CALIBRATE YOUR FERTILIZER NEEDS!

PINNACLE
CROP TECHNOLOGIES, INC.

April, 2019

by Matt Hagny

See the color differences? A tip-off something is wrong. Tissue tests soon afterwards confirmed N deficiency. When doing your N calibration, make sure you're applying early enough so that the crop never is deficient. This crop had already lost significant yield potential by this stage, and applying N afterwards doesn't bring back the lost potential. I.e., if you're not front-loading sufficient N, you may underestimate both your yield potential and how much total N you need.

Some of the best farm managers have been doing this, while others need to catch up. Are you doing test strips on your farm to see if the fertilizer rate you're applying is too little, too much, or just right?

You might be surprised to learn that I rarely have soil tests in front of me when writing up N fertilizer recs for my clients. Crazy? Not really. Under long-term no-till, I've gradually developed a good knowledge-base of how much N is required for a crop in any given crop sequence in the area where I work. Much of this knowledge is via strip-trials by the farmer, occasionally assisted by replicated small plots by KSU, assisted by tissue testing and visual symptoms to further guide us. (If we have a meager crop, we will do some soil nitrate testing after harvest to see if there's any extra nitrate leftover—central KS is the eastern edge of where soil nitrate is useful; wetter areas are likely to denitrify and/or leach before the next crop gets to use it.)

For instance, in central KS, I know that it takes a heck of a lot of N to grow a corn or milo crop following wheat stubble that's been cover-cropped to pearl millet after the wheat was harvested—if this pearl millet is thick and tall, that's a mountain of mulch with very high carbon content (wide C:N). There's never any leftover nitrate,

unless the pearl millet is pitiful (in which case we would likely do some soil nitrate testing to quantify). In contrast, corn or milo after full-season soybeans doesn't take nearly so much fertilizer N, because the soybeans were low-carbon and thus decomposing & releasing lots of N (& other nutrients) by the following summer. Corn or milo following wheat/dc soybeans is intermediate for N requirement between the two examples I just gave. So, the farmer and I have a pretty good idea of what the yield potential is on any given soil type, and how much N per bushel of yield goal we need for that crop sequence. Soil testing only becomes part of the equation when we happen to suspect leftover nitrate and will have dry enough conditions that the following crop can capture a significant part of it.

Costs of Too Much or Too Little

How do we set yield goal? I tend to use best-ever crop for that farmer on that field or a similar field or soil-type. Some experts will define it as the best crop in the past 5 yrs, or the best in the last 10 yrs. I'm not sure what this accomplishes, since yield trends should generally be upward, and also we sometimes have droughts that last multiple years on the Plains, so the past 5 yrs might not be indicative of what you can do when a wetter pattern returns.

From an environmental standpoint, we would want to consistently under-apply, and always split-apply while the crop is growing. That way, there's less escaping off-site via runoff or leaching into tile outlets or aquifers, etc. (We would also apply all the N subsurface to reduce NOx emissions, but that creates erosion problems in my part of the world due to running the extra openers.) From the economics standpoint of the farmer, you don't want to be significantly short of N—if a pound of N costs $.35 – 0.50, and you get something close to an extra bushel of corn* ($3+ currently) from it, that's a 6x – 9x ROI. (*Depending on crop rotation, and where you are in the response curve—very N-starved corn will produce a little over a bushel more for each additional lb of N, whereas corn that has nearly enough N might only produce 0.3 – 0.4 bushel with that extra lb of N, which is still a decent ROI.)

We can get into the debate whether long-term NT farmers are consistently over-applying or under-applying. This depends a lot on what region we're looking at. In areas where corn frequently follows soybeans, there may indeed be a lot of over-application of N. In the western & southern 'fringe' areas for corn production, which are more drought-prone, corn (or milo) is often planted into heavy mulch cover (wheat stubble, perhaps with a high-carbon cover crop—such as pearl millet or oats—following the wheat), and this is where I see a tendency to under-apply N. (Also, a meta-analysis[i] of 350 studies showed that under-application of N was a cause of yield drag in no-till crops.)

Some people think the Haney test is great because it usually has lower fertilizer recs than standard soil testing would give. If even your bin-buster crops have luxurious amounts of N, then you'd save a lot of money by following the Haney recs (and the environment would be less polluted). But if going with lower N rates causes you to shortchange the crop's potential significantly, even if just one year out of 5, then you're going to be a lot worse off financially. And, in the drought-prone areas I mentioned, a crop not using all the nitrogen in the soil isn't necessarily a bad thing since the following crop can make use of it (although if that crop is a legume, it could've made its own N for free). In the Corn Belt, droughts are less frequent and less severe, so although leftover N may leach, the situation with lots of N leftover after growing the crop is far less likely to occur.

We can get into debates as to whether the Haney test's reducing the N rec (by measuring microbial activity and the quantity of microbial food supply; i.e., an attempt to predict how much might mineralize in the future) is properly calibrated, or even useful at all. For now, I counsel against trusting it too far—at a minimum, don't get too carried away slashing N rates across your entire farm until you've tested lower rates for a few years on some strips.

If you're not using the Haney test (or don't know what soil testing is😊), you still need to be doing strip trials. Do a strip with 30% more than your typical rate. Do another strip with 30% less. Do them in multiple fields, and measure the yield differences. After a few years, you will have an excellent database to know exactly what you should be applying—for those cultural practices. If you add cover crops, manure or poultry litter, or alfalfa, or change from a high-carbon cover crop to low-carbon (or vice versa), you will need to repeat the calibration. It's really quite easy to do all this, and track the info—so easy that I'm astonished that it's not standard practice to do these strips!

If you do these strips in the current crop, also keep track of what next year's crop does in them—and if you grow a non-legume cash crop next, *repeat the strips in the exact same spots*—i.e, put the -30% rate directly on top of the -30% from the previous year. This is because the -30% the previous year will affect the C:N ratio (and perhaps the amount of biomass if it was seriously short of N), and alter the response in the following crop (unless it's a legume).

If you're applying S along with N, don't worry about that confounding the results, as they go together anyway. However, if your N application contains P or anything else, I'd do a different blend for the test to cut down on the confusion of what caused what (just plant certain strips with blend A, then immediately plant the in-between strips with blend B—but be careful about doing this first thing in the morning when the straw is tough, as you might have a lot more hairpinning in one treatment vs the other—an hour makes a huge difference at that time of day).

While some farmers are great at doing this sort of trial, others do none at all—and I can't for the life of me figure out why not. As much money as is spent on N fertilizer, you'd think everyone would want to dial that in as precisely as possible (and soil tests by themselves don't do that very well), especially as easy as it's gotten to be to do this sort of thing. Maybe you'll get confirmation after a few years that you were spot-on the whole time. More likely, you will find ways to improve profitability—you can thank me later😊. (In a future newsletter, we'll talk about how N fertilizer rates interact with soil OM changes.)

[i] M.E. Lundy, C.M. Pittelkow, B.A. Linquist, X. Liang, K.J. Van Groenigen, J. Lee, J. Six, R.T. Venterea & C. van Kessel, 2015, Nitrogen fertilization reduces yield declines following no-till adoption, Field Crops Res., 183: 204-210.