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## Agronomy Tips

### Corn Stalk Nitrate – Research Update – *(Jim Camberato)* –

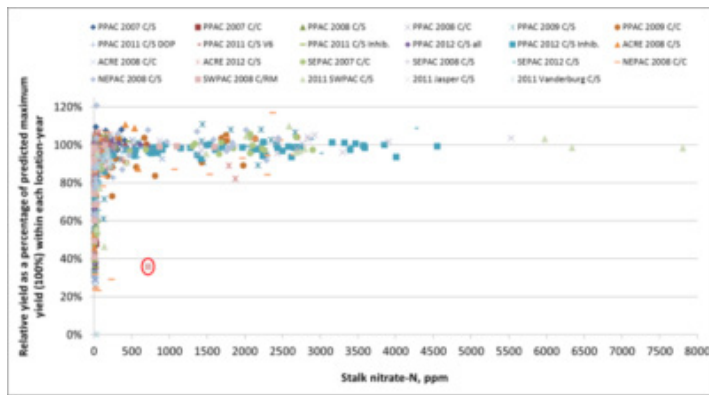
The cornstalk nitrate test (CSNT) is recommended as an end-of-season assessment of an N management program (N source, timing, placement, and rate). For this diagnostic test, 15 or more 8-inch stalk segments (beginning 6 inches above the soil surface) are taken from representative areas of a field within a few weeks after blacklayer and analyzed for nitrate-nitrogen ( $\text{NO}_3\text{-N}$ ). Accumulation of  $\text{NO}_3\text{-N}$  in the lower corn stalk results from N availability exceeding crop N utilization. More details on the test can be found in Extension Bulletin AY-322-W.<sup>1</sup>

The CSNT was developed at Iowa State University in the late 1980's and the interpretation of cornstalk  $\text{NO}_3\text{-N}$  concentrations used in Iowa differs very little from that used in Indiana. Iowa State Univ. considers less than 250 parts per million (ppm)  $\text{NO}_3\text{-N}$  to be low, 250 to 700 ppm to be marginal, 700 to 2,000 ppm to be optimal, and greater than 2,000 ppm to be excessive.<sup>2</sup> Previous research conducted in Indiana in 1996 and 1997 concluded that  $\text{NO}_3\text{-N}$  concentrations between 450 and 2,000 ppm were associated with optimal N availability while concentrations greater than 2,000 ppm  $\text{NO}_3\text{-N}$  indicated N availability was excessive.<sup>1</sup>

The relationship between cornstalk  $\text{NO}_3\text{-N}$  and relative yield from the most recent Indiana N response trials (23 location-years conducted in 2007-2009 and 2011-2012) (Fig. 1) are quite similar to the earlier findings in both Iowa and Indiana (despite 30+ years of hybrid improvement) suggesting similar interpretations are relevant today. Most of these studies were conducted with at-planting or sidedress N application as 28% urea-ammonium nitrate. Although the timing and form of N were not found to alter the relationship between cornstalk  $\text{NO}_3\text{-N}$  in earlier Iowa and Indiana research recent research conducted by the On-farm Network, Iowa Soybean Association suggests the fall application of manure may need to be evaluated differently (more on this later).

The recent Indiana data was categorized by cornstalk  $\text{NO}_3\text{-N}$  and for each category the average relative yield and the average difference in fertilizer N rate relative to the N rate needed to maximize yield was determined. Seventy-two percent of cornstalk samples had  $\text{NO}_3\text{-N}$  concentrations below 250 ppm (Table 1). Relative yield in this  $\text{NO}_3\text{-N}$  category ranged from 25 to 110% of maximum yield (Figure 1), averaging 82%. All relative yields less than 80% of maximum yield were associated with cornstalk  $\text{NO}_3\text{-N}$  concentrations less than 250 ppm (Figure 1). However, many N rate treatments producing maximum yield also had

We gratefully acknowledge the support provided for these trials by the Indiana Corn Marketing Council, Pioneer Hi-Bred Int'l and LG Seeds (seed contribution for Purdue trial sites), A&L Great Lakes Labs (discounted analysis costs), individual farmers and crop consultants, Purdue Univ. Office of Ag Research Programs, and all of the Purdue Ag Center staff.



### Using the end-of-season cornstalk nitrate test to adjust fertilizer-based N management programs

Multiple seasons of CSNT evaluation are warranted before altering an N management program because the optimum N rate varies from season to season. Many factors affect the optimum N rate; including differences in soil N supply, loss of N from the rootzone, hybrid differences in N use, pest and weed impacts on N use, and the interaction of these and other factors. The average correct N rate for maximizing profit over the long term<sup>3</sup> is almost certainly wrong in any one season – either too much or too little. Thus the evaluation of a N management system with the CSNT (or any other N assessment tool) on any given field in a single season is interesting, but not particularly useful in making management decisions for future years. Unfortunately, there is no concrete guidance on how many years the CSNT should be conducted, but I would suggest three or more seasons to be reasonable.

Figure 1. Stalk nitrate-N relationship to relative yield for 23 location-years of N trials conducted in Indiana from 2007-2009 and 2011-2012. Within each location and year the yield of an individual N rate treatment was related to the predicted maximum yield at that location in that year.

less than 250 ppm cornstalk NO<sub>3</sub>-N. Therefore, a low level of cornstalk NO<sub>3</sub>-N does not necessarily mean the crop was short of N.

Cornstalk NO<sub>3</sub>-N concentrations between 250 and 2,000 ppm were associated with relative yields greater than 80% of maximum yield (Figure 1) and an average relative yield of 98% for each category in this range of cornstalk NO<sub>3</sub>-N (Table 1). Nitrogen rate deficits for cornstalk NO<sub>3</sub>-N categories between 250 and 1,500 ppm ranged from 21-31 pounds of N per acre (Table 1). Adequate N (<2 pounds per acre excess) was associated with cornstalk NO<sub>3</sub>-N of 1,501-2,000 ppm (Table 1).

One-hundred percent of maximum yield and an excess N application of 25-31 pounds of N per acre were associated with cornstalk NO<sub>3</sub>-N concentrations between 2,001-4,000 ppm (Table 1). Only 7 cornstalk samples had NO<sub>3</sub>-N greater than 4,000 ppm. The average excess N application was 74 pounds of N per acre for this category.

Although it would be great to have applied the optimum N rate every year it is not likely to be possible. Unfortunately there is no concrete guidance on what level of N excess should trigger a reduction in N application rate. In my opinion plus or minus 20-30 lb N/acre is normal variation in optimum N rate from year to year for a particular cropping system. Based on the most recent Indiana research a NO<sub>3</sub>-N concentrations in excess of 4,000 ppm might represent excessive N application rates (74 lb N/acre excess). Unfortunately this estimate of excess N is based on only 7 samples. Ongoing research will hopefully add to this analysis after harvest this season.

If end-of-season cornstalk NO<sub>3</sub>-N concentrations are consistently less than 250 ppm or more than 4,000 ppm one might consider conducting N response strip trials, rather than rely solely on the CSNT to evaluate the current N management program. Guidelines on conducting suitable N response trials can be found at: <<http://www.agry.purdue.edu/ext/ofr/protocols/PurdueNTrialProtocol.pdf>>.

**Table 1. Relative yield (as % of predicted maximum yield within each of 23 location-years) and N rate deficit (-) or excess (+) (relative to the N rate needed to maximize yield in that location-year) for various categories of end-of-season corn stalk NO<sub>3</sub>-N. Individual data points are shown in Fig. 1.**

Category of corn stalk NO <sub>3</sub> -N, ppm	Number of observations	Average % of predicted maximum yield	N deficit (-) or excess (+), pounds per acre
≤250	490	82	-90
251 - 500	33	98	-21
501 - 1,000	35	98	-31
1,001 - 1,500	19	98	-25
1,501 - 2,000	25	98	2
2,001 - 2,500	34	100	29
2,501 - 3,000	23	100	31
3,001 - 4,000	12	100	25
≥4,000	7	101	74

## Using the end-of-season cornstalk nitrate test to adjust manure-based N management programs

Recent research conducted by the On-farm Network, Iowa Soybean Association suggests the current Iowa and Indiana interpretations of optimal and excessive N may be incorrect when fall-applied manure is the N source. Results of 52 trials with fall-applied manure showed that when cornstalk  $\text{NO}_3\text{-N}$  was 3,500 ppm or less there was a greater than 50% probability of having had a profitable response to additional N.<sup>4</sup> Conducting strip trials to assess N response in manure-based N management programs would definitely be encouraged in light of these findings. Interestingly the Iowa Soybean Association research with fall, spring, or sidedress fertilizer applications found a 50% probability of a response to additional N occurred at 500 ppm - well within the current interpretation used in Iowa and Indiana.

## References Cited

<sup>1</sup>Cornstalk testing to evaluate the nitrogen status of mature corn: Nitrogen management assurance. Sylvie M. Brouder. Purdue University Coop. Ext. Ser. AY-322-W. <<http://www.agry.purdue.edu/ext/pubs/AY-322-W.pdf>>.

<sup>2</sup>Cornstalk testing to evaluate nitrogen management. A.M. Blackmer and A.P. Mallarino. Dep. Agronomy, Iowa State Univ. PM1584. <<http://www.extension.iastate.edu/Publications/PM1584.pdf>>.

<sup>3</sup>Nitrogen management guidelines for corn in Indiana. J. Camberato, R.L. Nielsen, and B. Joern. <<http://www.agry.purdue.edu/ext/corn/news/timeless/NitrogenMgmt.pdf>>.

<sup>4</sup>R management: Differentiating nitrogen management categories on corn in Iowa. Peter M. Kyveryga and Tracy M. Blackmer. Better Crops/Vol. 97 (2013, No. 1, p. 4-6). <[http://www.ipni.net/publication/bettercrops.nsf/0/862AC3550E6594C385257B18005B7A41/\\$FILE/4.pdf](http://www.ipni.net/publication/bettercrops.nsf/0/862AC3550E6594C385257B18005B7A41/$FILE/4.pdf)>.

## Bug Scout



**“Hey...I’ve got to get stalk samples for nitrate testing first!!!”**

# Weather Update

**Weather Outlook by NWS OHRFC** - (James Noel, NOAA/NWS/Ohio River Forecast Center) -

The weather pattern has trended back toward normal after the hot and dry spell of August and early September.

Temperatures into the first week of October will run slightly above normal. At the same time weather systems have become progressive again which will give us a few rain chances over the next 2 weeks but rainfall totals will not be too far from normal so field work should be able to proceed. The next rain system will occur for the second half of the

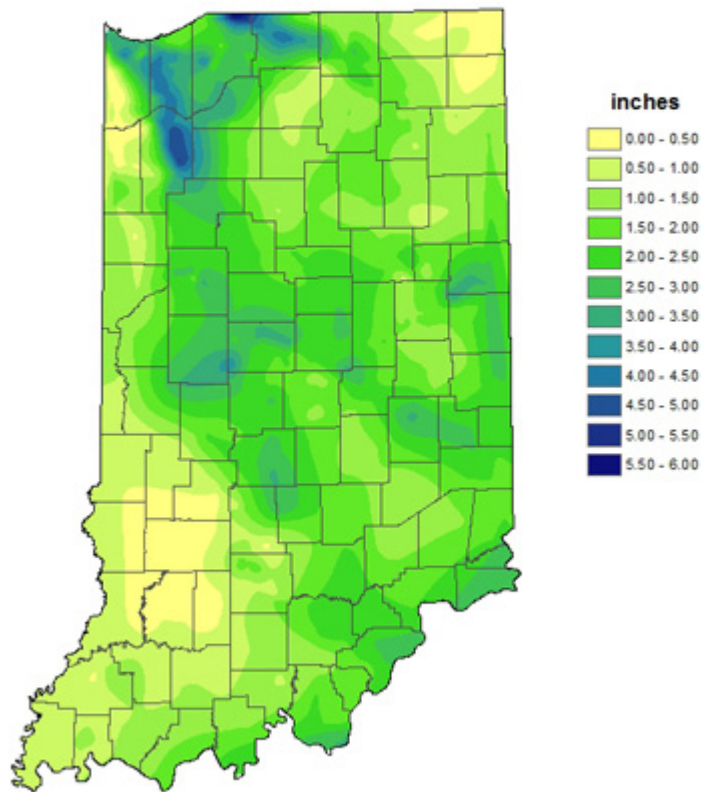
weekend. Another system should arrive late next week or the first weekend of October. Again, rainfall will be close to normal into early October.

There are some indications rainfall will go to above normal starting around mid October possibly lasting into November. The more crops are harvested as early as possible probably the better.

The latest 16-day rainfall totals from the NOAA/NWS Ohio River Forecast Center can be found here: <<http://www.erh.noaa.gov/ohrfc/HAS/images/NAEFS16day.pdf>>.

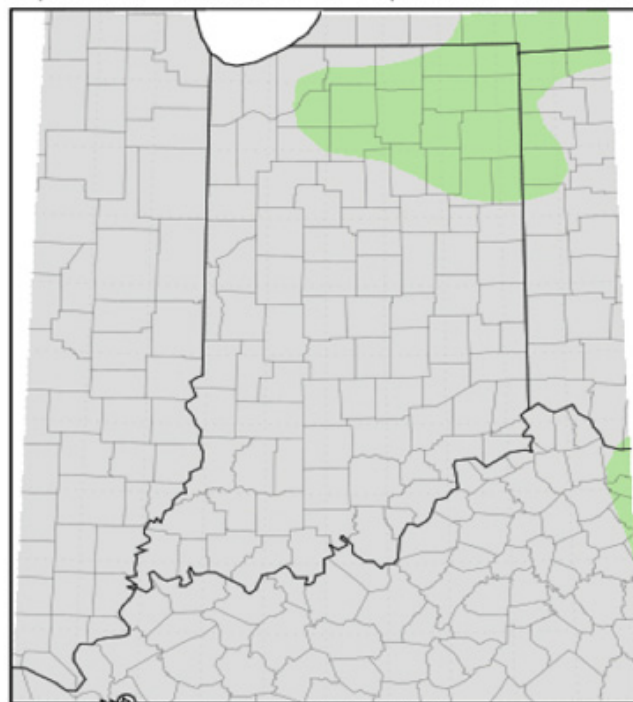


**Total Precipitation  
September 19 - 25, 2013  
CoCoRaHS network  
(499 stations)**



Analysis by Indiana State Climate Office  
Web: <http://www.iclimate.org>

**Average Temperature (°F): Departure from Mean  
September 18, 2013 to September 24, 2013**



Mean period is 1981-2010.



Indiana State Climate Office [www.iclimate.org](http://www.iclimate.org)  
Purdue University, West Lafayette, Indiana  
email: [iclimate@purdue.edu](mailto:iclimate@purdue.edu)

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