



AGVISE

LABORATORIES

Timely Information for Agriculture

WINTER 2023-24

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NORTHERN NOTES

Every now and then, you just have to sit back and marvel at Mother Nature. The 2023 weather year was a roller coaster of ups and downs with more than one or two unexpected turns. The year began with the longest and most snow-covered winter in over 25 years. For how wearisome winter became, I think we all share some thankfulness for so much snow after drought became the summer theme and crops were sustained through May and June primarily on stored soil water from snowmelt alone.

I am still marveling at crop yields that some producers obtained with so little rain. I know some producers had very poor crop yields, yet others had outstanding crop yields that defied what we know about crop yield potential and water use efficiency. A local Northwood, ND farmer shared with me that his spring wheat fields averaged 65 to 80 bushel/acre with a few fields exceeding 90 bushel/acre. The University of Minnesota spring wheat trials in northwest Minnesota had average site yields of 100 to 115 bushel/acre, with some varieties reaching 130 bu/acre! With so little rain in 2023, these spring wheat yields astounded me, so I did a little arithmetic on stored soil water,



JOHN BREKER
SOIL SCIENTIST,
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AGVISE Soil Fertility Seminars: Mark your calendar!

The AGVISE Soil Fertility Seminar dates and locations for 2024 are set. These seminars cover soil fertility and plant nutrition topics along with other issues that currently challenge our region. You will not want to miss the great program lineup, so mark your calendar now! A registration letter for the USA seminars was sent to AGVISE customers in early November.

If you did not receive the mailing, please call 701-587-6010 and we will send you the registration form. Please make sure you register early for these seminars if you plan on attending. Space is limited and there is usually a waiting list. To register for the Soil Fertility Seminars, please call 701-587-6010 and ask for Emily or Patti. You can also register online at <https://www.agvise.com/seminar-registration/>.

| Date | Location | CCA CEUs applied for |
|--------------------|------------------------|----------------------|
| Tuesday, Jan. 9 | Willmar, MN | 3.0 NM, 2.5 SW |
| Wednesday, Jan. 10 | Watertown, SD | 3.0 NM, 2.5 SW |
| Thursday, Jan. 11 | Grand Forks, ND | 3.0 NM, 2.5 SW |
| Tuesday, Mar. 12 | Portage la Prairie, MB | TBD |
| Thursday, Mar. 14 | Saskatoon, SK | TBD |

Northern Notes cont...

seasonal rainfall, and expected spring wheat yields.

In the Northwood area, there was little to no stored soil water after 2022, so let's assume that all stored soil water came from snowmelt. For the 2022-2023 winter, the Grand Forks NWS station recorded 62.6 inches of snow, which translates to 6.26 inches of liquid water equivalent. There was little snowmelt runoff in spring, so let's also assume all snowmelt infiltrated the soil as stored soil water. From May 1 to July 31, the Northwood area received only 4.8 inches of rain. This is 5.7 inches less than normal for the same period, or 46% of normal precipitation. In total, a generous estimate of 11.1 inches of stored soil water and precipitation was available. According to the North Dakota Agricultural Weather Network (NDAWN), the estimated crop water use for spring wheat was 15 inches and a crop water deficit of 4 inches.

Montana State University has a simple spring wheat yield potential equation for irrigation planning, where Estimated Spring Wheat Yield (bushel/acre) = $5.8 * [\text{soil water (inches)} + \text{rainfall (inches)} - 4.1]$.

Using this equation, the expected spring wheat yield potential should have been 40 bushel/acre. Yet, the local spring wheat yield reports were double or more! So, what do we really know about crop yield potential and water use efficiency? In part, we all have to recognize that we are not farming with the same crop genetics of two or three generations ago. We have also made great advances in agronomy (including seeding rates and planting date), soil fertility and plant nutrition, soil and water management, and pest management. When Mother Nature cooperates just a little bit, we have much better tools now to capture greater crop yield potential than we did in decades past.

This winter, I hope that you can join us at our AGVISE Soil Fertility Seminars. We will be talking about the latest soil fertility research in the region and new advances in soil testing. There will be a lot of great information to cover, so we will expect to see you there!

Soil Nitrogen Trends – Fall 2023: Some Up, Some Down

The 2023 drought was an all-too-soon reminder of the widespread 2021 drought. It covered much of the upper Midwest, Great Plains, and Canadian Prairies. From previous experience with droughts, we expected that residual soil nitrate-N following crops would be higher than normal, caused by the drought and reduced crop yields. The first wheat fields that were soil tested in August and September confirmed our expectation that residual soil nitrate-N was already trending higher than normal. Yet, some regions were spared the drought and received above average rainfall and achieved record-setting crop yields. For these regions, the amount of residual soil nitrate-N after high-yielding crops was near or below average.

The 2023 AGVISE soil test summary data highlights the great variability following the drought. The median amount of soil nitrate-nitrogen across the region was higher than the long-term average following wheat. Over 28% of wheat fields had more than 60 lb/acre nitrate-N (0-24 inch) remaining. Yet, another 17% of wheat fields had less than 20 lb/acre nitrate-N remaining, suggesting either lost crop yield

or protein due to insufficient nitrogen nutrition. For any given farm, the great variability in residual soil nitrate-N across all acres makes choosing one single nitrogen fertilizer rate impossible for next year, and soil testing is the only way to decide that right rate for each field.

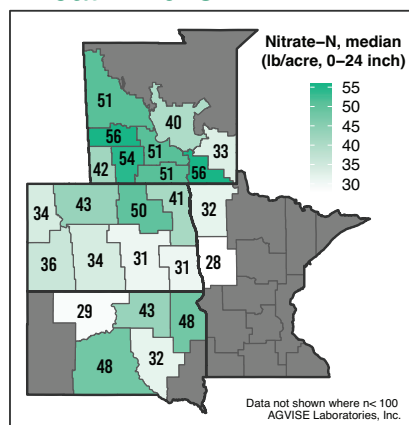
Through zone soil sampling, we are also able to identify that residual soil nitrate-nitrogen can vary considerably within the same field. This makes sense because we know that some areas of the field produced a fair or good yield, leaving behind less soil nitrate, while other areas produced very poorly and left behind much more soil nitrate. These differences across the landscape are driven by soil texture, soil organic matter, and stored soil water as well as specific problems like soil salinity or low soil pH (aluminum toxicity). Although the regional residual soil nitrate-nitrogen trends were higher overall, it is truly through zone soil sampling that we can begin to make sense of the field variability that drives crop productivity and determine the right fertilizer rate for next year.

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Soil Nitrogen Trends cont...

For fields that have not been soil tested yet, there is still time to collect soil samples in winter (see winter soil sampling article). Nobody wants to experience another drought, but this kind of weather reminds us how important soil nitrate testing is every year for producers in the Great Plains and Canadian Prairies. Each year, AGVISE summarizes soil test data for soil nutrients and properties in our major trade regions of the United States and Canada. For more soil test summary data and other crops, please view our soil test summaries online: <https://www.agvise.com/resources/soil-test-summaries/>

Residual nitrate following wheat in 2023



Winter Soil Sampling: You Need the Right Tools

Snowfall in late October and November slowed harvest and soil sampling across the region. This means some fields will be soil sampled into December and maybe January as harvest for late-season crops continues in the snow.

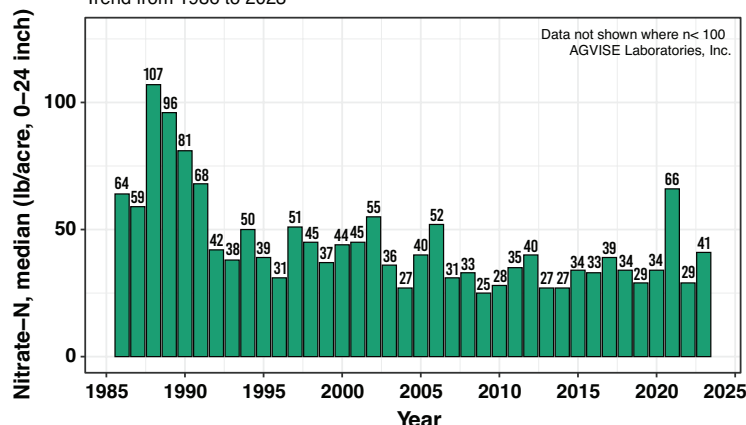
The right equipment is the key to any project, and winter soil sampling is no different. AGVISE heavy-duty (HD) chromoly soil probes were designed for hard, frozen soil conditions. Chromoly steel is much tougher than stainless steel, and it handles the stress of sampling frozen soil. To punch through several inches of frost, you will also require additional weight. Most soil sampling trucks have the hydraulic cylinder mounted inside the truck cab, where you can take advantage of the entire truck weight to push through the frost. This enables you to take soil samples through 4 to 6 inches of frost on most medium- and fine-textured soils in winter. For receiver hitch-mounted hydraulic cylinders, you will need to add extra weight in the truck box, and it may limit you to pushing through only 1 to 3 inches of frost.

AGVISE offers wet and dry soil probe tips for the HD chromoly soil probe. The wet soil probe tip is best suited for frozen soils. The HD chromoly soil probe is available with or without a slot.

You can view examples of in-cab and receiver hitch-mounted hydraulic soil sampling systems on our website (<https://www.agvise.com/installed-soil-sampling-kit-examples/>). You can also find videos of soil sampling in frozen soils with the HD chromoly soil probe and wet soil probe tip.

Residual nitrate following wheat

Trend from 1986 to 2023



Bob Wallace Retirement Party: December 29, 2023

Bob Wallace will be retiring as Chief Executive Officer (CEO) at the end of December 2023. Bob joined AGVISE in 1995 as CEO/CFO and guided the company's reorganization to an Employee Stock Ownership Plan (ESOP) that made AGVISE 100% employee-owned after 1996. Following the 1996 fire and 2007 tornado at the Northwood laboratory, Bob oversaw the reconstruction and expansion campaigns that has made AGVISE the leader in the agricultural testing industry. We wish Bob a well-deserved retirement!

Join us for a retirement party for Bob Wallace on Friday, December 29, 2023 from 2:00 to 4:00 pm. The party will be held at the AGVISE Northwood laboratory.



The Results Are In: Lime Works

In the fall of 2022, I hired a custom applicator to haul and spread lime across 238 acres of my family's farm in western North Dakota. The reason? To increase soil pH on five fields with very low soil pH. One field even had a soil pH at 4.7, so these were good candidate fields for a practical case study for liming on a real farm operation.

I wrote more about the soil sampling process and lime application in the AGVISE Winter 2022 newsletter (<https://www.agvise.com/wp-content/uploads/2022/11/AGVISE-Newsletter-2022-Winter.pdf>). Each field received approximately 2 ton/acre sugar beet lime (1.4 ton ENP/acre) from Sidney Sugar in Sidney, MT, and the lime was disced to 3 inches for incorporation. After one year, the soil pH had already increased by 0.36 pH-units in the 0-6 inch soil depth. The 2023 growing season was relatively wet in southwest North Dakota, and the additional soil water certainly helped the lime react and neutralize soil acidity quickly. The incorporation with a disc also helped distribute the lime more evenly and deeply, allowing the lime to react faster. One negative side effect of tillage was a flush of annual weeds, particularly green and yellow foxtail. This was the

first tillage event on these fields in 12 years, so I expect the annual weed community to diminish as we return to no-till after the one-time tillage pass.

Lime also works without incorporation, just at a slower pace. In 2021, we established a no-till lime trial to investigate lime rates without incorporation. Lime was applied in May 2021, and the fall 2023 soil pH results are shown in Figure 2. The highest lime rate at 2.5 ton ENP/acre increased soil pH in the upper 0-3 inch soil depth by 0.71 pH-units over 2.5 years. So far, no effect on soil pH in the lower 3-6 inch soil depth has been observed. In most no-till systems, the most acidic part of the soil profile is located at the soil surface, and a lime application correcting soil pH in the upper 0-3 inch soil depth is still effective. This is where seedlings and roots are most vulnerable to soil acidity, so correcting soil pH at the soil surface is critical and can be accomplished with a surface application in lime in no-till systems.

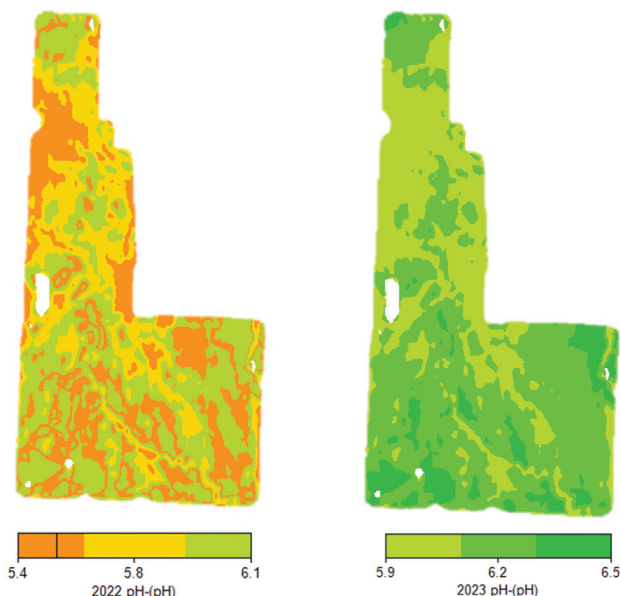


Figure 1. Zone soil pH map of field receiving 2 ton/acre sugar beet lime in fall 2022. Each zone increased 0.36 pH-units from 2022 to 2023. (Maps created in ADMS 32, GK Technology, Inc.)

Surface Soil pH (0-3 inch) in No-till Lime Trial, October 2023

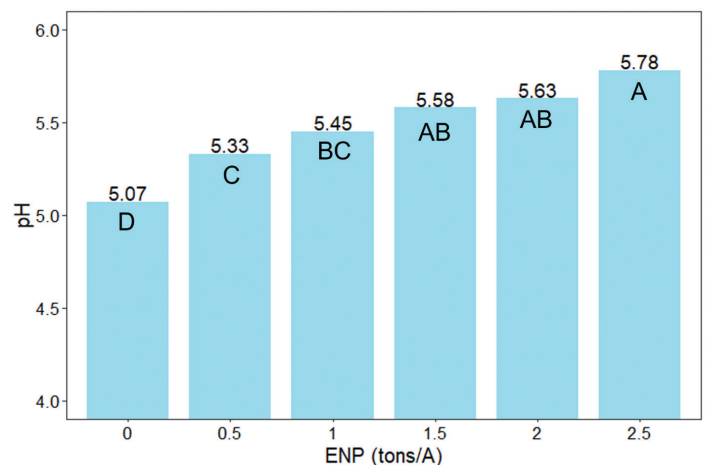


Figure 2. Soil pH following surface application of lime after 2.5 years in a no-till cropping system in southwestern North Dakota.

Zone Soil Sampling: How Many Zones?

Zone soil sampling has become a standard practice in precision nutrient management, but the grand question remains – How many zones should you be soil sampling?

Well, it depends! It just makes sense that a field with more variability requires more zones than a field with little variability. Zone soil sampling separates parts of fields that behave differently into similar zones that can be managed together. Common data layers used to build zone soil sampling maps include satellite imagery, plant vegetation indices, crop yield, salinity, topography, and even bare soil color.

As a soil testing laboratory, AGVISE does not know what data layers are used to create the zone maps, but we do know the soil nutrient levels in each zone. Clients often ask how many zone soil samples should be collected in each field to get the best soil nutrient information. Common sense tells us that splitting fields into more zones should provide more detailed soil nutrient data.

Summary of 24,000 precision soil sampled fields from Manitoba, Minnesota, North Dakota, and South Dakota in 2023.

| Number of zones per field | Average soil test range within a field (high zone – low zone) | | | |
|---------------------------|---|-------------|-------|-----|
| | Nitrate-N lb/acre, 0-24 inch | Olsen P ppm | K ppm | pH |
| 3 | 33 | 10 | 90 | 0.6 |
| 4 | 41 | 14 | 111 | 0.7 |
| 5 | 53 | 17 | 126 | 0.8 |
| 6 | 65 | 23 | 174 | 1.1 |
| 7 | 62 | 23 | 171 | 1.1 |
| 8 | 78 | 26 | 168 | 1.2 |

With soil test data from thousands of zone soil sampled fields, we mined the AGVISE database to see what the average range in soil test levels per field (high testing zone minus low testing zone) could tell us about field variability and the number of zones that should be sampled. The table summarizes the average range in soil test levels for over 24,000 zone soil sampled fields in 2023. The number of zones ranges from 3 to 8 zones per field. You can see, as the number of zones increases, the difference between the high zone and low zone gets larger and larger.

This data reminds us that more zones per field can tell us more about the soil nutrient status in

each field, providing more powerful information to develop variable-rate fertilizer applications. If you have variable landscapes with rolling topography, diverse soil types, or salinity problems, you may have to take more zone soil samples per field (5-7 zones) to see the greatest differences in soil fertility and to take full advantage of variable-rate fertilizer applications. If your landscapes have less variability with fewer soil types, relatively flat topography, and no salinity problems, then you can probably take fewer zone soil samples per field (3-4 zones).

SOUTHERN TRENDS

Which crop should be harvested first? That was a popular question among growers in fall 2023. Record high temperatures in June advanced corn development and maturity faster than normal. In September, some corn fields were ready for harvest before soybean, which is not normal for the upper Midwest. Late fall rains delayed soybean harvest, and some growers switched back and forth between harvesting corn and soybean more than once during harvest. Soybean harvest was also a struggle in some fields with severe soybean iron deficiency chlorosis (IDC). The unevenness and wide range in soybean growth stages in these IDC-afflicted fields forced some producers to pick and choose the zones to harvest first. This is a good reminder to choose the best IDC-tolerant soybean varieties to reduce the unevenness problem at harvest time.

The 2023 drought also revealed any differences in field variability and that was shown in combine yield monitor data. I heard reports of dryland crop yields in the same field ranging from zero to 240 bushel/acre for corn and zero to 65 bushel/acre for soybean. Such a wide range in crop yield potential is an argument in itself for precision soil sampling (grid or zone) and variable-rate fertilizer application. The year-to-year increase in grid and zone soil sampling speaks for itself. It is a precision practice that pays.

I wish to thank you all for a very productive fall soil sampling season. We got a lot done! Have a great winter and hope to run into you at a trade show.





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■ PRESIDENT’S CORNER

Every year, I look forward to the excitement that the busy fall soil testing season brings. It is a “rush” in more ways than one. Even after 32 fall soil testing seasons at AGVISE, I am already missing the rush and look forward to next year.

For the second year in a row, AGVISE has set a record fall soil testing season. We must all thank Mother Nature for cooperative weather as everyone worked hard to harvest crops quickly, collect soil samples right behind the combine, and complete fieldwork before the winter snow began to fly. It is truly amazing what we can all accomplish when we all work together with a little help from Mother Nature. Let us hope that 2024 brings another successful year, but maybe with some more consistent and frequent rains through the summer months!

I wish to extend a special thank you to all our customers for trusting AGVISE Laboratories with your agricultural testing needs. It is our privilege to serve you and provide you with the highest standard in laboratory services. This winter, I hope to see many of you again at winter trade shows and agronomy update meetings. We wish you and your company a successful end to 2023, a Merry Christmas, and a Happy New Year.



CINDY EVENSON
PRESIDENT
AGRONOMIST, CCA