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Corn Stalk Nitrate Interpretation

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Abstract
You've gotten results from corn stalk nitrate samples collected this fall. (Corn stalk nitrate analysis form.) Now, what do the results mean? The stalk nitrate test is based on the concentration of nitrate-N in the lower corn stalk (8 inch segment from 6 to 14 inches above the ground) when the plant reaches maturity (See Cornstalk testing to evaluate nitrogen management, PM 1584). In general, a larger amount of plant-available N in the soil during the time period before plant maturity results in a greater concentration of nitrate in the lower stalk. 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
You've gotten results from corn stalk nitrate samples collected this fall. (Corn stalk nitrate analysis form.) Now, what do the results mean? The stalk nitrate test is based on the concentration of nitrate-N in the lower corn stalk (8 inch segment from 6 to 14 inches above the ground) when the plant reaches maturity (See Cornstalk testing to evaluate nitrogen management, PM 1584). In general, a larger amount of plant-available N in the soil during the time period before plant maturity results in a greater concentration of nitrate in the lower stalk. 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 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. Similar but opposite situation for extremely wet conditions (like many fields in 2010); where stalk nitrate concentrations would be quite low due to excess rainfall and N losses. 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. Of importance for test interpretation is to monitor fields for multiple years before making adjustments in N management.

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). The test also does not predict an amount of under- or over-N supply, that is, how much to change N application rate. Interpretation at high concentrations is more definitive, as concentrations greater than 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 N inputs (fertilizer/manure) are too high and there should be adjustment to more moderate rates. Continued monitoring in future years can indicate if 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 sites and years of N rate trials (N applied at multiple rates from zero to 240 lb N/acre) was used to plot the difference in applied N fertilizer rate from the economic optimum N rate (EONR) versus stalk nitrate concentration. This N rate differential is how far a specific applied N rate in the trial was from the EONR. For example, if an

applied N rate was 160 lb N/acre, and the EONR was 110 lb N/acre at a site, 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 stalk nitrate 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 (excess) 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 over time are greater than crop need, and an economic and environmental benefit can come from improved application rate.

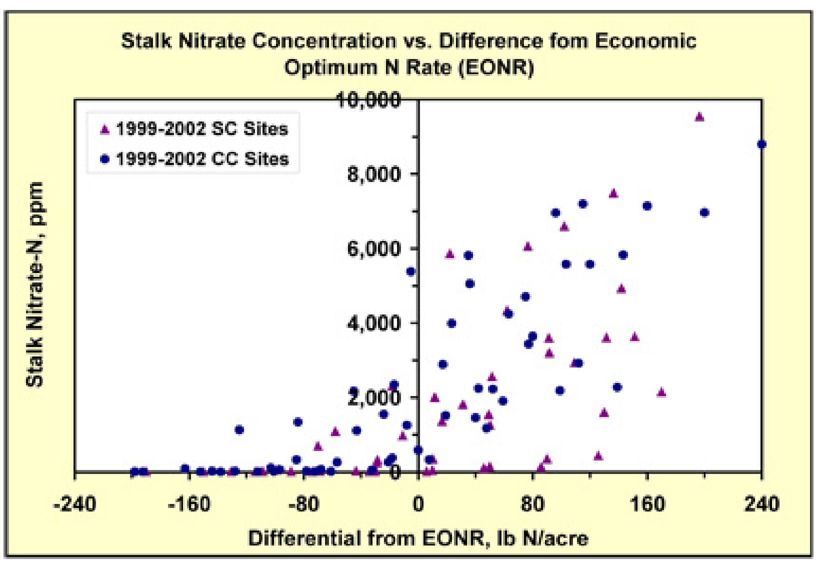

Figure 1. Graph showing the relationship between corn stalk nitrate-N concentration and the difference in N rate from the economic optimum N rate (EONR). Positive N rate values indicate rates greater than the economic optimum, negative values indicate rates less than the economic optimum, and zero is at the economic optimum rate. *Data from J. Sawyer with N rate response trials with continuous corn (CC) and corn following soybean (SC).*

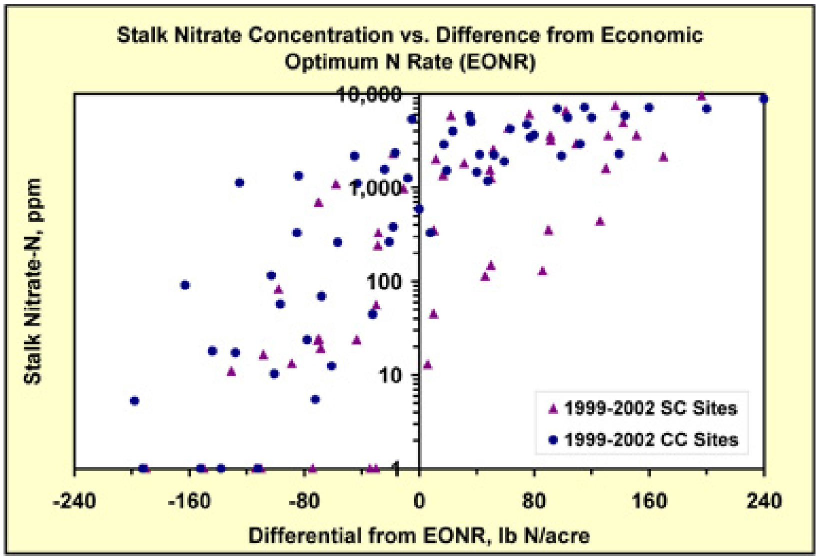

Figure 2. Graph showing the relationship between corn stalk nitrate-N concentration and the difference in N rate from the economic optimum N rate (EONR). Stalk nitrate concentrations were converted to a log scale. *Data from J. Sawyer with N rate response trials with continuous corn (CC) and corn following soybean (SC).*

John Sawyer is a professor with research and extension responsibilities in soil fertility and nutrient management.

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