AGVISE LABORATORIES

Timely information for agriculture

Spring 2020

NORTHERN NOTES

JOHN LEE
SOIL SCIENTIST, CCA

After last year's tough harvest, we are all hoping for good spring weather. Even if the weather is not perfect and all preplant nitrogen fertilizer is not applied, we have many options for topdressing nitrogen and sulfur to achieve high crop yields. Planting early is always the best decision, and you can always apply nitrogen later without losing crop yield. Do not delay planting to apply fertilizer!

Starter phosphorus fertilizer is always recommended for small grains and corn. A good supply of phosphorus near the seed is important to promote early plant growth and development. Starter phosphorus is important even if you have high soil test P levels!

Current soil test data is important for making fertilizer decisions. Last fall, it was difficult or impossible to get good quality soil samples. You may have a window this spring to collect soil samples before planting, but that window is usually short. If you do not have time to take soil samples this spring, you can use previous soil test results for non-mobile nutrients like phosphorus, potassium, and zinc. In soil nitrate testing areas, you may need to use soil test information from nearby fields with similar previous crop, soil type, and fertilizer history. In corn, you still have the opportunity to use the Pre-sidedress Soil Nitrate Test (PSNT), taken when corn is 6 to 12 inches tall, to direct sidedress nitrogen rates.

This spring, AGVISE Laboratories is prepared to provide next-day turnaround and great technical support as we have for the past 44 years. If you require soil sampling equipment or supplies, we have you covered. Call the Northwood or Benson laboratories with any questions or orders you have.

INSIDE

Giddyup and Go Soil Sampling

Desperate times call for desperate measures! Last fall's wet soil conditions made for very difficult soil sampling across much of the region. Several customers thought outside the box and mounted soil sampling systems on side-by-sides or UTVs to get the job done. Brunel Sabourin (Antara Agronomy, St. Jean Baptiste, Manitoba) mounted this hydraulic soil sampling system on his UTV with tracks (Figure 1), which allowed him to collect soil samples across very wet fields last fall and not get stuck. This UTV-mounted soil sampling system will also allow him to extend the window for spring soil sampling. The ingenuity and hard work of our customers to collect soil samples, even under adverse weather, speaks volumes to the value of up-to-date soil test information, and this is especially apparent when fertilizer budgets are tight.

Figure 1. Soil sampling system, 24-inch hydraulic probe, mounted on UTV with tracks. Photo courtesy of Brunel Sabourin, Antara Agronomy.

Now Hiring—Soil Scientist

Northwood, ND – AGVISE Laboratories, Soil Scientist. Sales and customer service, providing technical support on soil fertility and plant nutrition. Position requires travel and good communication skills including writing and large-group presentations. Qualifications: B.S. in agronomy or soil science minimum, M.S. in soil fertility preferred, 3 to 5 years' experience preferred. All qualified individuals are encouraged to apply. For more information and how to apply: https://www.agvise.com/work-for-us/

Late fall rainfall: Where did the nitrate go?

Fall soil sampling after wheat started normally last fall. But then, excessive rainfall started in September and even snow in October (Figure 2), exceeding 12 inches in some places. When the rain and snow came, we received many questions about potential nitrate-nitrogen loss from the soil profile. In northern stretches of the region, soils were quite dry when the first large rains arrived, and soils had capacity to absorb the first several inches of rain. As the rain continued to accumulate and soils became saturated (waterlogged), the fate of nitrate in the soil profile became uncertain. In poorly drained soils, nitrate can be lost to the atmosphere via denitrification. In well drained soils, nitrate is more likely to be lost via leaching.

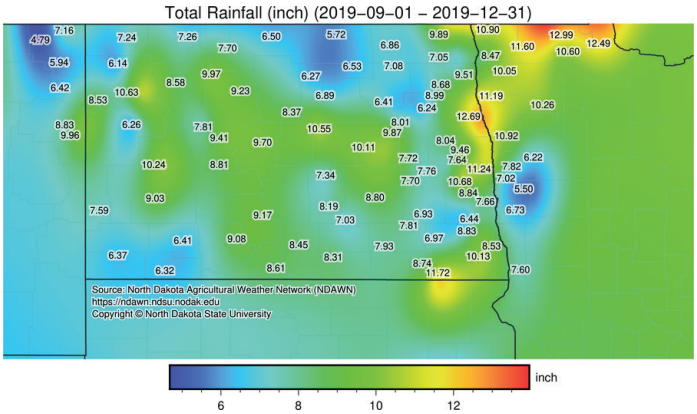

Figure 2. Accumulated rainfall in Fall 2019 (September 1 - December 31). North Dakota Agricultural Weather Network (NDAWN), NDSU, Fargo, ND.

In sugarbeet production regions, we receive several thousand soil samples after wheat with 48-inch soil nitrate tests (0-24 and 24-48 inch). The deep soil nitrate information helps sugarbeet producers manage nitrogen for highest recoverable sugar. As we received questions about soil nitrate loss, the data from these fields helped illustrate the fate of soil nitrate (Figure 3). In the northern Red River Valley (582 zip code area), the average nitrate-N (0-24 inch) in September was 45 lb/acre, but this declined to 30 lb/acre in late November, indicating some nitrate loss. During the same period, the average deep nitrate-N (24-48 inch) increased from 15 to 30 lb/acre, almost in parallel with the nitrate loss in the upper soil profile.

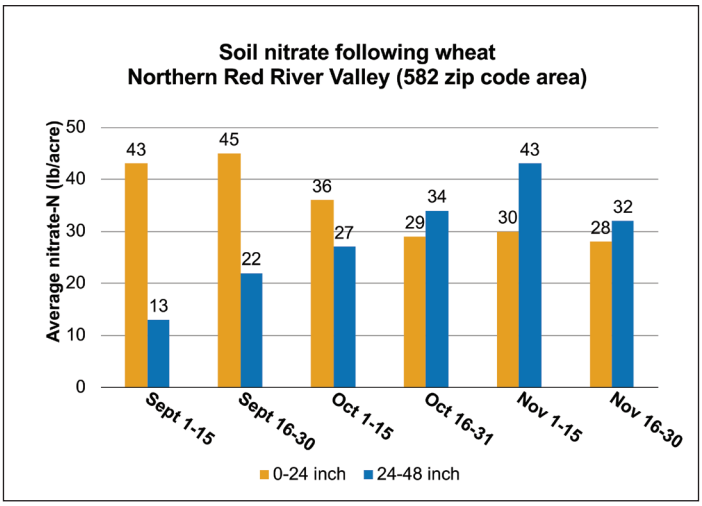

Figure 3. Average soil nitrate after wheat and soil sampling date in the Northern Red River Valley. While soil nitrate in the upper soil profile decreased over time, soil nitrate in the deeper profile increased.

The upward and downward soil nitrate trends suggest that nitrate in the upper soil profile (0-24 inch) was not entirely lost; it just moved deeper in the soil profile. This is good news for farmers with long-season, deep-rooted crops like corn, sugarbeet, or sunflower. Deep-rooted crops can access nitrate below 24 inches, and the nitrogen fertilizer rate for deep-rooted crops should not require much adjustment. Short-season crops, like wheat or barley, may not access deep nitrate (24-48 inch) in time, especially if soils are wet in spring. For small grains, an extra 10-15 lb/acre nitrogen may be good insurance if you collected soil samples before October 1; this will help account some nitrate movement into the deeper soil profile.

Soybean cyst nematode: Old traits, new resistance

Soybean cyst nematode (SCN) is the number-one cause of yield loss in all major soybean production areas in the United States, including the upper Midwest. Soybean yield loss may reach 30% before any visual aboveground symptoms develop. Soybean cyst nematode is a hardy plant pest, surviving in wet or dry soils, high or low pH soils, clayey or sandy soils. The SCN eggs can survive in soil for over 10 years, so once SCN has infested a field, it is near impossible to eliminate it.

Once detected, SCN control starts with integrated pest management strategies to minimize yield loss and reduce SCN populations. For the past 20+ years, the most effective option is SCN-resistant soybean varieties. The majority of soybean varieties contain SCN-resistance traits, and nearly all these soybean varieties (>95%) use the same resistance trait, PI88788. By relying on only one genetic trait, can we expect the similar resistance problems like we have experienced with herbicide-resistant weeds or insecticide-resistant insects? You bet. Whatever the selection pressure is, nature always finds a way and evolves.

Several years ago, Iowa State University researchers began tracking SCN evolution and resistance to the PI88788 SCN-

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Split the risk with in-season nitrogen

JOHN BREKER
SOIL SCIENTIST, CCA

For some farmers, applying fertilizer in the fall is a standard practice. You can often take advantage of lower fertilizer prices, reduce the spring workload, and guarantee that fertilizer is applied before planting. However, not much fertilizer was applied last fall after the slow and delayed 2019 harvest, and farmers are considering their options. As you work on this year's crop nutrition plan, you may want to consider saving a portion of the nitrogen budget for in-season nitrogen topdress or sidedress application.

Some farmers always include topdressing or sidedressing nitrogen as part of their crop nutrition plan. These farmers have witnessed too many years with high in-season nitrogen loss, usually on sandy or clayey soils, through nitrate leaching or denitrification. Split-applied nitrogen is one way to reduce early season nitrogen loss, but do not delay too long before rapid crop nitrogen uptake begins.

Short-season crops, like small grains or canola, develop quickly. Your window for topdress nitrogen is short, so earlier is better than later. To maximize yield in small grains, apply all topdress nitrogen before jointing (5-leaf stage). Any nitrogen applied after jointing will mostly go to grain protein. In canola, apply nitrogen during the rosette stage, before the 6-leaf stage. For topdressing, the most effective nitrogen sources are broadcast NPBT-treated urea (46-0-0) or urea-ammonium nitrate (UAN, 28-0-0) applied through streamer bar (limits leaf burn). Like any surface-applied urea or UAN, ammonia volatilization is a concern. An effective urease inhibitor (e.g. Agrotain, generic NBPT) offers about 7 to 10 days of protection before rain can hopefully incorporate the urea or UAN into soil.

Long-season crops, like corn or sunflower, offer more time. Rapid nitrogen uptake in corn does not begin until after V6 growth stage. The Pre-sidedress Soil Nitrate Test (PSNT), taken when corn is 6 to 12 inches tall, can help you decide the appropriate sidedress nitrogen rate. Topdress NBPT-treated urea is a quick and easy option when corn is small (before V6 growth stage). After corn reaches V10 growth stage, you should limit the topdress urea rate to less than 60 lb/acre (28 lb/acre nitrogen) to prevent whorl burn.

Sidedress nitrogen provides great flexibility in nitrogen sources and rates in row crops like corn, sugarbeet, or sunflower. Sidedress anhydrous ammonia can be safely injected between 30-inch rows. Anhydrous ammonia is not recommended in wet clay soils because the injection trenches do not seal well. Surface-dribbled or coulter-injected UAN can be applied on any soil texture. Surface-dribbled UAN is vulnerable to ammonia volatilization until you receive sufficient rain, so injecting UAN below the soil surface helps reduce ammonia loss. Injecting anhydrous ammonia or UAN below the soil surface also reduces contact with crop residue and potential nitrogen immobilization.

An effective in-season nitrogen program starts with planning. In years with substantial nitrogen loss (e.g. 2019), a planned in-season nitrogen application is usually more successful than a rescue application. If you are considering split-applied nitrogen for the first time, consider your options for nitrogen sources, application timing and workload, and application equipment. Split-applied nitrogen is another tool to reduce nitrogen loss risk and maximize yield potential.

Soybean cyst nematode cont…

resistance trait. In 2019 SCN soybean variety trials, the failed PI88788 trait resulted in nearly $200/acre loss, compared to the Peking SCN-resistance trait. The Peking-traited soybean varieties averaged 72.4 bushel/acre, while the PI88788-traited and susceptible soybean varieties averaged 51.2 bushel/acre. The final SCN populations also mirrored SCN-resistance trait efficacy. From the initial SCN population of 4,700 eggs/100 cc soil, the final SCN populations (eggs/100 cc soil) were 800 for Peking-traited varieties, 14,400 for PI88788-traited varieties, and 13,600 for susceptible varieties.

In 2019, AGVISE Laboratories started a project tracking SCN resistance with several clients in western Minnesota. The University of Minnesota SCN Laboratory in Waseca evaluated the SCN populations for PI88788 resistance, and all SCN populations had varying degrees of resistance to the PI88788 trait. In 2020, we will expand this project to track SCN populations from planting to harvest, comparing the increase in SCN egg counts. If the SCN population builds during the growing season, this is a simple indicator that the SCN-resistance trait is failing. If you observe SCN populations continuing to increase, even though you use SCN-resistant soybean varieties, you may need to find new resistance traits like Peking. This simple soil sampling protocol, at-planting and at-maturity, is a quick and effective way to check for SCN resistance in fields.

Soil Health Focus: Soil Aggregate Stability

As soil health testing evolves, AGVISE Laboratories continually evaluates soil health testing methods that can provide useful assessments of soil health and quality. 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 soil aggregate stability as a soil health tool.

They are the building blocks of soil structure. Soil aggregates are glued together with soil organic matter, plant root exudates, and microorganisms like fungi. Strong soil aggregates form naturally with plant root and microbial activity. However, disturbances like tillage quickly break the soil aggregates apart. Cropping systems that include reduced tillage or no-till are key to improving soil aggregate stability (Figure 4).

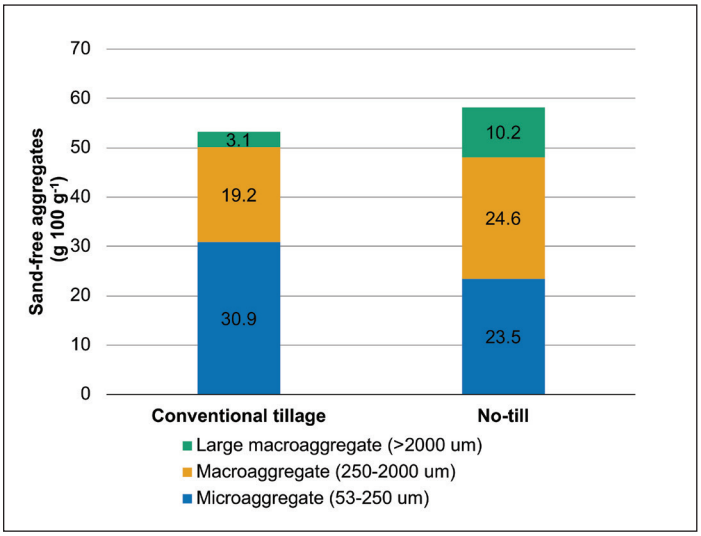

Figure 4. Soil aggregate stability increases with reduced tillage. Note the greater proportion of macroaggregates in no-till. Kansas, 10 year experiment (Mikha and Rice. 2004. SSSAJ 68:809-816).

Soil aggregate stability is a comprehensive soil quality measurement. Multiple soil management practices come together to improve soil aggregate stability. These include reduced tillage or no-till, greater crop rotation diversity, more plant roots, greater earthworm and microbial activity, and more soil organic matter. This is what makes soil aggregate stability such an attractive soil health indicator; it combines these benefits into one soil health test. Strong soil aggregates provide numerous soil ecosystem services:

- Resistance to water and wind erosion
- More pore space for air and water movement, allowing deep root exploration
- Faster water infiltration, reduced runoff
- Less surface crusting
- Improved equipment trafficability and reduced soil compaction, especially on wet soils
- Diverse habitat for soil microorganisms

The traditional manual sieving method to determine soil aggregate stability, used in research, was expensive and time consuming. In 2019, AGVISE developed automated equipment to replicate the manual sieving method while increasing throughput and reducing person-to-person error. This automated soil aggregate stability equipment gives us a commercially-viable tool to measure real improvement in soil quality for our customers.

With soil health tools like soil aggregate stability, you can quantify positive changes achieved through better soil management. Stable soil aggregates take time to form, so you should measure soil aggregate stability every 3 to 5 years. A separate soil sample must be taken for soil aggregate stability, and it must be collected with a spade or bulb planter to preserve the soil aggregates. Please call with any questions about the soil sampling protocol.

Up in Smoke: Nutrient loss in burned crop residue

As we prepare for spring planting, there is still a lot of crop residue left in fields. There was little fall tillage completed, and some fields still have unharvested crops standing. Excess crop residue can impair spring tillage and delay planting. To help manage the excess crop residue, some farmers are considering burning crop residue this spring.

Of course, no one wants to burn crop residue. You lose a lot of organic material that helps form soil organic matter, and you also lose valuable crop nutrients. The burning of wheat straw can lose 98% nitrogen, 75% sulfur, 24% phosphorus, and 35% potassium contained in the wheat straw (Heard et al. 2006. Better Crops, vol. 90, no. 3). With infrequent crop residue burning, the measurable negative effects are minimal. If farmers are considering crop residue burning this spring to accomplish timely planting, then the effects on soil are minimal. Although some valuable nutrient dollars will be lost in smoke, this is one year where burning some crop residue may be required to get spring planting done on time.

Understanding the Base Saturation (BS) Concept

Everyone knows farm budgets are tight right now. Yet, there are still individuals promoting the failed and costly philosophy of balancing soil nutrients by the base saturation (BS) concept. This concept encourages farmers to apply high potassium fertilizer rates to soils, even though there is little to no chance to get a crop yield response. In short, the BS concept revolves around reaching a certain percentage (%) of each base cation in your soil to obtain the "ideal" soil. If you do not have the right percentage of each cation, then you are instructed to apply large amounts of fertilizer to reach this "ideal" balance of each cation. Potassium is the most common nutrient where people fall into the BS trap, often suggesting that extra potassium will "fix" their soil.

Since the 1940s, university and industry researchers from around the world have thoroughly debunked the BS concept. But sometimes, you just need to show people how this works in the real world to get their attention. AGVISE Laboratories conducted a project investigating the BS concept, focusing on its primary claim that you can actually change the %K saturation in soil. We identified three soils in North Dakota, Minnesota, and Manitoba with low initial %K saturation. The goal was to increase %K saturation into the 4 to 6% range, which is recommended by BS promoters (BS-ers for short). We applied a staggering rate of 1000 lb/acre K2O (1666 lb/acre potassium chloride, 0-0-60), but we failed to achieve the "ideal" 4 to 6% K saturation (Table 1). As expected, soil test K (part per million, ppm) increased substantially, but the %K saturation did not reach the "ideal" soil range even with the enormous potassium fertilizer rate. You can find the project details and more university research online (https://www.agvise.com/educational-articles/uff-da-thats-a-lot-of-potash/).

Table 1. Soil test potassium and potassium base saturation after application of 1000 lb/acre K2O (1666 lb/acre potassium chloride, 0-0-60).

Location	Soil test K (ppm)		K saturation (%)	
	initial	1000 lb/acre K_2O	initial	1000 lb/acre K_2O
Northwood, ND	156	430	0.6%	1.6%
Benson, MN	154	290	1.9%	3.7%
Roseisle, MB	50	330	0.4%	2.8%

Do you need more proof? Let's see what the plants said. The soybean plant tissue K concentrations did not change either because the soil test K (ppm) was sufficient and above the 150 ppm critical level (Table 2). Simply put, the proven university-developed soil fertility guidelines would have told you that more potassium was not needed. You would think that people would have enough common sense not to follow the BS concept and apply ridiculous high potassium fertilizer rates, but I know some farmers who have. A few farmers were convinced to follow the BS concept and waste valuable dollars on the failed idea.

Table 2. Soybean leaf potassium concentration did not increase with additional potassium fertilizer applied on soils with soil test potassium above soil test critical level (150 ppm).

Fertilizer K rate	Soybean leaf K (%)	
lb/acre K_2O	Northwood, ND STK 150 ppm	Benson, MN STK 190 ppm
0	3.2%	1.8%
20	2.6%	1.8%
100	2.7%	1.8%
200	3.0%	1.8%
1000	2.6%	1.9%
	Sufficiency level = 1.7% K	

All things considered, there are still good reasons to apply potassium fertilizer (moderate rates) to achieve profitable yield responses. Either way, the base saturation (BS) concept is a really bad way to justify potassium fertilizer use, and it usually leads to very high fertilizer rates and costs. Here are some good reasons to include potassium in your soil fertility program:

- Soil test K below 160 ppm (grid or zone soil test)
- Soil test K below 200 ppm (composite soil test, high soil variability)
- History of low plant tissue K when no potassium fertilizer is applied; potential compaction
- Replicated strip trials showing profitable crop yield response to moderate potassium fertilizer rates
- Chloride required for small grains; potassium chloride (0-0-60-50Cl) is often the most available chloride source

President's Corner cont…

Planting acres last year, the cover crops (or even weeds) helped sustain mycorrhizae populations, and fallow syndrome should not be an issue. Plant species in the Brassiceae family (e.g. canola, radish, turnip) and sugarbeet do not host mycorrhizae, so fallow syndrome is often observed after these crops. Remember that Brassica cover crops, like radish and turnip, do not support mycorrhizae, so always make sure you have some mycorrhizae-supporting plant species, like grasses or legumes, in cover crop mixtures. For more details on fallow syndrome, visit the AGVISE website (https://www.agvise.com/educational-articles/fallow-syndrome-dont-skimp-on-starter-p/).

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

PRESIDENT'S CORNER

CINDY EVENSON
PRESIDENT
AGRONOMIST, CCA

After record Prevented Planting acres in 2019, we all hope there is no repeat in 2020. As planting commences on fields left idle last year, there are some challenges remaining, like fallow syndrome, that warrant special attention. Fallow syndrome is a phosphorus deficiency induced by low mycorrhizal fungi populations in soil, frequently observed after fallow. Beneficial mycorrhizae colonize plant roots and extend the plant roots' ability to access water and nutrients, especially phosphorus and zinc. Small grains and corn heavily rely on mycorrhizae to facilitate plant phosphorus uptake.

In fallow years, the lack of living roots causes mycorrhizae populations to drop. The next year, there is limited mycorrhizae to colonize plant roots, thus reducing plant phosphorus uptake. Without sufficient mycorrhizae, the plants experience phosphorus deficiency, often expressed as slow or delayed growth and even purple leaves in corn. In corn, the most effective strategy to overcome fallow syndrome is a high rate of starter phosphorus, along with sufficient broadcast phosphorus. As always, do not exceed the seed-safe fertilizer rate.

If you were able to plant cover crops on Prevented

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SOUTHERN TRENDS

RICHARD JENNY
AGRONOMIST, CCA

We are very hopeful the 2020 growing season will be much better than 2019! It was quite the struggle for everyone last year. The extremely wet growing season resulted in much lower than normal residual soil nitrate after crops. As you think about nitrogen management this year, the Pre-Sidedress Soil Nitrate Test (PSNT) is one helpful tool you can use to decide if sidedress nitrogen is needed. Plant analysis is also useful to troubleshoot problem areas, like yellow corn that might display nitrogen or sulfur deficiency (remember good and bad plant samples paired with good and bad soil samples).

Soybean cyst nematode (SCN) is continuing to overcome the PI88788 SCN resistance trait, which is the most common resistance trait in soybean varieties. In 2019, we conducted a SCN resistance project near Benson, MN. All soybean varieties with the PI88788 trait were susceptible to SCN. To learn if SCN populations are building tolerance to the PI88788 trait, you can take an early "at-planting" and a late "at-maturity" SCN egg count sample. If the SCN population increases during the year, the PI88788 trait is likely failing. With any SCN soil sampling, remember to take soil samples at hotspots like field entrances.