SOIL NITRATE SAMPLING – BANDED NITROGEN

John Sawyer, Professor, Department of Agronomy, Iowa State University

I've had a few calls the last week or so about soil nitrate test results (Late Spring Soil Nitrate Test, LSNT, 0-12 inch samples collected when corn is 6-12 inches tall; typically early June) from fields where anhydrous ammonia or other nitrogen was band injected. Quite often the question is about results that seem unreasonable low; although the opposite of unreasonably high results is possible but is likely not of as much concern. Why might these results occur?

Formation of Nitrate

The soil nitrate test is just that, it measures the concentration of nitrate-N. If an applied N source (fertilizer or manure) or organic matter has not converted to nitrate by the time of sampling, then that N will not be included in the test result. This could occur for fertilizers (like anhydrous ammonia, urea) and manures that have high ammonium or organic N. This is also a reason to not sample too early; and in colder than normal springs nitrification (and mineralization of organic N to inorganic N) to nitrate will be slower.

Nitrate Not in the Top Foot of Soil

Since the sample is collected only in the top foot of soil, then any nitrate that moves below the top foot or is lost via dentrification will not be included in the soil sample. If the loss is beyond the root zone for nitrate leaching, or denitrified, then the sample will reflect N not available to the crop. If the nitrate movement is below the top foot but still in the rooting zone, then the test will incorrectly indicate N not present that actually is available for plant use.

Nitrate in the Top Foot of Soil Not Sampled

If N fertilizer or manure is banded in the soil, then applied nitrate or nitrate resulting from nitrification will also be concentrated in a band. If nitrate moves with soil water, then it will move downward below the fertilized band (not horizontally). Therefore, soil sampling must correctly account for this concentrated zone, that is, the sample must have soil from the band that is mixed proportionally with soil outside of the band that does not contain applied N. This is quite difficult to do. There is no perfect solution to this, and the suggested approach has been to collect soil cores in three multiple sets of eight across the width of the corn rows. The intent is to have this sample then be representative of the field situation.

What an Injected Ammonia Zone Can Have for Nitrate Concentration

In the May 22, 2009 Current Topic article I gave data on the ammonium-N concentration about 1½ months after spring application of ammonia at various distances from the injection band (with 120 lb N/acre applied April 5 at Urbana IL, the ammonium-N concentration on May 18 was at approximately 700 ppm at 0-1 inch, 300 ppm at 1-2 inch, and 25 ppm at 2-3 inch from the injection point – sampled in a cross pattern vertically and horizontally). In that same soil sampling, the corresponding nitrate-N concentrations were approximately 225, 180, 120, and 75 ppm, respectively, for 0-1, 1-2, 2-3, and 3-4 inches from the injection point. As you see, the nitrate is concentrated in the same area as the applied ammonium.

Summary
Therefore, soil cores could easily miss nitrate in an application band/zone, or disproportionately overestimate the concentration. This is why a representation of cores from within the band and from outside the band are needed to correctly give a nitrate-N concentration to use for interpretation of the soil nitrate test. And, this is a reason many cores are needed per sample and why the cores need to be mixed very well so soil from the "hot zone" at or near the injection point is mixed with the entire soil collected and represented correctly in the soil put into the sample bag for analysis. The same type of issue (as with anhydrous ammonia) will exist for other N materials (fertilizer and manure) injected or placed into concentrated bands.