AGVISE LABORATORIES

Timely information for agriculture

Winter 2019-2020

PRESIDENT'S CORNER

CINDY EVENSON
PRESIDENT
AGRONOMIST, CCA

Every year, I get to experience the ups and downs of farming firsthand. Although my days are spent in the laboratory, my homelife revolves around family and farming. My husband is a fifth-generation farmer, and our son plans to continue as Generation No. 6 on our family farm. I get to see what is happening daily on the farm and help make many, many decisions. I cannot remember a year quite like 2019. From spring to fall, there was much more precipitation than average and even record setting in some areas.

This fall, there was no wonder why customers were asking about the heavy-duty wet soil probe tips or why the soil drying area smelled like WD-40. When harvest is difficult and delayed, it puts everyone in a difficult position. Collecting soil samples and applying fall fertilizer on wet, muddy soils becomes a struggle. Wet grain arriving at grain bins or elevators creates more backlog. When the weather finally cooperates for a few days, we rush to get work done in short spurts. Tough weather is hard on people and equipment.

In the Benson laboratory, we expected a typical early to mid-September start to the soil sampling season. However, weather delays slowed harvest and soil sampling alike, and no one can predict or control that. Some years, the laboratory is busy in September, while in other years, the busiest few weeks occur in November. This year was one of those November years.

This year certainly had its ups and downs. I hope you had more good times than bad. While I would not want to repeat 2019, I know everyone is looking forward to 2020.

AGVISE Soil Fertility Seminars 2020
January 7, 8, 9 | March 17, 19

AGVISE Soil Fertility Seminar dates and locations for 2020 are set. 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 agronomy updates, 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 mail and email the announcement for our Canadian seminars in late January.

Date	Location	CCA CEUs applied for
January 7	Granite Falls, MN	2.5 SW, 3.0 NM
January 8	Watertown, SD	2.5 SW, 3.0 NM
January 9	Grand Forks, ND	2.5 SW, 3.0 NM
March 17	Portage la Prairie, MB	TBD
March 19	Regina, SK	TBD

Variable weather brings variable soil nitrate

Residual soil nitrate levels across the region can be summarized in one word: variable. While the northern region experienced a very dry early growing season, there were areas not too far south that had more than excess rainfall throughout the growing season. Like any other year, weather is the dominant factor in nitrogen variability, and you can see that in the residual nitrate carryover after wheat this year (Figure 1). Regardless if your growing season was too dry or too wet, the residual soil nitrate test tells us what nitrogen is leftover and where to start for fertilizing next year's crop.

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Variable weather brings variable soil nitrate cont…

Reasons why residual soil nitrate may be higher than normal:

- Lower than average crop yield (lower plant nitrogen uptake)
- Over-application of nitrogen fertilizer
- In-season split nitrogen application, reducing nitrogen loss potential
- Warmer summer temperatures with above average nitrogen mineralization
- Little to no nitrogen loss (no excessive moisture to cause losses of N to leaching and denitrification)

Reasons why residual soil nitrate may be lower than normal:

- Higher than average crop yield (higher plant nitrogen uptake)
- Under-application of nitrogen fertilizer
- Preplant nitrogen application, greater nitrogen loss potential
- Cooler summer temperatures with below average nitrogen mineralization
- Large nitrogen loss from excess rainfall (nitrate leaching and denitrification)

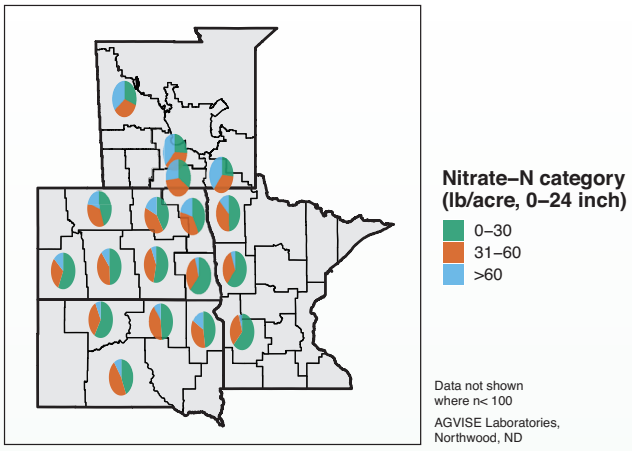

Figure 1. Residual soil nitrate distribution following wheat in 2019 (AGVISE, 2019).

Residual soil nitrate tells us what nitrogen still remains in the soil profile for next year's crop. Under normal conditions, the sweet spot for residual soil nitrate is between 30-60 lb/acre nitrate-N (0-24 inch). If residual soil nitrate is consistently less than 30 lb/acre, then you are likely losing crop yield or grain protein in crops such as corn or spring wheat. If residual soil nitrate is consistently more than 60 lb/acre, then you are applying more nitrogen than the crop requires.

Excess soil nitrate poses a greater risk of nitrogen loss to the environment in fall or spring. Over the years, consistent over-fertilization can result in nitrate accumulation in groundwater and surface waters, creating public health and environmental concerns. In the short term, excess leftover nitrogen is an unwanted cost to the grower because it was fertilizer that he or she did not need to buy until next year.

Precision soil testing doesn't cost, it pays

Fertilizer is one of the largest input costs that growers face in crop production each year. Optimizing fertilizer rates and dollars across each field is vitally important. Both over- and under-application are costly and must be avoided. Precision soil sampling, either grid or zone, is the best way to determine the appropriate rate of fertilizer and where it needs to be applied in each field. Conventional composite soil sampling (one soil sample per field) or just using crop removal rates without soil testing are not effective strategies to maximize profit. Without an effective soil test-based fertilizer program, such as grid or zone soil testing, you will likely miss the mark and either over- or under-apply fertilizer.

In 2018, 70% of soil samples submitted to AGVISE Laboratories were precision soil samples (grid or zone). While that number looks large, those soil samples represent a much smaller percent of all fields. In some areas, the adoption of precision soil testing has been slow, whereas other areas have over 60% of fields broken into grids or zones (Figure 4). The adoption rate is faster in regions with high-value crops (e.g. corn, sugarbeet), but the key in each region has always been a few early adopters showing that variable rate fertilization pays.

From university research to countless agronomist and grower experiences, precision soil sampling, whether grid or zone, is a more effective and precise strategy for soil fertility management than flat-rate fertilizer application. It is a proven tool to reduce over- and under-fertilization across fields, thus optimizing crop yield and profitability. As the number of fields that are precision soil tested continues to increase, growers can apply fertilizer inputs at the right rate and the right place to give them the best return.

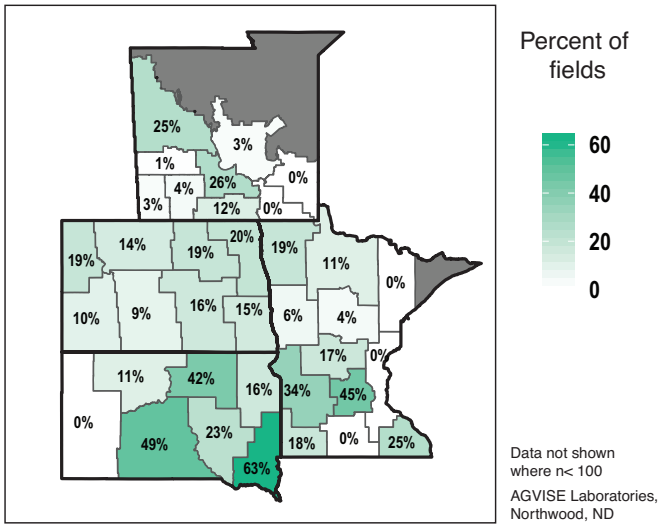

Figure 4. Percent of fields with precision soil sampling, either grid or zone (AGVISE, 2018).

Soil Health Focus: Active Carbon (POXC)

As soil health testing evolves, AGVISE Laboratories continually evaluates soil health testing methods that can provide useful assessments of soil quality and productivity. In 2019, we started offering three new soil health tests: active carbon, soil protein, and soil aggregate stability. In this issue, we will focus on active carbon as a soil health tool.

Active carbon, also called permanganate-oxidizable carbon (POXC), is a quick, repeatable soil test that captures the biologically active carbon fraction, that is microorganism food. This portion of organic matter is actively involved in nutrient cycling. Active carbon can be added to any routine soil test, simply requested as an additional analysis. Like any soil health test, it is a tracking tool measuring soil quality improvement, so make sure you are using GPS-marked soil sampling points.

Active carbon is closely related to total organic matter (r = 0.80, Figure 2), but it responds more quickly to changes in crop and soil management and shows that two soils with 4% organic matter can behave differently. A 17-year tillage experiment in Mandan, ND showed that conversion to no-till had only slightly increased total organic carbon; however, POXC increased significantly from 470 ppm to 600 ppm (Weil et al., 2003, Amer. J. of Alternative Agric. 18:3-17). This is why active carbon is considered a "leading" soil health indicator.

Agricultural soils of the upper Midwest and northern Great Plains usually contain active carbon ranging from 400 to 800 ppm (Figure 3). Active carbon increases with reduced tillage and greater organic matter inputs (e.g., plant biomass, manure). Active carbon can easily exceed 1000 ppm under perennial grass. With soil health tools like active carbon, you can more easily quantify positive changes achieved through better soil management.

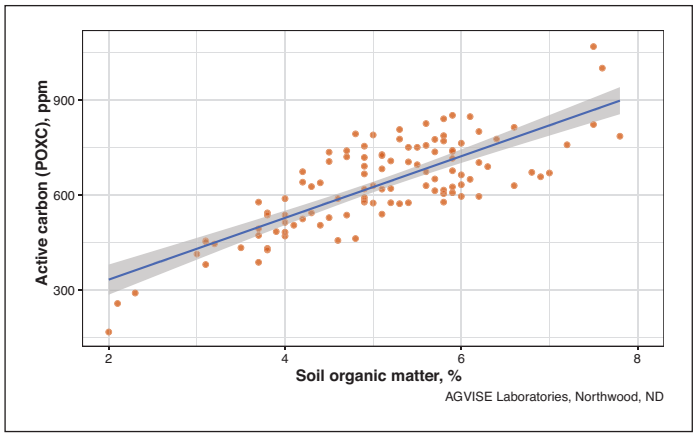

Figure 2. Active carbon (POXC) is one component of total soil organic matter (AGVISE, 2019).

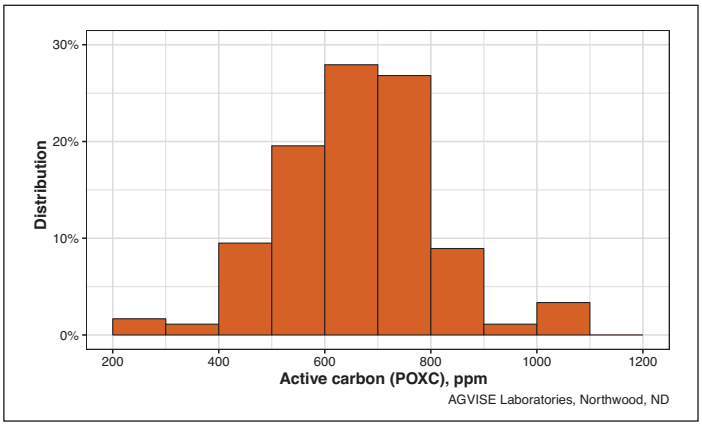

Figure 3. Active carbon (POXC) distribution among agricultural soils of the upper Midwest and northern Great Plains (AGVISE, 2019).

So, you have an acidic soil? How to soil sample

The problem of acidic soils (pH < 6.0) and aluminum toxicity in the northern Great Plains and Canadian Prairies continues to grow. Although soils across this region generally have high soil pH, there are localized areas battling acidic soils, particularly in long-term no-till fields of north-central Montana, southwest North Dakota, and central South Dakota. Without the established history and infrastructure of liming like in eastern North America, people are unsure how to handle acidic soils in the no-till dominated, semi-arid plains.

While the problem can be called "new," these soils did not suddenly become acidic overnight. The story is more that we are identifying them only now through precision ag technologies like yield mapping, satellite imagery, and precision soil sampling. Zone soil sampling has located low pH zones in fields, often sandy soils, that were otherwise

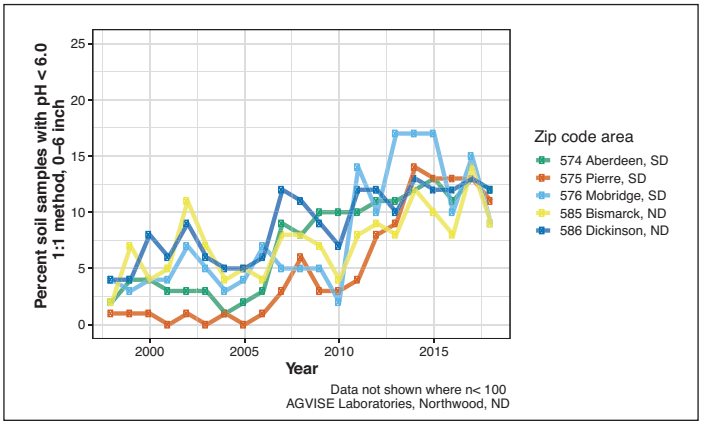

Figure 5. Soil samples with low pH (below 6.0) have increased in recent years (AGVISE, 2018).

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Battling acidic soils? Your wheat variety options

Ryan Buetow, NDSU Extension

RYAN BUETOW
NDSU EXTENSION

Over the past couple growing seasons in western North Dakota, soil acidity has become a frequent topic of conversation. In western North Dakota, we have found many soils with pH below 5.5 and even some near 4.0! The simple solution to correct low soil pH is lime, but it isn't all that simple since lime sources are not abundant everywhere and the transportation and handling costs soon become prohibitive. Many producers are reluctant to spend the money on lime, particularly on rented acres.

The main concern with low pH is aluminum toxicity, which starts below pH 5.5. Aluminum is highly toxic to plant roots, creating short and stubby root systems with poor water and nutrient uptake. Certain plant species and crop varieties have genetic traits that confer tolerance to aluminum toxicity. The more tolerant cereals include oat and rye. For wheat, varieties can be tolerant or sensitive. Hard red spring wheat (HRSW) variety MT Lanning has some genetic tolerance, while others like SY Soren do not.

To look at HRSW variety selection as a tool on acidic soils, we planted a variety trial in 2018. This was expanded in 2019, demonstrating that certain HRSW varieties perform better under adverse pH conditions (Figure 6). At this site, aluminum toxicity was a major concern as the soil pHs were 5.0 (0-2 inch), 4.5 (2-6 inch), and 5.6 (6-12 inch). With above average precipitation in 2019, there was also considerable leaf and head disease issues in all HRSW varieties. While fixing soil pH with lime should be prioritized, these results highlight that crop and variety selection should be included in an integrated approach to this problem. We plan to continue this work on crop and variety selection as well as surface-applied lime and in-furrow options in western North Dakota.

Ryan Buetow, NDSU Extension Cropping Systems Specialist, Dickinson REC.
(701) 456-1106. ryan.buetow@ndsu.edu

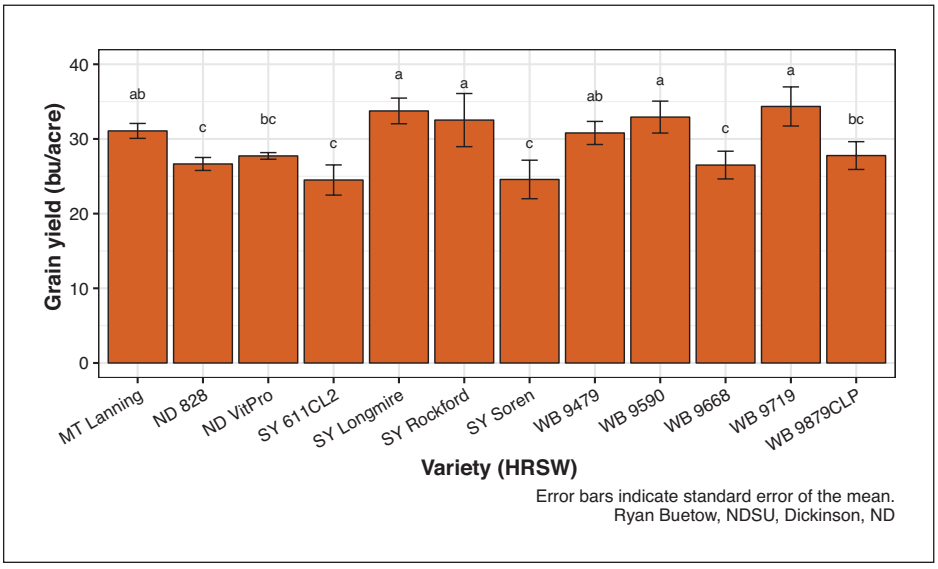

Figure 6. Spring wheat variety performance on an acidic soil near Dickinson, ND (NDSU, 2019).

So, you have an acidic soil? Cont...

masked in one composite soil sample for the entire field. In fact, the transition to zone soil sampling continues to identify more and more low pH zones each year (Figure 5).

Precision soil sampling is the first step to identify low pH zones. Most zones are developed for nutrient management and mapped at scales larger than the low pH pockets. To apply lime across the entire zone is often cost prohibitive, so more detailed soil pH information is usually needed for variable rate lime. Once you locate a low pH zone with pH < 6.0, then the next step is remapping that zone with more detailed data layers and finer zone delineation. Alternatively, this is one situation where 1.0-acre grid soil sampling might make sense. You are utilizing detailed zones or dense grids within larger zones to make that variable rate lime decision economically feasible.

Since no-till fields can have drastic pH stratification, soil sampling depth is critical. The larger nutrient management zones should still utilize 0-6 and 6-24 inch depths because fertilizer guidelines are calibrated to these soil depths. The secondary soil pH investigation should collect either 0-2 and 2-6 inch or 0-3 and 3-6 inch depths to capture pH stratification. Submit each soil depth as a one-depth soil sample, requesting pH and buffer pH (determines lime requirement). If only the upper depth requires liming, a surface lime application may be enough. If the lower depth is also very acidic, then a greater lime rate and incorporation might be needed.

Phosphorus and the 4Rs: The progress we have made

The year 2019 marked the 350th anniversary of discovering phosphorus, an element required for all life on Earth and an essential plant nutrient in crop production. Over the years, we have fallen in and out of love with phosphorus as a necessary crop input and an unwanted water pollutant. Through improved knowledge and technologies, we have made great progress in phosphorus management in crop production. Let's take a look at our accomplishments!

Right Rate

Phosphorus fertilizer need and amount is determined through soil testing, based on regionally calibrated soil test levels for each crop. Soils with low soil test phosphorus require more fertilizer to optimize crop production, whereas soils with excess soil test phosphorus may only require a starter rate. Across the upper Midwest and northern Great Plains, soil testing shows that our crops generally need MORE phosphorus to optimize crop yield (Figure 7), particularly as crop yield and crop phosphorus removal in grain has increased. Since plant-available phosphorus varies across any field, precision soil sampling (grid or zone) allows us to vary fertilizer rates to better meet crop phosphorus requirements in different parts of the field.

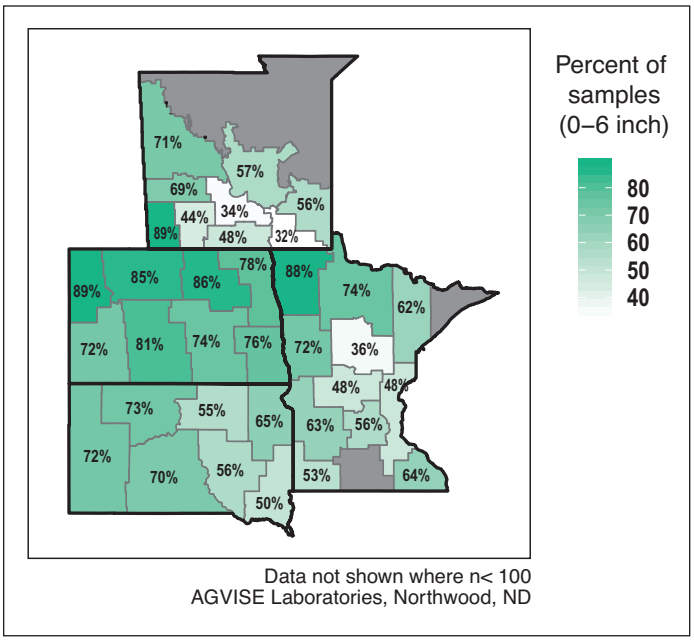

Figure 7. Soil samples with soil test phosphorus (Olsen P) below 15 ppm critical level (AGVISE, 2018).

Right Source

Nearly all phosphorus fertilizer materials sold in the upper Midwest and northern Great Plains are some ammoniated phosphate source, which has better plant availability in the calcareous soils of the region.

JOHN BREKER
SOIL SCIENTIST, CCA

Monoammonium phosphate (MAP, 11-52-0) is the most common dry source and convenient as a broadcast or seed-placed fertilizer. Some new phosphate products also include sulfur and micronutrients in the fertilizer granule, helping improve nutrient distribution and handling.

The most common fluid source is ammonium polyphosphate (APP, 10-34-0), which usually contains about 75% polyphosphate and 25% orthophosphate that is available for immediate plant uptake. Liquid polyphosphate has the impressive ability to carry 2% zinc in solution, whereas pure orthophosphate can only carry 0.05% zinc. Such fertilizer product synergies help optimize phosphorus and micronutrient use efficiency.

Right Time

Soils of the northern Great Plains are often cold in spring, and early season plant phosphorus uptake can be limited to new seedlings and their small root systems. We apply phosphorus before or at planting to ensure adequate plant-available phosphorus to young plants and foster strong plant development. In-season phosphorus is rarely effective as a preventive or corrective strategy.

Right Place

Proper phosphorus placement depends on your system and goals. Broadcasting phosphorus fertilizer followed by incorporation allows quick application and uniform distribution of high phosphorus rates. This strategy works well if you are building soil test phosphorus in conventional till systems. In no-till systems, broadcast phosphorus without incorporation is not ideal because soluble phosphorus left on the surface can move with runoff to water bodies.

In no-till systems, subsurface banded phosphorus is more popular because phosphorus is placed below the soil surface, thus less vulnerable to runoff losses. In general, banded phosphorus is more efficient than broadcast phosphorus. In the concentrated fertilizer band, less soil reacts with the fertilizer granules, thus reducing phosphorus fixation, allowing improved plant phosphorus uptake. Some planting equipment has the ability to place fertilizer near or with seed, which further optimizes fertilizer placement and timing for young plants.

For more information on 4R phosphorus management, check out this open-access article: Grant, C.A., and D.N. Flaten. 2019. J. Environ. Qual. 48(5):1356–1369 (https://dl.sciencesocieties.org/publications/jeq/articles/48/5/1356).

AGVISE LABORATORIES
604 Highway 15 West
P.O. Box 510
Northwood, North Dakota 58267
701-587-6010 / FAX: 701-587-6013
Home Page: www.agvise.com

NORTHERN NOTES

JOHN LEE
SOIL SCIENTIST, CCA

Uffda! That is the word that comes to mind when I think about 2019. In the northern region, the year started with wet soils and late planting, followed by a cool summer. Farther north, some areas suffered through another drought. To cap that off, add a rainy September and snow in October that delayed harvest. You know this year has been a struggle for everyone.

With the late harvest, soil sampling was also delayed, but most of the soil sampling eventually will get done. In-cab mounted hydraulic soil sampling systems enable you to collect soil cores through several inches of frozen soil and get the job done. With wet soil conditions over the whole region, we had many customers ask for our wet soil sampling tips. These customers commented on how well the wet tips work, even in very wet, sticky soils. If you are still struggling with wet, sticky soils, please give us a call so we can get you the equipment you need.

The winter meeting season is here, and our staff will be at many regional meetings. Please stop by our booth and say, "Hello!" The 2020 AGVISE Soil Fertility Seminars are scheduled for January 7, 8, 9 in the U.S. and March 17, 19 in Canada.

We hope you had a safe harvest season and enjoy the upcoming holidays with family and friends!

SOUTHERN TRENDS

RICHARD JENNY
AGRONOMIST, CCA

With all the unplanted acres this year, soil sampling is still the most cost effective way to determine fertilizer rates for next year's crop. Crop yields varied greatly across the region with many areas having a very challenging growing season this year. Across the southern territory, it was too wet, too late, too cool, too many unplanted acres, variable yields, and low prices for everyone! I am optimistic that our regional ag sector will turn around in 2020, and next year we will all be bragging about the great crop we raised!

I hope you have a safe harvest and we will see you at our seminars and at regional meetings this winter.

AGVISE Soil Fertility Seminars

January 7	**Granite Falls, MN**
January 8	**Watertown, SD**
January 9	**Grand Forks, ND**
March 17	**Portage la Prairie, MB**
March 19	**Regina, SK**