The drought that has affected most of Kansas in recent years has limited yields of wheat, row crops, and forages. But there’s one upside – at least part of the nitrogen (N) that has been applied to these crops is probably still in the soil, well within the root zone of wheat. That carryover N can be utilized by wheat, which means that producers may be able to cut back on their fertilizer N for wheat this year without affecting yields.

If enough extra N is already present in the soil after one or more years of dry weather and poor crop yields, producers could literally save thousands of dollars per quarter section on their fertilizer bill for wheat this year just by taking a profile N test.

This is a possibility. But there’s no way to know for sure unless the producer takes a profile nitrate-N test this summer, before wheat planting begins and before any preplant N is applied. A profile N test means just that – a 24-inch sample.

A 6-inch or 10-inch sample is of little value in determining nitrate-N values in the soil, and the results could even be misleading. Nitrate is highly mobile in the soil, and moves with water. During the dry parts of the summer, nitrate may be drawn towards the surface with water evaporating from the soil. But one good rain can easily move the N deeper than 6 or 10 inches in the soil. Under normal conditions, wheat roots go down deeper than 10 inches even before reaching winter dormancy. In most cases, wheat roots ultimately utilize N from at least the upper 24 inches of soil. So to get an accurate reading of how much N the wheat crop will have access to in the soil, and how much extra might be needed as applied fertilizer, a 24-inch soil sample is needed.

Having a nitrate-N test analyzed at K-State’s Soil Test Lab costs less than $5 per sample. How many samples are needed? That depends on the size of the field and how uniform it
is. On a uniform quarter section, producers should take at least one good composite sample, made up of a minimum of 10-15 cores/subsamples collected at random from the field. Soil samples for profile N analysis should be dried soon after collection, within 24 hours, to minimize mineralization and the release of additional N from organic matter, and nitrification ammonium.

The results of the nitrate-N analysis will be entered into K-State’s N recommendation equation for wheat. If no nitrate-N test was taken, the K-State Soil Test Lab will assume the soil has about 30 lbs per acre of nitrate-N in the profile. But the results from past years would suggest that many fields in central and western Kansas will likely have actual nitrate-N values closer to 60-80 lbs of available nitrate-N per acre in the soil profile. That’s a big difference, and could reduce fertilizer N bills by as much as $10 to $20 per acre.

The amount of nitrate-N in the soil is not just a function of fertilizer N carryover. The soil also releases a certain amount of N during the summer through the mineralization of soil organic matter and crop residue. Significant amounts of N for plant growth are provided each year through these processes. Environmental conditions play a big role in how much N is mineralized each year. The amount of N available to crops within a field may vary as much as 50 percent or more from year to year, depending on differences in temperature and precipitation.

Because the amount of nitrate-N supplied by the soil is a function of both fertilizer-N carryover and mineralization, producers really need to have their soils tested for both organic matter levels and profile-N. The K-State N recommendation equation includes both organic matter levels and a profile test for nitrate-N as important factors, along with yield potential, cropping history, tillage practices, and other factors.

In summary, with the potential for higher than “normal” nitrate-N carry over in many fields, and high N fertilizer prices, the profile N test may well pay big dividends for Kansas wheat growers this fall. For additional information on sampling and sample handling procedures, producers can contact their local extension office or the K-State Soil Testing Lab.

-- Dave Mengel, Soil Fertility Specialist
dmengel@ksu.edu

2. Beware of high nitrate and prussic acid levels in drought-stressed sorghum

The first row crop to succumb to drought stress in Kansas this year was dryland corn. Then soybeans. Now grain sorghum. As with the other crops, severe drought stress on grain sorghum is spotty, but getting more widespread every week. Along with the obvious damage to yields and forage production, the drought conditions are making grain
sorghum, forage sorghum, sudangrasses, and certain other plants more susceptible to prussic acid or nitrate poisoning.

**Prussic acid.** Prussic acid, a derivative of cyanide, is a serious potential problem. Crop species most commonly associated with prussic acid poisoning are sorghum, Johnsongrass, and sudangrass. Grain sorghum typically has more potential for toxic levels of prussic acid than forage sorghum or sudangrass. New regrowth from Johnsongrass and shattercane can also pose problems for grazing animals because of toxic levels of prussic acid.

Young, rapidly growing plants are the most likely to contain high levels of prussic acid. Cyanide is more concentrated in young leaves than in older leaves or stems. New sorghum growth following drought or frost is dangerously high in cyanide. Generally, any stress condition that retards normal plant growth may increase prussic acid content. Hydrogen cyanide is released when plant leaves are physically damaged by trampling, cutting, crushing, chewing, or wilting.

Drought-stunted plants accumulate cyanide and can possess toxic levels at maturity. Prussic acid poisoning is most commonly associated with regrowth following a drought-ending rain or the first fall frost. New growth from frosted or drought-stressed plants is palatable, but dangerously high in cyanide. After a killing frost, wait at least four days before grazing to allow the released hydrogen cyanide to dissipate.

The following are some guidelines producers should follow:

* Do not allow hungry cattle to graze where prussic acid may be a problem.
* Do not allow animals to graze drought-stressed sorghum after regrowth occurs from a rain, or after a light frost.
* Chop or ensile plants high in prussic acid to reduce toxin levels.
* Have representative samples of any suspect forage analyzed before feeding.

Prussic acid concentrations are higher in fresh forage than in silage or hay because hydrogen cyanide is volatile and dissipates as the forage dries. Hay or silage that may have contained high prussic acid levels at harvest should be analyzed before being fed to livestock.

Forages can be analyzed for high levels of prussic acid at K-State’s Veterinary Diagnostic Toxicology Laboratory. For information on how to prepare and send in samples for prussic acid analysis, call the diagnostic lab at 785-532-5650 and ask to speak to a toxicologist.

**Nitrates.** Drought-stressed forages may also be high in nitrates. Forages that contain high levels of nitrates also can cause animal sickness or death, though not as quickly as prussic acid poisoning. All livestock are susceptible to nitrate toxicity, but cattle and horses are affected most often.
Crops such as forage sorghum, grain sorghum, sudangrass, sudan-sorghum hybrids, and pearl millet are notorious nitrate accumulators. Kochia, lambsquarters, sunflower, and pigweed also are routinely high in nitrate. Under certain conditions, Johnsongrass, corn, alfalfa, soybeans, wheat, and oats can also accumulate potentially toxic levels of nitrate.

Nitrate normally accumulate in stems and conductive tissues. Highest nitrate levels occur in the lower third of the plant stalk. Concentrations tend to be low in leaves because nitrate reductase enzyme levels are high in leaves.

Nitrate accumulate in plants during periods of moderate drought because the roots continually absorb nitrate, but high temperatures inhibit its conversion to amino acids. During a severe drought, lack of moisture prevents nitrate absorption by plant roots. Following a rain, however, the roots rapidly absorb nitrate and accumulate high levels. After a drought-ending rain, it requires 7 to 14 days before the nitrates will be metabolized to low levels, provided environmental conditions are optimum.

The guidelines to reduce nitrates in forages include:

* When cutting drought-stressed sorghum for hay or silage, raise the cutter bar 6 to 12 inches to exclude basal stalks. This also will minimize harvesting many weed species that have accumulated nitrate from shading.
* Delay harvesting until weather conditions have improved. A week to 14 days of favorable weather generally is required for plants to reduce accumulated nitrate.
* Never feed green chop that has been heated after cutting or held overnight.
* Harvest plants containing high levels of nitrate as silage rather than hay.
* Have representative samples of suspect forage analyzed before feeding.

High nitrate forages may be grazed, but a dry roughage should be fed first to limit intake. Stocking rates should not be too high because overgrazing forces cattle to eat the stems, which contain the highest nitrate levels. Cattle should be removed from potentially susceptible forage for 7 to 14 days after a drought-ending rain. Lush regrowth of heavily fertilized grasses contains high nitrate levels and should not be grazed.

When roughages are made into silage, fermentation normally reduces nitrate levels by 40 to 60 percent. Forages with extremely high nitrate levels at harvest may still be dangerous after ensiling and should be analyzed before feeding. If forages are harvested as hay, nitrate concentrations remain virtually unchanged over time.

If plants are fed as green chop, the harvested forage should be fed immediately after cutting, not allowed to heat up. As the plants respire, nitrates are converted to nitrites, which are about 10 times more toxic than nitrates.

There is a quick field test available for nitrates in forages which uses diphenol amine. This test is for qualitative, not quantitative analysis. It can give producers an idea of whether nitrate levels are present in the stalks, but a lab analysis would be needed to give
precise nitrate levels. The K-State Soil Testing Lab will run plant nitrate tests for $5 per sample.

-- Jim Shroyer, Extension Agronomy State Leader
jshroyer@ksu.edu

3. Ammonium thiosulfate as an AMS replacement in glyphosate applications

Everyone recognizes the need for including ammonium sulfate in glyphosate applications. Depending on water quality, environmental conditions, weed size, etc. – the addition of 8.5 to 17 pounds of ammonium sulfate per 100 gallons of water will often greatly improve the performance and consistency of glyphosate applications. While dry ammonium sulfate works well, it often presents logistical challenges of handling dry bags of ammonium sulfate and completely dissolving the solid ammonium sulfate in the glyphosate spray solution.

While ammonium sulfate is fairly soluble in water, fertilizer grades of about 8-0-0-9S or 8.5-0-0-9.7S are about the highest analysis liquid products that can be made from ammonium sulfate and water. This is equivalent to about four pounds of ammonium sulfate per gallon of solution. Currently there are many liquid ammonium sulfate replacement products in the marketplace. As long as the liquid ammonium sulfate replacement product supplies the required amount of ammonium sulfate (8.5-17 pounds ammonium sulfate per 100 gallons), these products provide the same efficacy and consistency as dry ammonium sulfate - while minimizing logistical problems.

However, ammonium thiosulfate (a liquid product containing nitrogen and sulfur) is also being positioned by some as a replacement for dry ammonium sulfate. Ammonium thiosulfate [12-0-0-26S, (NH₄)₂S₂O₃] is not the same thing as ammonium sulfate [21-0-0-24S, (NH₄)₂SO₄]. The sulfate portion of ammonium sulfate is thought to interact with certain problem cations in the spray water, such as calcium and magnesium, and possibly reduce tie-up of the glyphosate molecule with these cations.

The ammonium (NH₄⁺) portion of ammonium sulfate associates with the glyphosate molecule in addition to improving the uptake of the glyphosate molecule by plant leaves. The thiosulfate molecule, on the other hand, has been shown to be somewhat toxic to plants and has not been shown to improve glyphosate uptake or performance. At the same time, ammonium thiosulfate contains free ammonia and has a relatively high pH, typically 8.0 to 8.5. Application of ammonium thiosulfate to plants, by itself, would be expected to result in leaf burn.

In summary, ammonium sulfate has been shown to be very effective in improving the consistency and performance of glyphosate applications and is suggested on various glyphosate labels. Because of logistical mixing problems, many dealers and farmers prefer convenient liquid sources of ammonium sulfate instead of dealing with the bags and mixing problems associated with dry ammonium sulfate. There are several effective
liquid ammonium sulfate replacement products in the marketplace, but unfortunately, ammonium thiosulfate is not one of them. Ammonium thiosulfate is not the same thing as ammonium sulfate and should not be used as a spray solution conditioning agent for glyphosate applications.

-- Dale Leikam, Nutrient Management Specialist
dleikam@ksu.edu

4. Evaluation of AMS replacement products in glyphosate solutions

For the past few years, we have been testing various ammonium sulfate (AMS) replacement products for use in glyphosate applications. AMS is commonly added to glyphosate solutions before application in order to condition hard water and increase absorption by the target weeds. In its dry form, AMS works well and is relatively inexpensive, but it can be bulky to handle. AMS is added at the rate of 17 pounds per 100 gallons of solution. Liquid AMS products are also available and the equivalent use rate is 5 gallons liquid AMS per 100 gallons of solution. Dry and liquid AMS have performed equally well.

In recent years, many AMS replacement products have entered the market. The main selling point of these products is they have lower use rates than liquid AMS and are easier to handle than dry AMS. At K-State, we have compared the performance of AMS to several of these AMS replacement products, using their recommended rates, with glyphosate.

In these tests, AMS dramatically improved weed control with glyphosate compared to glyphosate alone. In many cases, 8.5 lb dry AMS per 100 gallons of solution (2.5 gallons of liquid AMS per 100 gallons) provided similar control to the higher recommended rate, but the lower rate of AMS may not work as well with hard water or for control of velvetleaf. Of the AMS replacement products, only those products that actually contained AMS and were applied at comparable rates provided similar control to AMS. None of the commercially available low-rate AMS replacement products worked as well as AMS. In fact, weed control from glyphosate with the low-rate AMS replacement products (recommended at rates of 1 to 2 quarts per 100 gallons of spray solution) was often no better than weed control with glyphosate alone.

-- Dallas Peterson, Weed management specialist
dpeterso@ksu.edu

These e-Updates are a regular weekly item from K-State Extension Agronomy. All of the Research and Extension faculty in Agronomy will be involved as sources from time to
time. If you have any questions or suggestions for topics you'd like to have us address in this weekly update, contact Jim Shroyer, Research and Extension Crop Production Specialist and State Extension Agronomy Leader 785-532-0397 jshroyer@ksu.edu