AGVISE LABORATORIES

Timely information for agriculture

Fall/Winter 2018

SOUTHERN TRENDS

RICHARD JENNY
AGRONOMIST/CCA

The early-summer (June) grid topsoil sampling season continued to increase this year, even though heavy precipitation in southwest Minnesota and southeast South Dakota made for difficult soil sampling. Our customers have found this early-summer soil sampling season so useful that it remains a growing part of their businesses under even the most adverse soil sampling conditions.

The 2018 fall soil sampling season and corn-soybean harvest started earlier than 2017, and then a very wet early October hit our entire service area of South Dakota and southern Minnesota. The weather finally turned around for the next few weeks to assist soil sampling, harvesting, and fertilizer application.

We will be attending a couple regional tradeshows again this year: Minnesota Crop Production Retailers (MCPR) Tradeshow at the Minneapolis Convention Center, December 11-12, and the South Dakota Ag Expo in Sioux Falls, January 16-17. We will hopefully see you there.

We hope your 2018 work-year finishes off successfully and the upcoming holiday season is enjoyable for you and your family. Best wishes!

AGVISE Soil Fertility Seminars January 8, 9, 10 | March 12,13

AGVISE Soil Fertility Seminar dates and locations are set. The dates and locations for our 2019 Soil Fertility Seminars are listed below. A registration letter was sent to U.S. customers in early November. If you did not receive the mailing, please call 701-587-6010 and we will send it to you. Please make sure you register early for these seminars if you plan on attending as space is limited. An email was also sent to everyone on our mailing list in mid-November. If you received this newsletter, you are on our mailing list, but you may not be on our email list. If you want to receive future emails on our seminars, newsletters and technical information, please call Teresa at our Northwood office and give her your current email (701-587-6010). To register for our Soil Fertility Seminars, call 701-587-6010 and ask for Shelly or Patti. We will be mailing and emailing the announcement for our Canadian seminars in late January.

Seminar Locations		CEU Credits applied for
January 8	Granite Falls, MN	1.5, SW, 2.0 NM, 1.0 CM
January 9	Watertown, SD	1.5, SW, 2.0 NM, 1.0 CM
January 10	Grand Forks, ND	1.5, SW, 2.0 NM, 1.0 CM
March 12	Portage La Prairie, MB	To be determined
March 14	Saskatoon, SK	To be determined

Soil Nitrate Testing: Great Tool for Agronomists

Fall soil nitrate testing is a great tool for agronomists in western and northern areas with limited rainfall and frozen winters! Yes, I am talking about those hardy agronomists that call the plains and prairies of the U.S. and Canada home!

This year, many northern areas received less than normal precipitation, and some areas experienced their second year of drought. Scattered rainfall this year left some very dry areas only a few miles from areas with near normal precipitation. This spotty rainfall is one reason that soil nitrate levels are quite different from field to field with the same cropping history this fall.

In good production years, the long-term average of 30-35 lb/acre nitrate-N following wheat is considered normal, but there were multiple areas that had much

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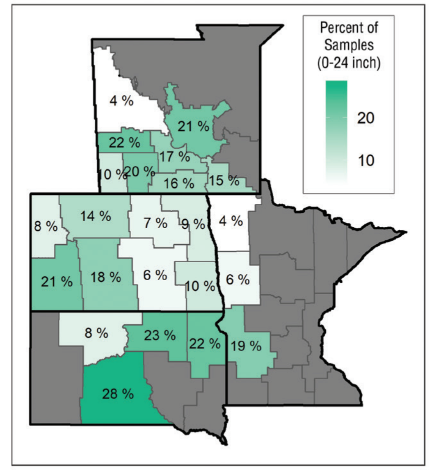
Soil Nitrate Testing Cont...

Soil samples with residual nitrate-N greater than 80 lb/acre following wheat in 2018.



higher residual nitrate remain this fall. The figure shows the percentage of wheat fields that had over 80 lb/acre nitrate-N remaining. Many areas in Manitoba, southwest North Dakota, and central South Dakota had more than 15% of wheat fields testing higher than 80 lb/acre nitrate-N.

With more fields testing higher in nitrate-N than normal, we have received many questions about why these fields are testing so high. There are numerous potential reasons why residual soil nitrate is testing higher this fall. Here are some that may have occurred in your area:

1. Dry soil conditions reduced crop yield and N uptake
2. Extremely variable rainfall in your area
3. Applied N fertilizer rate was higher than required
4. Little to no soil nitrate was lost through wet soil conditions (this is common in wet years)
5. Plant roots acquired water and residual nitrate from below 24-inch depth when upper soil profile was too dry
6. Warm summer temperature increased N mineralization from organic matter
7. Previous crop N credit from legume was not considered in N management

In summary, there are numerous factors that we cannot model or predict to determine how much nitrate-N will be left in the soil profile after harvest. Soil nitrate testing is a great tool to assess the N amount remaining in the soil profile. Agronomists in the northern region utilize the residual soil nitrate test to manage nitrogen fertilizer inputs for the best economic and environmental result for their growers.

Aluminum Toxicity: What It Is and What To Do

Aluminum toxicity is a serious yield limitation in acidic soils, particularly when soil pH is less than 5.0-5.5 (Fig. 1). In the Northern Great Plains and Canadian Prairies, we rarely find soils with such low pH; however, soil samples with moderately to strongly acidic pH (5.0-6.0) are becoming more common. Many of these low pH soils are from long-term no-till fields in north-central Montana and southwest North Dakota. Why is low soil pH becoming an issue now?

We know that continuous application of nitrogen fertilizer will lower soil pH over time. Low pH is more pronounced in long-term no-till fields where acidity is concentrated at the soil surface (0-2 inch depth). Surface soil pH may be in the 4.0-5.0 range, which will cause aluminum toxicity for young seedlings. In addition, grid and zone soil sampling has helped locate low soil pH zones in fields, often sandy areas, that were otherwise masked in one composite soil sample for the entire field.

When soil pH is below 5.0-5.5, soluble aluminum (Al^{3+}) becomes present in the soil solution. Soluble Al^{3+} damages root growth and limits root-zone size. The damaged root system has impaired water and nutrient uptake, causing poor plant growth and yield. These effects are made worse in drier environments where large root systems are vital to obtain water and nutrients from deeper soil depths.

There are some strategies for combating Al toxicity:

1) Choose crop types and varieties with Al tolerance. Grass species generally have better tolerance to Al toxicity than legume and pulse crops. On-going research in North Dakota and Montana is evaluating existing wheat varieties for Al-tolerance genes (Fig. 2).

Fig. 1. Aluminum toxicity can reduce plant growth and yield to nothing. No lime added since 1911, soil pH 4.7 in 2004. Cullars Rotation, oldest soil fertility experiment in the Southern United States, at Auburn University, Alabama. Photo: JSB, August 2015.

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Fig. 2. Genetic tolerance to aluminum toxicity between susceptible (left) and tolerant (right) wheat varieties grown on low pH soil near Dickinson, ND. Note reduced plant height, tillering, and root mass of susceptible variety. Photo: JSB, June 2018.

2) Apply high rates of seed-placed phosphorus (about 40 lb/ acre P_2O_5) to tie-up soluble Al^{3+} in the seed zone, improving small grain seedling establishment. Do not exceed seed-safe fertilizer rate, based on crop type, soil moisture, and seedbed utilization.

3) Apply lime to increase soil pH and reduce soluble Al^{3+}. A buffer pH test is required to determine the lime rate. Target pH is 6.0 for most crops and 6.5 for alfalfa.

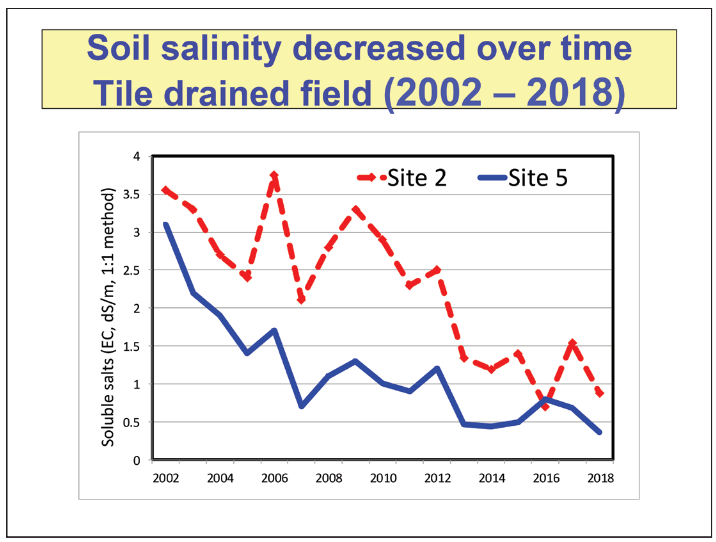
This region does not traditionally apply lime, and the major hindrance remains access to lime sources and equipment. Spent lime from sugar refining or water treatment facilities are the most accessible lime sources, but these sources have high water content that makes long-distance transportation expensive and require specialized application equipment. Where lime is difficult to obtain, we suggest choosing plant species and varieties more tolerant to Al toxicity and consider applying higher seed-placed phosphorus rates. If you have any questions on managing acidic soils and lime application, please contact one of our soil scientists for more information.

Tile Drainage Demonstration: 16 Years and Counting

Soil salinity (soluble salts) became a serious concern across the Northern Plains during the past 20- to 25-year wet cycle. Excessive precipitation and fine-textured, poorly drained soils are a bad combination. In high rainfall years, the water table was close enough to the soil surface that saline groundwater could wick upward and evaporate, leaving salts behind. Soluble salts left on the soil surface reduce plant growth and yield. If this process occurs over many years, soluble salts will accumulate on the soil surface and reach high levels that greatly reduce yield of many crops. Some areas in the northern region have experienced a few dry years in a row recently, but we are still suffering from the salinity problems that developed during the previous wet years.

Surface drainage, tile drainage, and continuous cropping are the most effective ways to lower the water table and reduce soil salinity over time. There are no soil amendments that will remove salinity from soil (we wish there were). Once the water table is lowered, you can reduce capillary rise that brings water and salts to the soil surface. Then, you need some additional rainfall to move salts lower in the soil profile, below the root zone. If you have tile drainage, some salts will leave the field through the tile on wet years. Over time, soil salinity will be reduced, and crop yields will increase.

In 2002, AGVISE started a drain tile demonstration project in cooperation with Grady Thorsgard, a farmer near Northwood, ND. Salinity in this field had increased to where multiple crops that he grew suffered reduced yields. Drain tile was installed, and we began monitoring salinity in Fall 2002. We established ten GPS-marked locations across the field. Each fall, we collected 0-6 and 6-24 inch soil samples for salinity and nutrient analysis.



Over the past 16 years, salinity in the 0-6 inch depth decreased significantly. Sites 2 and 5 had the highest initial salinity (see figure). In dry years, salinity at these sites stayed the same or increased slightly, but over many years, salinity decreased greatly. Salinity eventually decreased because tile drainage lowered the water table and allowed excess rainfall in wet years to move salts deeper in the soil profile. Improved crop growth also removed additional water each year, helping keep the water table lower. This field now produces high yielding crops without losing yield to salinity. Even with tile drainage, this field required many years to reach acceptable salinity levels; therefore, you must set your salinity remediation expectations accordingly. These salinity problems developed over many years and will take many years to fix. We expect salinity in this field to continue decreasing slowly in the future.

Aggregate Stability: The Next Thing in Routine Soil Health Testing?

JOHN BREKER
SOIL SCIENTIST

As soil health testing evolves, AGVISE Laboratories continually evaluates soil health testing methods that can provide useful assessments of soil quality and productivity. In the past decade, soil heath testing has focused on biological CO_2 respiration, microbial population diversity, and easily oxidizable C. These measurements are widely variable across fields and over time, so tracking improvement in soil management is uncertain. Interpreting such biological and biochemical measurements is difficult because some popular soil health assessments have not been regionally calibrated and fail to detect changes in soil management (Roper et al. SSSAJ 81:828-843). If you are trying to improve soil management, you need a soil health test that can actually measure change, right?

This is why we cannot ignore the obvious. When a farmer transitions from conventional tillage to strip-till or no-till and diversifies the crop rotation (maybe with cover crops), the first comment you will hear is, "Look at this soil tilth! It is so crumbly, and the earthworms!" These farmers are seeing their soil structure and aggregation visibly improve pretty quickly! Soils with high soil aggregate stability have less soil erosion, better equipment trafficability, and faster water infiltration. Multiple management practices come together to improve soil aggregate stability such as reduced tillage, greater crop rotation diversity, more plant roots, greater earthworm and microbial activity, and more soil organic matter.

Soil aggregate stability testing is not new to people familiar with the soil quality efforts in the 1990s. The difficulty then and now is that the manual laboratory methods are time-consuming and expensive and only used in research. If we can develop a commercially-viable, routine soil aggregate stability method, then we will have a tool to measure real improvement in soil health and management. Stable soil aggregates are the result of many processes occurring in soil, and we can measure that! Soil aggregate stability is a real soil property measurement that will reflect changes on soil health and productivity. AGVISE Laboratories is working on a commercially-viable, routine soil aggregate stability method that will help measure real improvement in soil health and soil management for growers. We will update you on our progress at our winter seminars.

Charlie Bernstrom

Kent Carrier

Zack Johnson

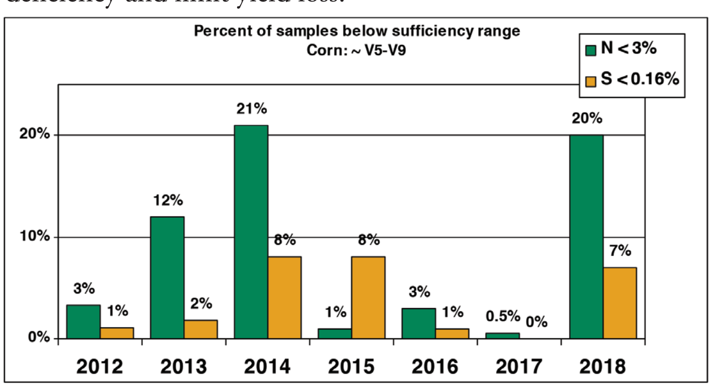
North Dakota Giant Pumpkin Record Broken!

Giant pumpkin growers benefited greatly from the warm growing season this year, resulting in many personal records! The Minnesota record is 1,918 lbs, and Charlie Bernstrom from Lancaster, MN got close with an 1,810 lb giant pumpkin this year. In North Dakota, Kent Carrier from Wahalla broke the state record with a 1,920 lb giant pumpkin that smashed the old state record of 1,659 lbs! The next generation of giant pumpkin aficionados is also doing well. Zack Johnson (son of long-time giant pumpkin grower Adam Johnson) won the youth division at the 2018 Minnesota State Fair. Congratulations to everyone on a great year!

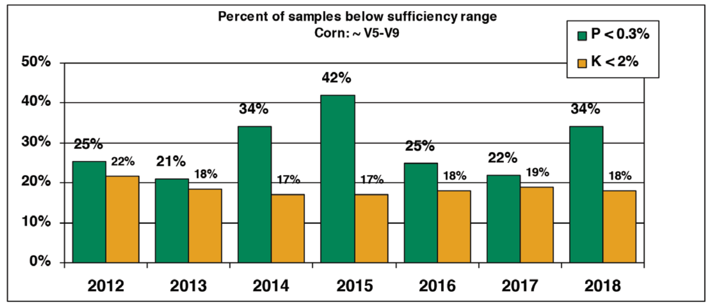
Trends in Corn Plant Tissue Analysis: 2012-2018

Interest in plant tissue analysis has increased greatly in recent years. In the past six years, our Benson, MN laboratory has analyzed the nutrient content of many thousands of corn plant tissue samples. With the increasing volume of corn plant tissue samples, we are able to see some nutrient content trends on a regional scale. The Benson, MN laboratory primarily serves eastern South Dakota and southern Minnesota; this region is dominated by corn-soybean production. We receive corn plant tissue samples from growth stages as early as V2-V3 to R3 (milk) stage. After black layer forms at the end of the growing season, we also receive numerous corn stalk samples for nitrate analysis. For this article, we will narrow our discussion to corn growth stages between V5 and V9. This growth stage generally occurs from late May through June each year. We will cover the plant tissue data from 2012 through 2018, noting the "bookend" years of 2012 (drought) and 2018 (very wet) in this region.

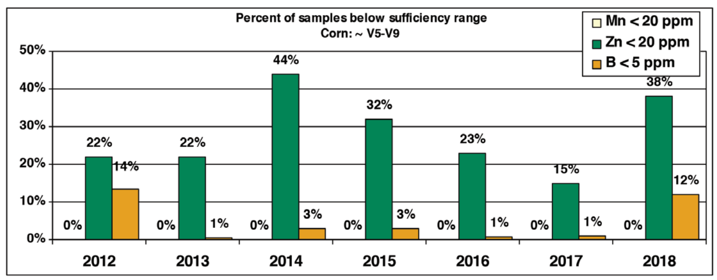
In the charts below, plant tissue analyses for each year were summarized according to the sufficiency level considered low or deficient for each nutrient. For example, the sufficiency levels for nitrogen (N) and sulfur (S) are 3% and 0.16%, respectively, during the V5-V9 growth stages. In the 2012 drought year, only 3% of corn plant tissue samples had low N, and only 1% had low S. This would be expected because there was little opportunity to lose N or S from excessive wet soil conditions. In the 2018 wet year, 20% of samples had low N, and 7% had low S. This was also expected as excessive rainfall in the area provided conditions for soil N and S loss. Excessive wet conditions were also present in 2014, when 21% of samples had low N. In 2014, yellow corn, suggesting either N or S deficiency, was widespread in the area. In wetter years, we often see more corn samples with low N or S content. When these observations are noted early in the growing season, there is opportunity to apply rescue fertilizer to correct the nutrient deficiency and limit yield loss.



For phosphorus (P) and potassium (K), we observe a much different story than N or S. Phosphorus and K do not follow wet/dry growing season trends like N or S. The data indicates that corn plant tissue samples are rather consistent in the proportion testing below the sufficiency range for P (2.1-4.2% P) and K (1.7-2.2% K) each year. This shows that there is potential to improve P and K fertilization, and plant issue analysis can help determine which fields or parts of fields require more fertilizer.



Micronutrient concerns in corn are mostly restricted to zinc (Zn). In the figure, 15 to 44% of corn plant tissue samples were below the sufficiency range each year, indicating that Zn fertility has potential for more improvement. In 2018, corn plant tissue samples with low boron (B) was less than 12% and with low manganese (Mn) was less than 1%.



Plant tissue analysis is a good tool to help determine if any plant nutrients are less than sufficient. Plant tissue analysis summaries such as this indicate trends over several years, but they do not tell you anything about what is happening in each field or parts of fields you manage. For the best information, it is always recommended to collect paired plant tissue and soil samples from the good and bad field areas for troubleshooting.

President's Column Cont...

There is much you can learn about a field from simply breaking whole fields into management zones. This example highlights why certain areas of fields must be managed differently. A high nitrogen rate is not needed over the entire field, and gypsum application is only warranted in certain areas as well.

Soil salinity and nitrogen carryover on a wheat field near Northwood, ND. September 2018.

Crop	Soluble salts	Nitrate-N	Sodium
	mmhos/cm	lb/ac (0-8 inch)	%
Good	0.89	28	2.6
Poor	3.35	96	9.3
No growth	4.83	412	15.6

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PRESIDENT'S CORNER

BOB DEUTSCH
PRESIDENT
SOIL SCIENTIST/CCA

Soil salinity is not new to this region. In the fall newsletter, I discussed the various ways that high salinity reduces crop growth and yield. Where salinity reduces plant growth, nutrient uptake is also reduced, resulting in high nutrient levels accumulated in the soil over time. We see this most frequently occur with residual nitrogen.

This fall, I was soil sampling a nearby wheat field. A 65-mph drive-by survey could tell you this field has salinity problems: areas with no wheat stubble (maybe kochia), areas with thin wheat stubble, and areas with thick, bright wheat stubble. The wheat yield obviously varied across the field. I collected soil cores with my hand probe from each area.

The table below clearly illustrates how salinity affects nitrogen carryover. The area with no crop growth (4.83 mmhos/cm) had 412 lb/acre nitrate-N (0-8 inch depth)! On this saline area, annual fertilizer application has not been utilized by crops and instead accumulates each year. A soil sampler in this field should purposefully collect soil cores from the good production areas and avoid areas with high salinity. One or two soil cores from the area with no crop would highly skew soil test nitrogen results. This could lead to under-fertilizing the good production areas, where residual soil nitrate was actually much lower. Ideally, the field should be zone sampled to prevent over-fertilizing the saline areas and under-fertilizing the good areas.

When I was in this field, there was drain tiling equipment being staged in the field. The landowner is aware that high salinity is reducing crop production and decided that drain tile is appropriate. Soil test results showed that the saline areas also had high sodium (above 5% Na). The producer may need to consider gypsum application on the saline areas to maintain water flow into the drain tile once salinity begins to decline.

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NORTHERN NOTES

JOHN LEE
SOIL SCIENTIST/CCA

We experienced a genuine mixed bag of weather and crop production in the northern region this year. Some areas experienced their second year of drought, while others had decent moisture and above average crop yields. Snow in early October threw a monkey wrench into harvest too! Mother Nature finally gave us a break in late October and November, but crop quality was hurt in some cases.

Soil testing got an early start as wheat harvest started in August in many areas. Soil sampling conditions were on the dry side to begin with, and many customers tried our new dry tip for the HD probe. This dry tip allowed them to obtain good quality soil cores under pretty dry soil conditions. Later in the season after many areas had received ample rainfall, customers switched to the wet tip for the HD probe and were able to collect quality soil cores as well. You need to have a diversity of sampling equipment to get the best quality soil cores in all soil conditions!

The winter meeting season is here and our staff will be at many regional meetings to say, “Hello!” Our soil fertility seminars are scheduled for January 8, 9, 10 in the U.S. and March 12 and 14 in Canada (more details inside). If you did not receive an announcement by mail or email, please call our office for more information and registration (701-587-6010 – ask for Shelly or Patti). We hope you enjoy the upcoming holidays with family and friends!