K-STATE Research and Extension | Wildcat District

FOR IMMEDIATE RELEASE

For more information,
contact: James Coover
Crop Production Agent, Wildcat Extension District
jcoover@ksu.edu, (620) 724-8233
Photo(s) Enclosed To Print Media

Nitrogen: A Farmer's Analysis in Soil Nitrogen Chemistry

FOR IMMEDIATE RELEASE: In previous articles we have talked about (P) Phosphorus), we have talked about (K) Potassium, but now we continue on this journey to talk about the big one, (N) Nitrogen. This is good timing because nitrogen losses in corn production is currently a very relevant topic. However, like in the previous P and K articles, this one is going to be about nutrient chemistry and increase nutrient understanding, rather than just a current issue in agronomy. Nitrogen is by far the most applied, the most necessary, and it also the most difficult to quantify. The reason for its elusiveness is because it is mobile within the soil, it's always changing forms, and can have gaseous losses (unlike P or K). To really get a handle on what is currently happening with nitrogen in the corn fields, right now we need to understand all the pieces as play.

- Nitrogen Forms
  Ag producers know the forms of nitrogen, but should be covered just for completeness. Atmospheric nitrogen, N_2, is where it all starts and where it all ends up. It's highly stable so it takes microbes or human vast quantities of energy to convert it into a usable form. This form is usually ammonia or ammonium, neither of which is absorbable by plants in meaningful quantities. Microbes convert ammonium into nitrate, NO_3, which requires oxygen. This is called nitrification. In waterlogged soil where microbes can't get to oxygen, they use nitrate to breathe instead, converting NO_3 to N_2O or N_2 which are both gases that leave the soil. This is call denitrification. It is important to note that denitrification ($NO_3 \rightarrow N_2$) is not the opposite of nitrification ($NH_4 \rightarrow NO_3$). Also the process of nitration leaves the hydrogen behind, which is why nitrogen fertilizer acidifies the soil.

- Fertilizer Types
  Unlike every other nutrient, fertilizer type is an important part of understanding nitrogen because it all behaves differently in the soil. The most common types of nitrogen fertilizer are anhydrous ammonia, urea, UAN (urea ammonium nitrate), and the DA part of DAP (Di-Ammonium Phosphate). Anhydrous ammonia chemical formula is NH_3. Note that ammonium is NH_4 and ammonia is NH_3 but this transition from NH_3 to NH_4 is fairly quick, taking a couple of weeks at most and doesn't require microbes. However before that happens, the NH_3 is a toxic gas that suppresses microbes and kills crop seeds. Urea's chemical formula is complex, CH_4N_2O, but no need to worry because microbes convert it into ammonium. UAN is a mix of urea, ammonium and nitrate. The nitrate part is an important distension because it's already in the usable, a potentially losable, nitrate form. N-serve, encapsulation or other forms of nitrification inhibitors work by slowing down the microbes from converting ammonium into nitrate.
- Nitrogen In the Soil
  Each form of nitrogen moves differently in the soil. The ammonia in anhydrous is a gas but easily dissolves in water. This is why the application conditions when is applied is important because if it can escape the knife without touching the water in soil, it's gone. Ammonium is a cation that adsorbs onto soil surfaces, which is why is mostly immobile in the soil. Only nitrate, being an anion, moves with the water it is dissolved in.
- Nitrification and Denitrification
  Both nitrification and denitrification requires certain conditions to be present for microbes to perform their processes. Like previous mentioned, nitrification requires oxygen, but the process is sped up with warm temperatures, reaching an optimum at 75 to 80 degrees F and somewhat slowed down in acidic soils below 6.5 pH. At the point of anhydrous injection, the microbes are suppressed for a while, which also slows down nitrification. In a way, anhydrous is its own nitrification inhibitor. Denitrification also speeds up in warm temperatures, but requires a lack of oxygen. Except when the soils are frozen or extremely dry, there is always some nitrification and denitrification happening and often at the same time.
- The Current Nitrogen Situation
  The importance of the current situation is that while our soils have been incredibly waterlogged for weeks, which would normally have huge denitrification losses, the ammonium fertilizers will have stayed safe because the microbes never got the oxygen they needed to convert it into nitrate. It is hard to determine how much fertilizer we have lost due to denitrification. It is likely a large portion of the nitrates have been denitrified but only 25% or less ammonia has converted to nitrate. Higher parts of the fields could have received more oxygen but were also less waterlogged. It is likely that nitrogen levels, both ammonium and nitrates, are very uneven throughout a field. It is hard to soil test for nitrogen during a growing season because much of it is "hiding" on soil surfaces and in different forms. Also, normal nitrogen soil test will only test for nitrate. The ammonium

soil test is a separate, additional soil test add on. Corn only needs small amounts of nitrates during its early vegetative stages but then increases dramatically, shortly before tasseling (Figure 1). Young corn that was yellow this year was because of “wet feet” roots that couldn’t get to the available nitrogen, which is why it is greened up when the soils dried out. I personally suspect that before it is all done we will have a fairly high denitrification year. It is difficult to tell if corn will need a top-dressed application. If you suspect it will need it, or want to play it safe anyways, 30 to 50 lbs N per acre can be side dribbled anytime in the few weeks before tasseling. Ideally, leave a strip or two of the field without top-dressed application and another where it is doubled as check strips. This only gives you an answer after the fact so it is more of learning observation thing.

This detailed focus on the soil chemistry of nitrogen is intended to give a whole picture view about what is going on in the field, rather than just fertilizer rate prescriptions. If you have any questions about top dressing nitrogen on corn or other crop fertility questions, please give me a call.

For more information, please contact James Coover, Crop Production Agent, jcoover@ksu.edu or (620) 724-8233.

# # #

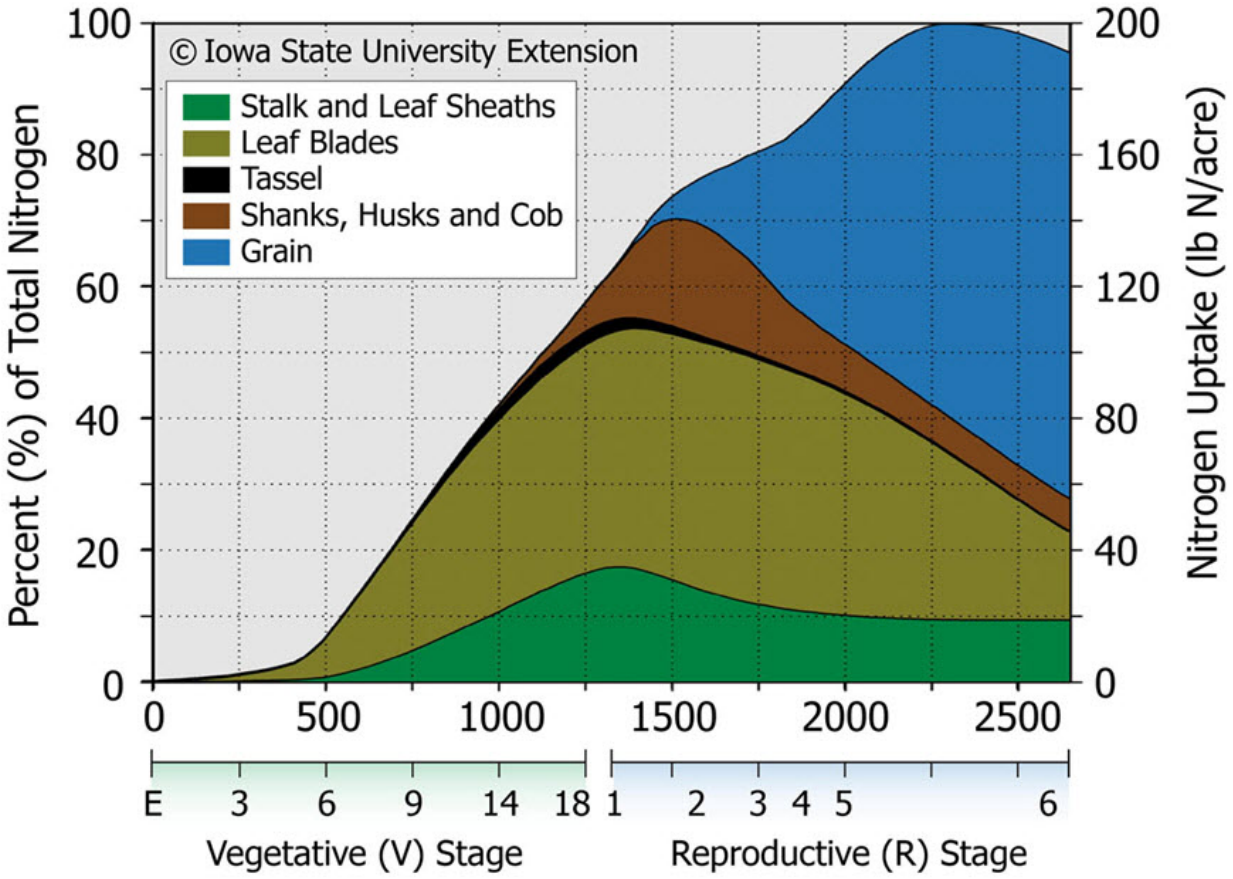

Figure 1. Nitrogen uptake during corn growth stages.