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Banking Nutrients

by Dwayne Beck

PERSPECTIVE

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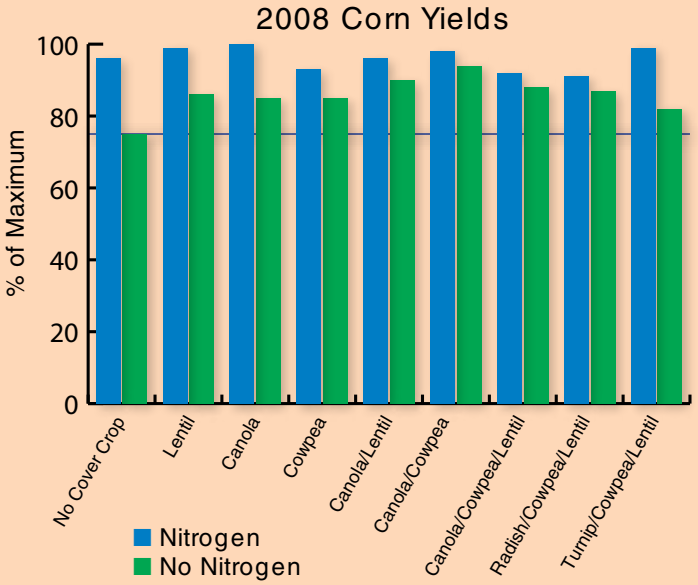
This is a complex topic, but here is a useful analogy: The nitrogen measured using the nitrate-nitrogen soil test is like obtaining the current balance for your checking account. If you need more N to grow the crop (or more money to cover a check), you need to add it. The N contribution from a cover crop is obviously not like the money in a checking account. For instance, if you have decent biomass from a cover crop that either fixed N as a legume, or sequestered N that otherwise would be lost, there might be 100 lbs/a of N in the aboveground plant material. It could be more than that, but we will use that number for simplicity. We can guess at the amount underground and include that too, and we can try to estimate the amount of microbial biomass that will cycle in the next few months and include that as well. We also have to estimate how much N will be immobilized in making the high-carbon plant residue into organic matter. Now it is like outguessing the stock market or the grain markets.

The amount of N contribution gained from a cover crop is *not* like someone putting money into the checking account. In tillage systems it kind of works that way because most of the N to be released will do so within a few days after tillage. Most of the high-carbon residue is used up, with the carbon leaving the system as carbon dioxide. The resulting nitrate-nitrogen level in the soil is now pretty much what you will have. The soil nitrate test gives you the balance. You go from there and put in the extra you need for a certain yield, assuming the nitrate is not lost or does not change.

With cover crops and *long*-term no-till, it is more like a savings account. If you would do a total N analysis of your soils (organic matter N plus nitrate-N) the numbers would be in the 1,000s. At Dakota Lakes Research Farm, ours will go from 2,500 to over 4,000 lbs of total N. That is the savings account. If you put 100 lbs of organic N into the system this year ($100 into a savings account with a $2,000 balance) the change in the interest it generates the next year would be small. But if I put $100 into the system every time I get a chance, say 2 years out of 4, in 20 years you have increased the balance to $3,000 as long as it is not in stocks and I don't take the principal.

What happened at Cronin's [see graph] is, in my opinion, a combination of good conditions (like higher interest rates), the cover crops, and several years of building soils with good agronomic practices and continuous no-till. The discrepancy between the nitrate-nitrogen contents between fall and spring in the check plots reflects the *sum* of nitrogen changes that occurred. These changes could include leaching and denitrification losses, and conversion of nitrate to organic forms by microorganisms decomposing the wheat straw. This latter process is called immobilization. Basically it is putting the N into the savings account. If we are always marginally low on N or if we have too large of a proportion of broadleaf crops in the rotation, or if we do tillage, we are getting N *but it is being taken from the principal*, not the interest. You look like you have lots of money for awhile. But then you start running deficits and are scrambling to stay solvent. We often do not notice this because it happens slowly, but it is manifest in a greater reliance on N fertilizers (greater crop responsiveness to N fertilizers). The economic impact is undefined since no one has figured out a way to document and quantify the future value (*loss of value* in the soil OM, i.e., sacrificing some of the principal) associated with collecting the short-term gain.



Dryland corn yields in a study at Cronin Farms, west of Gettysburg, SD. The yields where zero N was applied gives some indication of improved N cycling (less N needed following the cover crop, regardless of legume or non-legume), as well as showing how much N was lost in the check (no cover crop) due to denitrification and/or leaching. The greatest cover-crop biomass was the canola, followed by the canola + cowpea. Soil moisture levels to a 3-foot depth were nearly identical by spring across all plots. Excellent corn year—the field surrounding the plot made 160 bu/a. Study by Shannon Osborne (USDA-ARS).