The Analysis

Agronomic Information From
Spectrum Analytic Inc.
Summer 2012

Another spring season has come and gone. 2012 will be a year for all of us to remember. Winter started out with one of the mildest in the record books. Many areas had minimal amounts of snowfall and in many areas there was little to no accumulation. Then we had record temperatures during the month of March. To many, one of the biggest decisions was when would it be safe to begin planting corn. The corn and soybeans were all planted again in record time thanks to the efficiencies of the American farmer and the dealers and wholesalers that service them. Stands were excellent with good emergence. There were some areas of the northeast that had alfalfa growing and it was hit by frost and decisions had to be made on what to do with the frosted crop. Many of us enjoyed the Memorial Day weekend off without having to worry about growers calling and needing product thanks to the good spring conditions. Then June comes along and we still have high temperatures and rainfall begins to become more scattered. Now we have areas that are in drought conditions. I have talked with dealers that are hearing stories of corn crops drying up and selling the corn as silage. What started out looking like a record year is slowly starting to decline.

Newsletter articles for this month consist of a couple topics to refresh our memories since the last dry season. One deals with taking soil samples during drought conditions and how your soil test results may be affected by these conditions. We also have an article dealing with possible high nitrate levels in silage and testing for these levels.

We have made the decision to no longer send plant tissue information forms with the plant analysis kits. Most people are using the on line submittal or are down loading the pdf form from our website. If you do not have access to a computer to use these information sheets, please let us know and we will send you a supply.

Mike will soon be starting his summer visits. Fall soil sampling is just around the corner. If you need supplies, please let us know and we will see that he brings all or part of your order with him.

Have a safe and enjoyable summer.

Who To Contact...

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What's Inside...

An Audit of Plant Nutrition

by Raymond B. Lockman

Used together, plant analysis and soil testing give more accurate crop nutrition insights.

When your pick-up truck needs both an oil change and a grease job, changing oil twice does not meet these needs. Using more soil tests when you also need plant analysis doesn't work either.

Soil testing and plant analysis are a team of agronomic tools. As a team, they complement each other. However, both of these tools have their strengths and weaknesses. As agronomist and growers, we need to know the strengths and weaknesses of each of the tools in order to fully utilize them. The quality of our work (recommendations) is the product of our skills and our tools. Sometimes I think we are prone to place all the blame for imperfections on the tools. Plant analysis is a valuable tool. It cannot replace soil testing. Instead, it adds unique data to our pool of crop information. Let's review our agronomic tools.

Starting point. Soil testing is the foundation of an agronomic program. The first thing we need when making fertilizer recommendations is a current soil test. The soil test has many strengths:

- It gives us a quantitative assessment of the soil nutrients.
- It can be taken at wide periods of time during the season.
- It is practical and low cost. It is relatively stable throughout the year.

However, a soil test also has built-in weaknesses:

- The soil has three dimensions-how should it be sampled properly? Our ability to sample the soil is probably the weakest link in the science of soil analysis.
- Soil tests do not take into account plant-soil interactions , but using both nutrient levels and ratios can help resolve some problems.
- Soil tests do not measure the effects of other agronomic variables such as variety, weather, and soil physical conditions.
- Soil tests are analytically less precise-lab results will vary more with the "extractable" type of nutrient analysis as compared with the "total" analysis used in plant analysis.
- Soil analysis predicts both current and "potential" nutrient problems, some of which may never become a limiting factor until high yield pressure is applied and /or other more limiting factors are first eliminated.

Find problems. Plant analysis is basically an audit of plant nutrition. It is excellent for pinpointing current plant nutrient problems; but when used alone, does not explain why they exist. The plant analysis has several other advantages:

- Telephone people say "let your fingers do the walking." Agronomists should let the plant do the soil sampling. Plants will sample the three-dimensional soil better-in the most accurate way they sample only the areas where roots can grow.
- Labs agree more closely on total nutrient analysis as compared with "available" soil analysis.
- Plant analysis does take into account the effects of soil-plant interactions and interactions among the nutrients.
- Plant analysis systems usually (or should) require more detailed crop history information, thereby further expanding the pool of information.

But plant analysis does present its own set of problems:

- Plant analysis is not quantitative in itself. One element can increase or decrease the level of another element in the plant, regardless of soil "availability," making these levels appear "high" or "low."
- Plant analysis interpretations are more complex and vary with time and tissue. DRIS can help resolve some of these problems, but it too is imperfect.

- Plant analysis sampling is more complicated and more expensive.

Also sampling time is limited.

Why limit yourself? Use soil testing and use both concepts of interpretation (the pounds-per –acre and the percent saturation information) when applicable. Also use plant analysis to audit the end result of a program. Again, you don't have to choose between the critical level and the DRIS approach for the interpretation. Glean the most from all pints of view. Plant analysis does call for more skill by the user, but it is worth it. The strengths of plant analysis, in effect, reduce the weaknesses of soil analysis and vice versa. You really need to do both to do a complete diagnosis. Finally, take all this nutritional information, together with all the other factors that are required, to come up with a Total Program approach to profitable crop production.

Are you "changing oil twice?" How many plant samples do you normally take each year? Are you auditing your "nutrition accounts" often enough? If not, you are not using the best tools available to you.

What is Going on Underground?

Dr. Robert Mikkelsen, Western North America Director, IPNI

We spend a lot of time and money to get crops the nutrition they need for maximizing growth and yield. When planning for the next season, don't forget about the part of the plant hidden beneath the soil surface. There are two obvious functions for roots that come to mind; anchoring the plant to keep it upright and getting the water and nutrients needed to support growth, but there are many other things too.

Roots release a large number of organic compounds that aid the plant in its growth. As much as one-third of the carbon fixed through photosynthesis can be pumped out of the roots into the soil, assisting the plant in numerous ways. The organic compounds released from roots are grouped into high molecular weight compounds such as carbohydrates and enzymes, and low-molecular weight compounds such as sugars and organic acids.

The zone surrounding the root is called the rhizosphere, typically extending a few millimeters in to the soil (about the thickness of a nickel). A jelly-like substance is excreted at the root tip that reduces friction and physically protects the delicate cells at the root tip, aggregates soil particles, maintains a pathway for water and nutrient uptake, and influences the growth and development of surrounding plants and microorganisms. These root exudates play a vital role in providing a constant nutrient supply for plants. Some of them regulate microbial growth surrounding the roots. Specific bacteria can be triggered to form nodules in legumes when signaled by the proper root exudates. Other compounds induce spores of mycorrhizal fungi to germinate and assist the plant with P and micronutrient uptake.

Many exudates can directly improve nutrient availability. For example, organic acids released from roots can solubilize P compounds in the soil. Enzymes originating in the root can speed the release of P from soil organic compounds to a form that can be used for nutrition. Specialized root compounds, called phytosiderophores, will chelate iron (Fe) in the soil and enhance plant nutrition and growth.

Roots have the ability to modify the soil pH in the rhizosphere. Plants that receive nitrate as the primary source of N nutrition generally have an elevated pH in the rhizosphere. However, plants that have an abundance of ammonium often cause their rhizosphere to become more acidic.

The physical properties of roots are also important. For example, the root length and the degree of branching are important for exploring soil resources. A root system with a large surface area has greater opportunity for nutrient uptake. The presence of abundant root hairs is beneficial for water and nutrient uptake. It is estimated that up to three-quarters of the total root surface area of many cultivated crops is provided by root hairs.

Healthy root systems are often unappreciated, but essential for vigorous plant growth and high yields. Even after the crop is harvested, the decaying root system continues to provide benefits to the soil and to the following crop. Providing an environment where nutritional, chemical, physical, and biological barriers are eliminated allows the crop to reach its full potential. Don't overlook what you can't see.

Interpreting Drought Soil Test Results

Adapted from Antonio P. Mallarino, Department of Agronomy at Iowa State University article "Be Cautious When Interpreting Early Fall Soil-Test Results"

Much of the Midwest has been having dry and in some cases drought conditions start to affect our area. This is going to create some challenges in soil sampling and soil test results this summer and if conditions do not improve will run into this fall. I just wanted to take a minute to remind those of you taking samples this summer that you may see some differences in your soil test levels compared to when taking samples under more normal soil moisture conditions.

Soil Sampling Issues

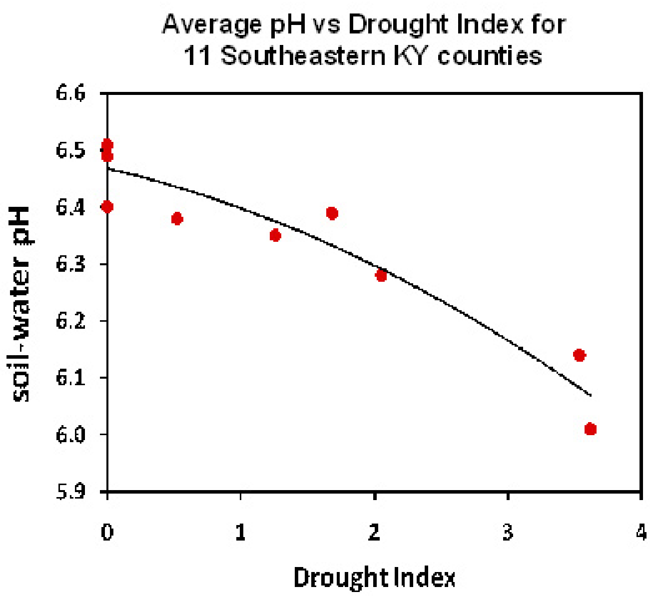
Sampling under very dry conditions may increase soil sampling error because it is more difficult to control sampling depth and proper soil core collection. This may be a problem for P and K due to nutrient stratification, which usually is more pronounced in reduced till, no-till and pastures. Both P and K tend to concentrate at or near the soil surface and therefore, the depth control for core collection is very important. Also, when the top inch of soil is very dry and powdery it is very easy to lose this soil portion, which will affect the soil-test result significantly.

One solution to getting a good sample is to use a portable electric drill with a stainless steel bit. You can cut a hole slightly larger than the bit in a plastic bucket or a stainless steel pan to catch the soil. Avoid using anything that may be aluminum or galvanized as this may affect the soil test results.

Soil-test Results Issues

Very dry soil conditions may result in more acidic soil pH. Differences from of 0.5 to 1.0 pH units are common with very dry conditions. This is because small concentrations of cations or soluble salts present in the soil solution are not leached by rainfall or are not retained by soil particles, which result in higher hydrogen concentration in the soil solution.

The University of Kentucky produced an informative graph that illustrates the typical pH changes that are seen after a droughty summer.



This Kentucky data shows a maximum pH drop of about 0.5 pH units during an extreme drought, which is typical of loamy or clay-loam soil types. The amount of drop could be as much as 1.0 pH units in very sandy soils and almost unnoticeable in Midwestern heavy clay soils.

This pH change is caused by the upward movement of ionic elements in the soil (Na+, K+, Cl-, NO_3-, etc.). In other words, this is the opposite of leaching. As the soil dries out, water at the soil surface evaporates and is replaced by water deeper in the soil profile. As with downward water movement during leaching events, whatever is dissolved in the water moves with the water, so as this upward movement continues, these ions accumulate in the surface of the soil and depress the "water-pH" of the soil.

Short-term nutrient recycling from plant residues and the equilibrium between soil nutrient pools also may be affected by rainfall, especially for potassium (K). Potassium is present in the soil in water-soluble, easily exchangeable and slowly exchangeable forms, and in mineral (unavailable) K form. Potassium in fertilizer and manure sources is water soluble and application quickly increases the solution and exchangeable K pools, which are readily available for crops. Potassium in plant tissue also is soluble in water, because little or no K combines in organic compounds.

Re-distribution of K among soil pools occurs as K is added to soil with fertilizer, manure or crop residues. Plants take up K from soil solution, which is readily replenished by the easily exchangeable soil K fraction. In moist soils, some slowly exchangeable K can become exchangeable when easily exchangeable K is depleted by plant uptake or leaching. With dry soil at the end of the growing season, this replenishment of the solution and easily exchangeable K fractions, which is what soil tests measure, is limited or does not occur. These processes also occur for phosphorus (P), but to a much lesser extent and through completely different mechanisms.

Therefore, knowing patterns of K release to soil from maturing plants and crop residues could be important to help understand temporal soil-test K variation. Starting in 2009 a project has been focusing on K release from plants and residue in corn and soybean fields at Iowa State University. At physiological maturity and at the normal grain harvest time the above-ground portion of plants (grain and vegetative parts) were sampled, weighed and analyzed for K concentration. After grain harvest, residue left on the ground also was weighed and analyzed for K concentration several times until April of the next year.

Figure 1 summarizes average results for five soybean fields. There was a very sharp decrease in the amount of K remaining in vegetative tissue from physiological maturity until harvest. This sharp decrease can be explained by K contained in dropped leaves (which were not collected if they were badly contaminated with soil) and K leaching out of the standing biomass. There was a sharp K decrease in the crop residue from harvest until late fall, and a much smaller decrease in spring. The K content of residue changed little during winter (with snow and frozen ground).

There was significant variation in patterns of K loss from plant tissue and residue most likely related to rainfall amount and distribution. The study of rainfall patterns along with the K test results has not been completed at this time, and the research continues. The preliminary results strongly suggest, however, that with little or no rainfall from crop physiological maturity until soil sampling there is less K recycling from plant tissue and crop residue and lower soil-test K values than with normal rainfall.

Study for P recycling from plant tissue and crop residue began more recently and data are not available at this time. "Because most P in plant tissue and crop residues is organic, I don't believe that these processes will be nearly as important as for K" according to Antonio Mallarino.

Soil Sampling Suggestions

1. Try to delay soil sampling until meaningful rainfall because it will result in a better sample and more reliable soil-test results. At this time it is not possible to say how much rainfall would be helpful, but at least one inch or more.

2. If you have to take soil samples under the current dry conditions:

o Be careful with sampling depth control and that you get the complete soil core in the bag.

o Soil pH test results may be a bit more acidic than it would in normal conditions.

o Soil K test results may be lower than they would be under normal conditions due to less recycling to the soil and less replenishment of soluble or easily exchangeable soil K pools.

o Soil P test results probably will be affected little by the recycling issue.

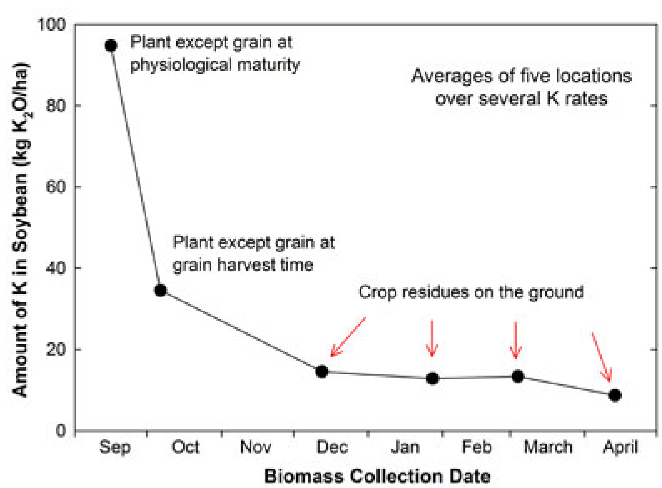


Figure 1. Amount of potassium contained in soybean vegetative plant tissue at physiological maturity (except grain) and in residue from harvest until the following spring. (Iowa State University)

Do High Yielding Soybeans Need to be Fertilized With Nitrogen?

Dr. T. Scott Murrell, Northcentral Director, IPNI

Are higher yielding soybeans running short on N? Do they need additional N fertilizer to ensure they are properly fed? Recently, a group of scientists at University of Nebraska examined 108 published scientific studies on this topic to see if any trends could be discovered. Soybean yields in the studies ranged from 9 to 88 bu/A, and averaged 40 bu/A. Here are a few of their findings.

Soybean N requirements. The above-ground portion of a soybean plant takes up, on average, about 4.72 lb N/bu. This means that a 40 bu/A crop takes up about 189 lb N/A, while an 88 bu/A crop takes up about 415 lb N/A. The average concentration of N in the seed was found to be 6.34%. This works out to be 3.3 lb N/bu. So that same 40 bu/A crop will remove 132 lb N/A from the field at harvest, while the 88 bu/A crop will remove 290 lb N/A.

Sources of N for soybean uptake. Soybeans get their N from three sources: 1) N_2 fixation by Bradyrhizobium, 2) nitrate and ammonium in the soil, and 3) fertilizer N. The studies showed that on average, 50 to 60% of the N in soybeans comes from N_2 fixation. Normally, the remainder comes from the N in the soil. The maximum amount of N_2 that can be fixed was considered by the authors of the review to be 300 lb N/A. When fertilizer N is applied, it can reduce the amount of N_2 fixation. This reduction is exponential. The first 45 lb N/A can reduce maximum N fixation to about 190 lb N/A. Applying 90 lb N/A can reduce it to 125 lb N/A.

Soybean response to fertilizer N. Information about soybean response to N fertilization was reported in 67 of the 108 studies. Positive responses to N fertilization occurred in about half of them. The average yield response was 8 bu/A. A slightly higher average response of 10 bu/A occurred when low rates of N (less than 45 lb N/A) were applied after growth stage R3 (beginning pod). Typically, seasonal N demand peaks after this stage. When a subset of 12 studies with soybean yields greater than 67 bu/A was examined, 9 of the studies (75%) responded positively to N fertilization. The authors concluded that in high yielding environments, fixed N and soil N supplies may not be great enough to meet the N demands of the plant, increasing the probability that soybean may respond to N fertilization.

Conditions favoring soybean response to N. High yielding environments may have a greater chance of responding to fertilizer N, but at lower yields, there are still several situations the authors listed where responses to N were more likely. These included poor establishment of the nodule system, extremely low soil N supplies at planting, plant water stress, soil pH problems, low soil temperature, or an absence of native Bradyrhizobium resulting from a cropping history with infrequent or no legumes.

So do high yielding soybeans need to be fertilized with N? The answer appears to be that they might, but the yield response may only be marginally profitable. When soybean prices outpace the price of N, profitability is more likely, but such a window is usually not long-lasting. Therefore, N fertilization of soybeans still carries a financial risk even under high yielding environments. Local trials can help determine whether or not the practice makes sense in individual situations.

Nitrate Testing of Drought Stressed Corn

By Bill Urbanowicz

With the current drought that has affected many parts of the country; many fields of grain corn are being chopped for cattle feed. Because of this, we have received questions about how to sample corn for excess nitrates.

There are two plant nitrate tests for corn. One is the widely called either the "Post-Season Cornstalk Nitrate Test" or simply the "Stalk Nitrate Test". The other doesn't have a commonly accepted title, but could be called the "Forage Nitrate Test". These two tests identify the same nitrate (NO_3), but the purposes for taking the tests are different and the sampling procedures are different. They are not interchangeable. The Stalk Nitrate Test is designed to evaluate the appropriateness of the nitrogen rate used on the crop that season, while the Forage Nitrate Test is designed to evaluate the safety of the forage for feeding livestock, primarily cattle. There isn't enough space in the newsletter to write a complete article on both tests, but this information is available on our web-site at spectrumanalytic.com. They can be found in the Library section under the titles "End of Season Cornstalk N Test" http://www.spectrumanalytic.com/doc/library/articles/cornstalk_n_test

and "Excess Nitrates in Drought Stressed Corn" http://www.spectrumanalytic.com/doc/library/articles/excess_nitrates_in_drought_stressed_corn .

The "Stalk Nitrate Test" involves sending us an 8 inch section of cornstalk taken between 6" and 14" above the ground. The nitrate level of this section of stalk is pretty well calibrated to identify if the corn plant had sufficient, too little or too much N for that seasons growing conditions. If the test comes back with an excess of NO_3-N, it is an indications that in that season, conditions other than the supply of N were the factors that limited growth. If it comes back low, it indicates that N was the primary limiting factor and more N would have increased the yield. When using this test we have to keep in mind that each season is different and the same N rate could be too high in one year and too low in another. It is the long term average results of this test that best indicate a need to adjust N rates.

The "Forage Nitrate Test" is calibrated to find out if corn forage (or any forage for that matter) contains an excessive amount of NO_3-N that might be toxic to cattle when fed to them. Since the cattle would consume the entire portion of the corn that was chopped, the only way to get a reliable prediction of the safety of feeding that forage is to analyze the entire plant portion that is chopped. In other words you have to analyze a representative sample of what is being fed to the cattle. About the only time that you might need this test is when the corn crop has suffered significant yield reduction due to drought. In these conditions, the dry weather is the main limiting factor and nearly any typical rate of N will have been excessive for the grain yield obtained. The excess N is stored in the corn plants as nitrate-N (NO_3-N), which can be toxic to cattle in high amounts. In these situations, the grower wants to know what he is dealing with and be in a position to make the correct management decisions.

From this brief description of the tests and their uses, you might logically conclude that we ought to be able to predict the suitability of a drought-stressed corn crop for cattle feed by using the Stalk Nitrate Test. Unfortunately, that isn't the case at this time.

The Analysis is published as a service to agricultural dealers and crop consultants by Spectrum Analytic Inc.

If you have any questions or comments, please call 800-321-1562 or 740-335-1562 or Fax us at 740-335-1104.

Bill Urbanowicz
Editor

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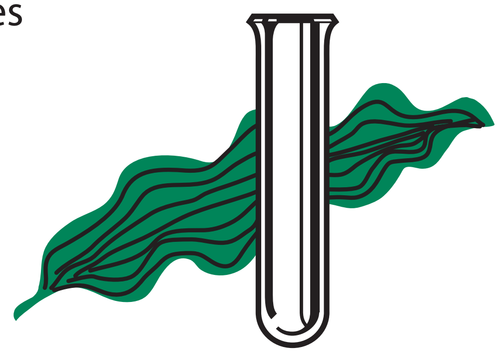

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