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Cornstalk nitrate interpretation

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Cornstalk nitrate interpretation

Abstract
So you've gotten back the results of the cornstalk nitrate samples collected this fall. Now, what do the results mean? The stalk nitrate test is based on the concentration of nitrate-N in the lower cornstalk (8-inch segment from 6 to 14 inches above the ground) when the plant reaches maturity (ISU Extension publication PM 1584, Cornstalk testing to evaluate nitrogen management). In general, as the amount of plant-available N in the soil during the time period before plant maturity increases, nitrate in the lower stalk increases. However, the stalk nitrate-N concentration can be greatly influenced by other external and internal plant factors.

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Interpretation of Test Results
So you’ve gotten back the results of the cornstalk nitrate samples collected this fall. Now, what do the results mean? The stalk nitrate test is based on the concentration of nitrate-N in the lower cornstalk (8-inch segment from 6 to 14 inches above the ground) when the plant reaches maturity (ISU Extension publication PM 1584, *Cornstalk testing to evaluate nitrogen management*). In general, as the amount of plant-available N in the soil during the time period before plant maturity increases, nitrate in the lower stalk increases. However, the stalk nitrate-N concentration can be greatly influenced by other external and internal plant factors.

An example is precipitation/soil moisture. It has been known for a long time that drought conditions can result in elevated nitrate in the lower stalk. This can be due to nitrate uptake late in the season in combination with a much-reduced grain fill or missing ears. For chopping grain silage, the long-standing suggestion is to raise the cutter bar and leave more of the stalk portion with high nitrate. While results of the stalk test are reasonable in this situation, that is, high concentrations indicate more N than needed in a drought-affected yield, the results should not be extrapolated for normal production years. Another example is high grain yield and/or combination with a long and slow grain fill. Nitrogen taken up by the plant is directed to developing grain, so nitrate does not accumulate.

These external and internal factors complicate interpretation of stalk nitrate test results, and make specific interpretation from low to optimal concentrations difficult (less than 2,000 ppm nitrate-N). Interpretation at high concentrations is more definitive, as concentrations above 2,000 ppm nitrate-N more consistently indicate excess N available to the plant. If high levels are found for several seasons, and with no drought-reduced production, then the interpretation becomes clear that the N applications are too high and there should be adjustment to more moderate rates. Continued monitoring can indicate if the high stalk nitrate concentrations are no longer found after adjustment in rate.

Research Evaluation
The stalk nitrate test should help guide future N applications toward economic optimum rates. To evaluate the potential for this, and to examine complicating issues related to interpretation, a dataset from many site-years of N rate trials (N applied at multiple rates from zero to 240 lb N/acre) was used to plot the difference in N rate from the economic optimum N rate (EONR) versus stalk nitrate concentration. The N rate differential is how far a specific applied N rate in the trial was from the site EONR. For example, if an applied N rate was 160 lb N/acre, and the site EONR was 110 lb N/acre, then the N rate differential was a positive 50 lb N/acre (an excess rate). If an applied N rate was 80 lb N/acre, and the EONR was at 125 lb N/acre, then the N rate differential was a negative 45 lb N/acre (a deficit rate). If an applied N rate was 120 lb N/acre, and the EONR was 120 lb N/acre, then the differential was zero (at the economic optimum rate).

Figure 1 shows that when concentrations were above 2,000 ppm (especially well above 2,000 ppm), almost every time the N rate was greater than the EONR. However, when concentrations were less than 2,000 ppm, the N rate differential from EONR spanned a wide range from deficit to excess. This means interpretation and potential for future rate adjustment is not clear. Figure 2, which shows the stalk nitrate concentrations on a log scale (visually “expands” the low concentrations and “contracts” the high concentrations), highlights the large variation in stalk nitrate concentrations at near optimal to deficit N and the difficulty in trying to provide specific adjustments in N rate based on the stalk test when concentrations are less than 2,000 ppm. From this type of data analyses, it is clear that greatest confidence occurs in interpretation of high concentrations, and less confidence can be placed in low concentrations or in specific rate adjustments.

For any N test, perfection should not be assumed. Also, each test will have specific strengths and weaknesses. For the stalk nitrate test, the strength lies in interpretation of high concentrations. This means the test is best suited for understanding when N applications are greater than crop need, and a major economic benefit can come from improved application rate.
John Sawyer is an associate professor with research and extension responsibilities in soil fertility and nutrient management.