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Nitrate Testing for Nitrogen Management

by Jack Legg, CCA-ON

Although the nitrogen cycle is well understood, predicting and determining the maximum economic rate of nitrogen for corn is an annual challenge. We know that organic N must mineralize into ammonium, and ammonium then nitrifies converting it to nitrate-N; processes largely dependent on environmental conditions and soil microbial activity. Also impacted by weather and soil conditions are the losses of N, namely volatilization and denitrification of ammonia and nitrate respectively, essentially 'gassing off' to the atmosphere. Nitrate-N, the plant-available form that is taken up in the largest quantity, is very soluble and thus prone to leaching.

This begs the question, "What is the best way to apply nitrogen to the crop, to maximize availability and minimize losses?"

The answer is not simple, and variable from one field to the next. Applying a rate of 8 lbs/ac every week of the growing season would definitely feed the crop and minimize N loss, but is neither very practical nor economically efficient. A 100% up-front application in the spring, or even the autumn prior, as occurs in some North American regions, is definitely easy but vastly increases the likelihood of N losses. So, the answer must lie somewhere between these two extreme examples.

Equipment and technology now allow for easier application into the growing crop, and in fact research has shown that corn has much demand for N late in the growing season. It is logical then, that an initial application pre-plant or with planting, followed by a supplemental rate in-season, is the best management strategy. The question still remains though, how much to apply?

One could use the old rule of thumb, 1 pound of N for each bushel of yield; but it isn't a linear relationship as zero N does not result in zero yield, and 300 lbs N does not necessarily produce 300 bushels of corn. Knowing how much is currently available near sidedress timing allows for the fine-tuning of final rates, and this can be accomplished with a PSNT (pre-sidedress nitrate test). The most common question around PSNT's relates to the accuracy of the test. It should be noted, that with proper sampling and handling, the test itself is accurate. The suspected 'inaccuracy' of nitrate testing is due to the difficulty of rate determination, since we have no way of accurately predicting what the growing season's weather conditions

will be, and therefore what the mineralization rate will be or the amount of losses that will be incurred. The other misconception about the test, is that it will reflect all of the nitrogen in the soil, such as manure additions, clover or cover crops for N sequestration, or bio-solids application as examples. The PSNT will capture the portion of these that have converted to nitrate and ammonium, but there will be continued release from these sources during the growing season that are currently still in the form of organic N.

It is expected that with soils this spring relatively cooler than normal, that perhaps there will be less soil nitrate than typical. The rate of mineralization is generally consistent from year to year, but when it is slower to start due to cool soils the accumulated nitrate will be less. Only with a PSNT can this be determined.

Sampling & Handling Guidelines:

Nitrate samples should be collected as close to sidedress time as possible, usually when corn is 4-5 leaf in the period from late May to mid June. Extract samples to a 30 cm (12") depth, randomly across a representative area, but between the corn rows to avoid any starter nitrogen. Where obvious variability exists, due to soil type, topography, or variable organic matter, independent samples may reveal an opportunity to apply at different rates, which further lessens potential of environmental losses and improves economic efficiency. Nitrate samples should be kept cool and sent to the laboratory as soon as possible.

In 2015, OMAFRA released a new recommendation chart for N rates, variable by yield goal, that is based on a 30cm (12 inch) nitrate test. The previous N recommendations did not consider yield, and provided a zero N recommendation when soil nitrate was greater than 25 ppm. The new table provides N rates well beyond this limit, for high yield expectations. It should be noted though, that starter applied N can be credited from the recommended rates, as well as a predicted credit from previous crops such as clover, soybeans, or alfalfa since there will be additional N released through the growing season.

An approximate conversion of soil test nitrate to pounds is $\text{ppm} \times 4$. And, it is generally assumed that 60% of this value is available in the 12 to 24 inch depth. So, a 25 ppm nitrate test is equivalent to $25 \times 4 \times 1.6 = 160$ lbs of available N.

Contact your local CCA for assistance with submitting and interpretation of PSNT samples.

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