SOIL PROFILE NITRATE IN CORN FIELDS FOLLOWING THE 2012 DROUGHT

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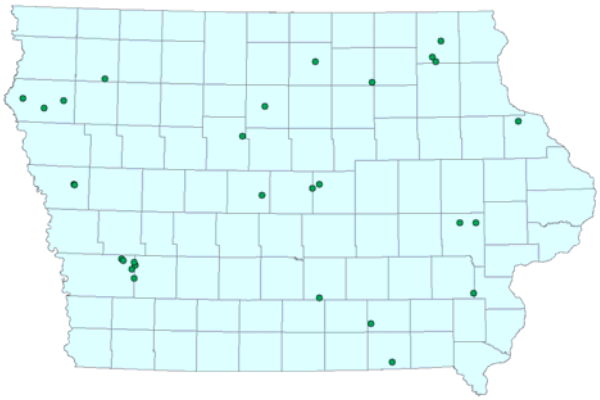
I wrote a Current Topic article last summer (8/13/2012) outlining various items to consider for nitrogen (N) management in 2013 corn crops. One item was the potential for residual nitrate-N carryover from 2012 drought affect corn fields. After harvest this past fall, Iowa State University Field Agronomists, ISU FARM specialists, and staff in our research group collected profile soil samples from 38 field locations across Iowa (Fig. 1). Most of the fields were on-farm, with some samples collected from a research study conducted at several ISU Research Farms. Samples were collected in early fall and late fall, with some sites having samples from both times. Samples were collected by one-foot increments to either a two foot or three foot depth. Samples were analyzed for nitrate-N concentration, with concentration converted to lb nitrate-N/acre (lab analysis ppm x 4 = lb nitrate-N/acre). The amount in the profile sample was then summed across the depth samples. Profile nitrate-N amounts generally did not change between the first and second sampling due to low rainfall in the fall. Therefore, the following summary is a combination of early and late sampling, but not repeating results from the same site. That combination was done to have the greatest number of samples collected to the three foot depth.

Fig. 1. Sampled locations, fall 2012.



Soil Profile Nitrate Summary

The fall post-harvest profile sampling clearly shows a large amount of nitrate-N in many fields (Table 1). However, there is a wide range. In normal production years, the amount of residual profile nitrate-N is around 50 to 60 lb/acre. The average of all samples collected is approximately twice that amount, and clearly shows that considerably more than normal nitrate-N is in the soil profile in much of Iowa corn fields. In Table 1, the maximum measured amount was with the lowest applied N rate, but that site had first-year corn following alfalfa and severely reduced yield (23 bu/acre). Therefore, it makes sense that field would have considerable profile nitrate.

Two sites had cattle manure applied (1 to 2 ton/acre), but the amount of available N from the manure application was not included in the amount shown for the fertilizer rate. The sampling results also clearly show that fields should be sampled to correctly determine potential for carryover nitrate-N, rather than assuming some average amount. As discussed in the ICM article last summer, do not account for the full profile amount to subtract from the 2013 corn N fertilization rate, rather, first subtract 50-60 lb N from the measured profile amount.

Table 1. Summary of fall post-harvest soil nitrate sampling in Iowa, 0-2 or 0-3 foot profile depth.

Number of sites sampled	38
Average profile nitrate (lb nitrate-N/acre)	122
Minimum profile nitrate (lb nitrate-N/acre)	27
Maximum profile nitrate (lb nitrate-N/acre)	348
Standard deviation in profile nitrate-N	78
Average fertilizer N rate applied (lb N/acre)	171
Minimum fertilizer N rate applied (lb N/acre)	77
Maximum fertilizer N rate applied (lb N/acre)	220
Average corn yield (bu/acre)	132
Minimum corn yield (bu/acre)	20
Maximum corn yield (bu/acre)	240
Average spring thaw to sample date precip. (inch)	15.4
Minimum precipitation (inch)	6.2
Maximum precipitation (inch)	21.2

Web Site to View Individual Soil Profile Nitrate Information

In an effort to assess residual soil nitrate-N following the 2012 corn crop, a soil nitrate monitoring network map was developed in conjunction with the University of Wisconsin. The amount of residual nitrate-N at each sampled location and for each sample timing, along with field information, can be found at the following University of Wisconsin web site (http://uwlab.soils.wisc.edu/soilnitratemonitoring). Appreciation goes to Dr. Carrie Laboski and the nutrient management team in Wisconsin for developing the web site. Currently, sampled sites are available for Wisconsin and Iowa. The intent is to collect profile soil samples again this spring and post those on the soil nitrate monitoring network web site.

Residual Soil Profile Nitrate Relationship to Field Conditions

The amount of profile nitrate-N was compared to several field conditions, such as corn yield level, season precipitation, fertilizer N application, and calculated N application minus N removal in harvested grain. In all cases, no strong relationship existed with profile nitrate-N amount (Figs. 2-6). These results indicate the need for sampling fields, and also indicate the complex interaction of factors that influence residual nitrate in soils.

Fig. 2. Corn yield vs. profile nitrate-N, fall 2012.

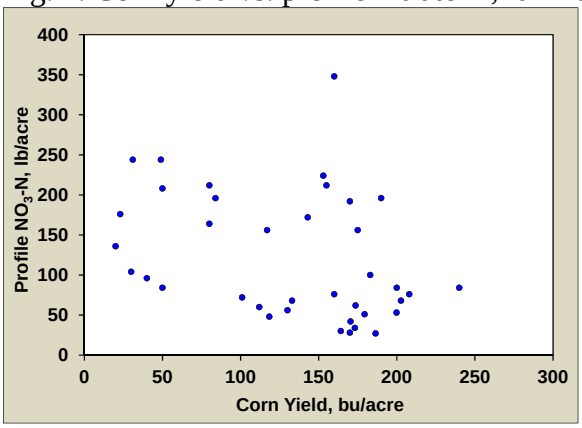


Fig. 3. Fertilizer N rate vs. profile nitrate-N, fall 2012.

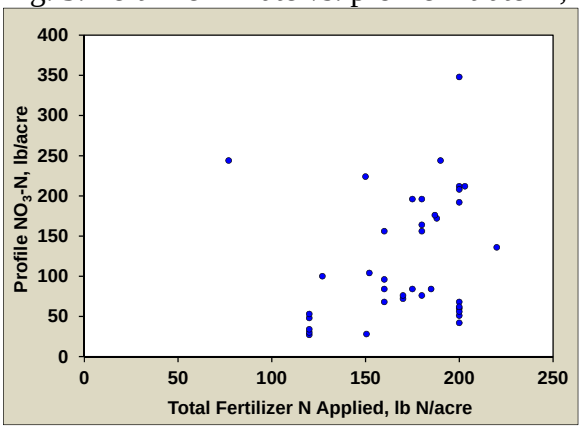


Fig. 4. Precipitation from spring thaw to soil sampling date vs. profile nitrate-N, fall 2012.

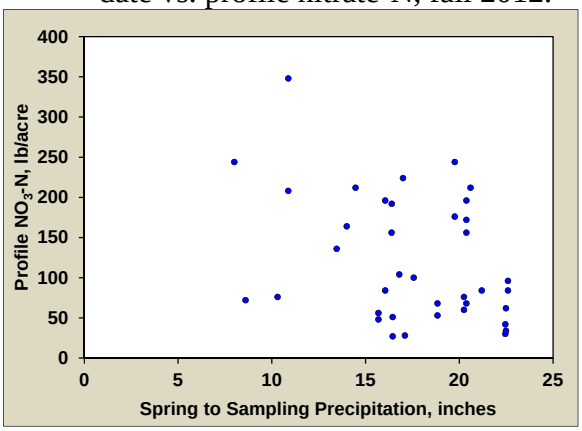


Fig. 5. Fertilizer N rate vs. corn yield, fall 2012.

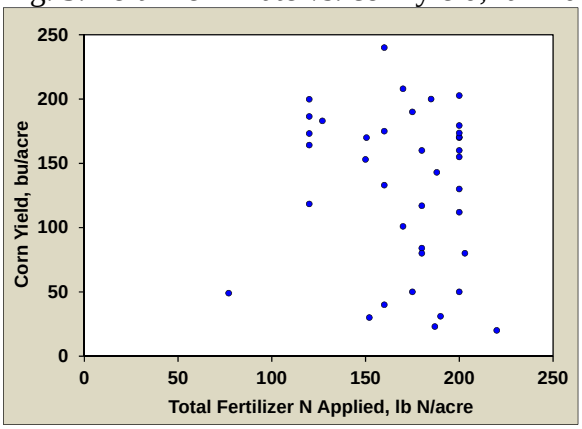
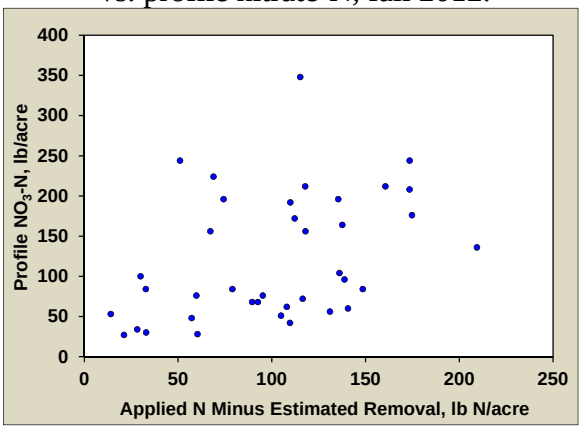


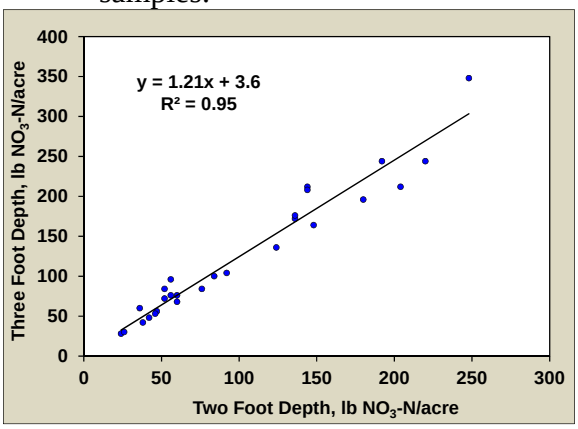
Fig. 6. Applied N minus estimated grain N removal vs. profile nitrate-N, fall 2012.



Predicting the Three Foot Nitrate-N Amount

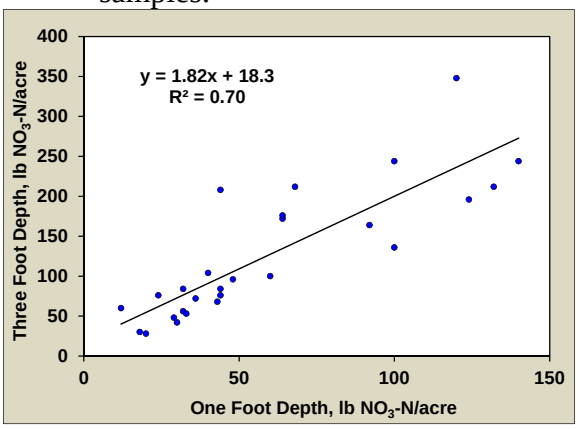
For preplant nitrate testing (PPNT), the University of Wisconsin has previously been able to predict the three foot profile nitrate-N amount from analysis of the two-foot depth. That allows for collection of a shallower two-foot sample depth. The data from the fall Iowa profile sampling shows a good relationship between the two foot and three foot depth nitrate-N amounts (Fig. 7). Although it is preferred to collect samples to a three foot depth, if that sample depth is not possible due to soil conditions, then results from the two-foot depth could be used to estimate the three foot amount. The equation shown in Fig. 7 gives that conversion (y is the predicted three foot amount in lb nitrate-N/acre and x is the two foot amount in lb nitrate-N/acre). Since the equation intercept is close to zero, one could simply increase the two foot amount by 21% to estimate the three foot nitrate-N amount.

Fig. 7. Relation between the two foot and three foot profile nitrate-N amount, Iowa fall 2012 samples.



The relation between a one foot sample and the two or three foot profile amount was also determined. Those relationships are not as strong (Fig. 8 for one foot vs. three foot profile amount), and highlights the need that when sampling for residual or carryover profile nitrate-N, a deeper sampling than one foot is helpful. In all cases, the relationship between depths was better with low (< 50 lb nitrate-N/acre) nitrate-N amounts. These results also highlight a potential problem where presidedress nitrate tests (PSNT) this spring could miss considerable nitrate deep in the profile, since that test is only calibrated for a one foot depth. It is unknown if the relationship shown in Fig. 7 would hold for the sidedress sampling time, and even for spring preplant profile sampling. As long as rainfall is less than normal, it should be an adequate adjustment for sampling this spring before planting. If rainfall returns to normal, or is above normal, then sampling should be done to three feet if possible.

Fig. 8. Relation between the one foot and three foot profile nitrate-N amount, Iowa fall 2012 samples.



Spring 2013 Preplant Soil Sampling

Soil profile nitrate-N amounts will likely vary across fields, due to many factors such as variable corn yields, soils, and 2012 crop fertilizer or manure band placement. Therefore, sampling should include several sites within each field and collection of many cores per sample. Suggestions from various state Universities for preplant profile sampling, and ISU Extension publication PM-1714 for late spring soil nitrate sampling, indicate the following should be considered: sample by one-foot increments with a minimum two foot depth, each sample represent no more than 10 to 20 acres, collect 15 to 30 cores per sample depth (use the higher number in fields where N had been banded), thoroughly mix each sample depth, subsample/label, and keep separate samples per foot. Since these samples are to represent soil nitrate-N, do not store for any period of time unless dried or frozen. Otherwise, send samples immediately (within one day) to the lab.