

Effect of Sampling Height and Length on Corn Stalk Nitrate Test Results



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Introduction

The end-of-season corn stalk nitrate test (CSNT) measures nitrate concentrations in the lower portion of corn (*Zea mays* L.) stalks at silage harvest time. This test is a useful tool as it helps fine-tune nitrogen (N) management over time and on a field by field basis.

The recommended sampling protocol for the CSNT is to collect an 8-inch portion of each stalk, between 6 and 14 inches above the ground. Leaf sheaths should be removed from stalk samples and stalks handled to avoid contact with the soil. While sampling, it is also recommended to avoid taking stalk samples from corn damaged by disease or insects, such as corn borers.

In the fall of 2009, the Cornell Nutrient Management Spear Program (NMSP) occasionally received samples that were shorter or longer than 8-inches. It was also frequently remarked by farm advisors that it was easier to take the samples after the chopper had passed through the field, but that this was only possible if fields were chopped at 14 inches or higher, compromising dry matter yield. This raised questions about the impact of sampling 8-inch stalks closer to the ground, and/or taking shorter stalks than the recommended 8 inches to reduce sample volume and accommodate lower chopper heights. Work by Wilhelm et al. (2005) showed that stalks taken between 4 and 12 inches and those taken between 8 and 16 inches above the ground showed minor deviations from stalks taken 6 to 14 inches above the ground. This implies that samples can be taken closer to the ground to enable sampling after harvest. However, little is known about the impact of taking shorter stalks.

Our objective was to evaluate the impact of taking shorter stalk samples (6-7 inches length) on CSNT results using stalks varying in CSNT values from low to excess.

Methods

Ten corn fields were selected from two farms: the Musgrave Research Farm in Aurora (2 fields) and the Teaching and Research Center in Harford (8 fields). At each

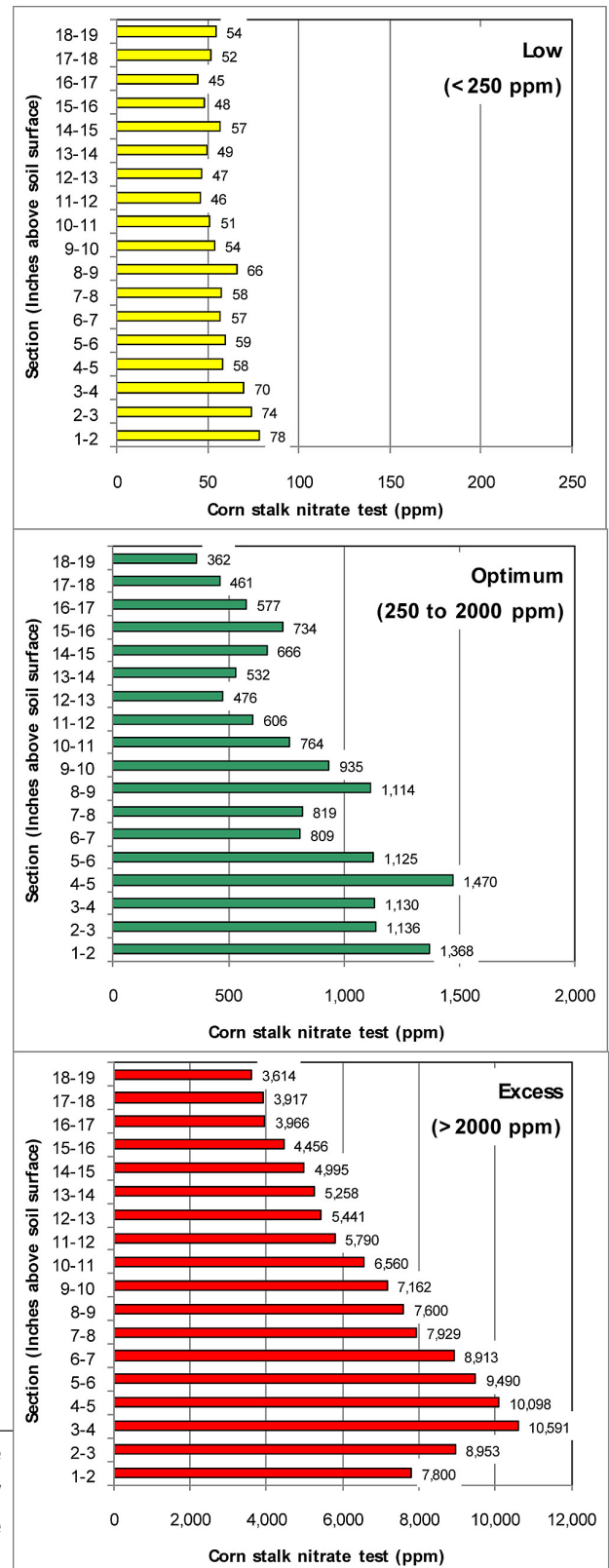


Figure 1. Average corn stalk nitrate test results as impacted by the position of the 1-inch piece in the stalk for average of 10 fields, low fields (2 locations), optimal fields (2 locations) and fields with excessive CSNT (6 fields).

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location, five 20-inch stalks were collected (in one row) from 0 to 20 inches above the ground. Each stalk was separated into eighteen 1-inch segments (the top segment (18-20 inches) was discarded). Corresponding sections of five plants per field were combined to obtain sufficient material to conduct the study. In total, 180 stalk segments were dried, ground, and measured for stalk nitrate concentration in the NMSP laboratory using the $Al_2(SO_4)_3$ extracting solution and a nitrate combination ion selective electrode.

Results

Distribution of CSNT

Stalk nitrate decreased with distance from the soil with the exception of the first section 0 to 1 inch above ground. Fields that were low in CSNT (two fields at the Musgrave Research Farm) showed no differences among stalk sections (Figure 1, top chart). However, for fields that were optimal in N (two fields) and those that showed excessive N levels (six fields), nitrate accumulated at the bottom 10-12 inches of the stalks (Figure 1, middle and bottom charts).

Effect of sampling height (distance from ground) on 8-inch samples for CSNT

For corn that was low in stalk nitrate (CSNT less than 250 ppm; two fields), sampling height above the ground did not impact the CSNT of 8-inch samples as long as samples were taken 3 or more inches above the ground (Figure 1, top chart). For corn optimal in CSNT (250-2000 ppm), 8-inch samples could be taken from 5 to 9 inches above the ground without significant differences in CSNT. Taking samples 4 inches or

Table 1. Impact of length of stalk and position above the ground on corn stalk nitrate test (CSNT) averaged over ten fields. The standard protocol is an 8-inch sample taken 6 inches above the ground (in blue). In red are listed the sampling protocols for samples that resulted in means no more than 5% different from the standard protocol.

| Position from ground (inches) | Length of stalk (inches) | | | | | | | Effect of cutting height on 8-inch samples ↓ | |
|-------------------------------|-------------------------------------|--------|-----|--------|--------|-------|--------|---|---------|
| | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 8 | P value |
| Average | ----- % nitrate concentration ----- | | | | | | | | |
| 1 | 154 | 150 | 146 | 141 | 135 | 131 | 127 | 146 | <0.0001 |
| 2 | 146 | 141 | 136 | 131 | 126 | 122 | 119 | 136 | <0.0001 |
| 3 | 138 | 133 | 127 | 123 | 118 | 115 | 112 | 127 | <0.0001 |
| 4 | 127 | 121 | 117 | 113 | 109 | 107 | 104 | 117 | 0.0791 |
| 5 | 116 | 112 | 108 | 105 | 103 | 100 | 97 | 108 | 0.9564 |
| 6 | 106 | 103 | 100 | 98 | 95 | 93 | 90 | 100 | . |
| 7 | 99 | 96 | 95 | 92 | 90 | 87 | | 95 | 0.9658 |
| 8 | 92 | 90 | 88 | 86 | 83 | | | 88 | 0.1005 |
| 9 | 87 | 84 | 82 | 80 | | | | 82 | 0.0017 |
| 10 | 81 | 79 | 77 | | | | | 77 | <0.0001 |
| 11 | 78 | 76 | | | | | | | |
| 12 | 74 | | | | | | | | |
| 6 | 106 | 103 | 100 | 98 | 95 | 93 | 90 | ← Effect of stalk length on 6 inch cutting height | |
| P value | 0.0365 | 0.8962 | . | 0.7798 | 0.0002 | 0.002 | <0.001 | | |

closer to the ground did result in higher CSNT values than the standard 8-inch samples taken at 6 inches above the ground (Figure 1, middle chart).

Where stalks were excessive in CSNT (2000 ppm or higher), samples taken 1 or 2 inch above the recommended height of 6 inches were not significantly different, whereas samples taken closer to the ground showed higher CSNT levels and those taken higher above the ground were lower in CSNT (Figure 1, bottom chart).

The 8-inch stalk samples taken at 5 and 7 inches above the ground resulted in CSNT values that were less than 5% higher or lower than those obtained with the standard protocol of 8-inch stalks taken 6 inches above the ground. The 8-inch stalk samples taken 4 inches (or lower) or 8 inches (or higher) above the ground had CSNT means that were more than 10% higher or lower than the CSNT obtained with the standard protocol (Table 1).

Effect of stalk length on CSNT

Six-inch samples resulted in CSNT values within 5% of the standard protocol only when samples were taken 7 inches above the ground (Table 1). The CSNT of 7-inch stalks was within 5% when samples were taken 6 inches above the ground. Seven-inch samples taken 7 inches above the ground showed less than 5% deviation in CSNT as well, but this alternative requires a 14-inch chopping height (i.e. no different from the standard protocol). Samples taken 5 inches above the ground needed to be 9 inches or longer to be within 5% of the value obtained with the recommended 8-inch stalks, a disadvantage compared to the standard protocol (greater sample volume to handle).

Conclusions

The standard protocol for CSNT sampling is to take an 8-inch sample between 6 and 14 inches above the ground. Results within 5% of this value can be obtained with sampling of (1) 7-inch stalks taken between 6 and 13 inches above the ground, or (2) 6-inch stalks taken between 7 and 13 inches above the ground. Both alternatives reduce sample volume (by 1 and 2 inches, respectively) and allow for sampling after harvest for fields chopped at 13 inches or higher.

References

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- Wilhelm W.W., G.E. Varvel, and J.S. Schepers. 2005. Corn stalk nitrate concentration profile. *Agron. J.* 97:1502-1507.