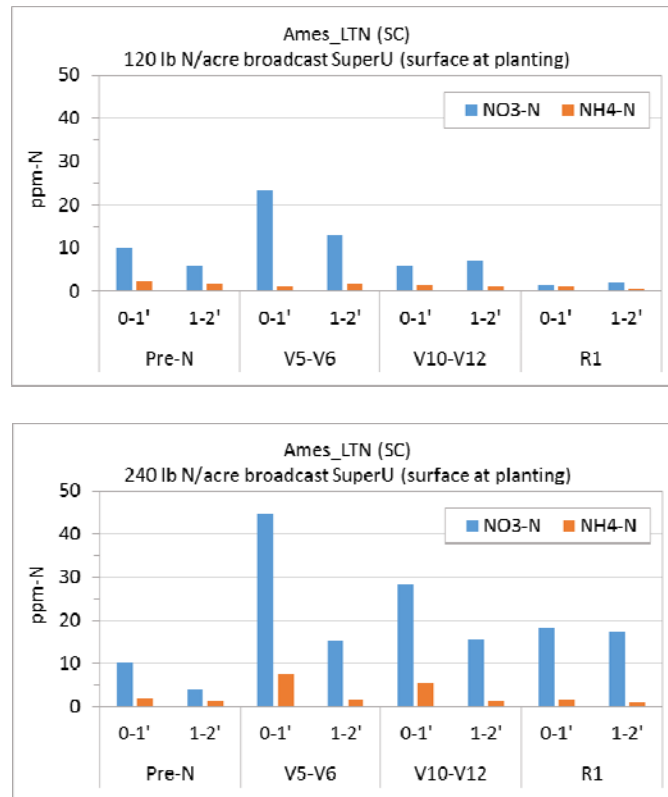


Figure 2. Soil nitrate-N and ammonium-N concentrations with anhydrous ammonia injected before planting (Ames, 2015).

