

Soil health - the basics

eBook





Not all acres are equal, getting the optimal performance out of crops starts at the soil level

Soil is the foundation of everything produced in our industry. Getting the most from every inch of your soil is, of course, always the goal. But understanding the variable qualities and yield potential held within each of those inches of soil across acres of farmland is not so simple.

Catch up on insights and useful resources about all things soil health and best practices with our eBook.



Soil health: A balancing act

Agriculture continues to demand more from you all the time. Producing higher yields per acre while taking better care of the land and environment means progressive farmers like you are constantly looking for new ways to take on the world. The technology and innovation you count on may be complex, but when you hit the fields you can trust the science has been done behind the scenes, so your workday remains streamlined.

Balancing higher production with better fertility management takes good agronomy to manage all the determining factors affecting your crop's nutrient uptake and ultimately, its performance. It starts with knowing your soil like the back of your hand.

Get to know your soil

Underneath the surface of your fields, there's a lot going on. From texture to organic matter, nutrient content, water holding capacity and compaction, your soil health program starts with leveraging all the information gained through accurate soil testing. This includes knowing your fields' variable zones and the ways they change throughout the season.

With that, you'll have an accurate picture of how your soil is currently performing, as well as which nutrients will be required for optimal plant growth in the upcoming season. Your soil's nutrient uptake and removal are at the foundation of your zone management and fertility strategies. "Understanding this allows you to build strategic plans and optimize your fertilizer use across the farm," says Garth Donald, Decisive Farming co-founder and manager of agronomy. "With that understanding comes the knowledge to create sound yield goals while avoiding over or under-fertilizing for the crops you are growing."

As you manage your fields according to their various growth zones, you can achieve the best yield potential by integrating a tailored variable rate (VR) program that works for you. Using VR fertility, you can be confident that you're applying the right amount of nutrients in the right place, so they're used most efficiently. You can focus on the areas of your fields you can make shine, putting your investment in the places where it will grow you the best returns in yield and profit.

The best approach is a balanced approach

As your soil is changing all the time, it's essential to determine any factors that might be inhibiting optimal nutrient levels according to the crops you are growing. "There are many things within your soil which will not allow you to achieve the required nutrient levels for your crops," says Donald. "A balanced fertility program creates a healthy plant that has all the nutrients required for it to grow. The key is working together for a common goal and having realistic yield goals in creating that balanced approach."



Soil sampling: The key to soil health

It's often said, the more you know, the better you do. When it comes to your soil, this sentiment could not be more true. Understanding what's happening beneath all those acres across your farm requires an appreciation for variability at the zonal level in order to maximize the potential from every inch of that soil. It begins with solid soil testing.

If you don't sample soil, how can you appreciate what's happening at the root of everything on your farm? Proper zone management must account for variability in texture, organic matter, nutrient content, water holding capacity and compaction, all essential influences in crop nutrient uptake and therefore, crop performance.

Garth Donald, Decisive Farming co-founder and manager of agronomy, says soil sampling is the key to understanding how your soil is currently performing, and which nutrients will be required for optimal plant growth in the upcoming season. This includes understanding residual nutrient levels in order to plan accordingly for next year's crop nutrients and fertilizer strategy.

Things to consider include the fact that your soil affects the nutrient availability for your plants, the levels of micronutrients to be applied – if in fact needed – and the organic matter levels that impact the overall health of your soil.

To address all these factors, Decisive Farming by TELUS Agriculture advocates for yearly soil sampling using GPS referenced points. Donald says an accurate sample requires a minimum of 12 soil cores at two depths. Conducting such complete analysis every year creates a dataset for you to manage your fields with ongoing optimal efficiency.

"We soil test every single year," says Andrea Bilodeau, Decisive Farming senior agronomist. "And we run a complete analysis every single year including all the macros and all the micros."

Soil samples can be taken throughout the entire year, but Donald recommends considering the value of the data you're receiving from soil testing to up your ability to make sound purchasing decisions according to your farm's unique strategies.

"We know that trial data states the ideal time to sample is when the ground is below 10 degrees Celsius," he adds. "But, if you want to apply fall fertilizer or prepurchase nutrients, the value of getting soil tested prior to those events occurring has a greater value than waiting for the ideal temperature."

Your unique story

Gathering all this soil information helps you meet two essential priorities. One, it helps address your financial expectations and two, it balances them with environmental impact to ensure you're not over or under applying.

"We are feeding the crop that is out there in any given year," says Bilodeau. "We take last year's soil test, the VR prescription, harvest review insights along with this year's soil test to give us a wonderful overview to move forward with. It creates this meaningful conversation between Decisive Farming and our farmers about their goals and their strategies for improving on their farms."

Once you get down to it, soil sampling not only looks at the nutrient needs of your field today and tomorrow but can further serve as a diagnostic tool to address problems along the way. Collaboration with an experienced agronomic advisor who can explain the interactions in your soil gives you the ultimate advantage.





Understanding soil variability

Variability is still too often overlooked. Even if your field is flat, there is vast variability across that field. To confirm this, picture any given harvest: do you recall a time on your harvest monitor that your bushels per acre jump at any point? The answer would be yes. The reason for that jump? Variability.

As the first step to strategically managing your fields, making your farm more economically and environmentally sustainable, it's worth digging into.

Your soil is a living thing containing mineral and organic materials, air, water and numerous microorganisms that provide energy for plants and contribute to organic matter. The soil changes throughout the season and when you understand how it's changing; you can manage it in ways that bring the most potential and the least waste to your operation.

Because it's the foundation of all you do, let's break down the basics of soil variability.

Soil zones

Knowing which soil zone you're farming in is important. It directly impacts your fundamental agronomic decisions, including fertilizer strategy. Here in the Prairies, land is divided into five general soil zones: Brown, Dark Brown, Black, Dark Grey and Grey wooded. Topsoil colour in any given area indicates organic matter content, precipitation and temperature, crop nutrients, rotation and herbicide options.

Mapping soil variability on the farm is becoming increasingly common to manage different soil types and crops.

Soil texture

Soil is composed of variable amounts of sand, silt or clay. Sand particles, the largest, can be seen with the naked eye,

as can silt particles, intermediate in size. Clay particles, the smallest, require a powerful microscope to be seen. Loam soil is an equal mixture of each.

Soils are termed heavy/fine or light/coarse based on their texture and the amount of horsepower required to pull implements through. Generally, crop productivity is greater on medium-textured soils than those that are light or heavy. This is influenced by texture's effect upon water holding capacity, water movement, nutrient supply, density and temperature of the soil.

Soil pH

When measuring soil's acidity or alkalinity, we generally consider pH 6.5-7.5 as neutral, with lower values indicating an acid soil, and higher numbers an alkaline soil. Most Prairie soils sit between pH 5.5 and 8.5 with optimum levels for most plants and soil microorganisms ranging between 6.5 and 7.5. The pH influences nutrient availability and can directly impact plant growth while also affecting the breakdown rate of certain soil residual herbicides.

Also noteworthy are alkali soils, containing high concentrations of sodium. These are not to be confused with saline soils, which contain dissolvable salts that can be problematic as they keep water and dissolved nutrients, including fertilizer, from entering plant roots. When looking for indications of soil salinity, you can look to weeds such as kochia and foxtail barley, relatively drought tolerant pests that can, therefore, survive saline conditions.

The next level of success

With the basics covered, you can now take your knowledge to the next level using soil testing, an integral tool for nutrient and crop management. Testing indicates nutrient status, pH, salinity, organic matter and soil texture.

"Most farmers do get their soil tested," Bilodeau says.



“Typically, they look at the nutrient needs, nitrogen, phosphorous, potassium and sulfur and they go from there. That’s a good start.”

But soil testing can further serve as a diagnostic tool to deal with problems in the field, especially when working with an experienced agronomic advisor who can explain the interactions in the soil between the pH, Cation Exchange Capacity (CEC), texture and organic matter.

Where some nutrients may not change significantly year to year, nitrogen and sulfur – typical money makers especially in canola and the cereals – are two that can change significantly. That’s why it’s key to test your soil yearly.

You could perform your own tests but getting the job done requires the right equipment, and more importantly, valuable time and energy to get the most accurate results, often at the busiest times of the year.

Strategically manage your fields

Once you understand the variable conditions of the soil across your farm, you can greatly improve risk management. “Soil is the fundamental beginning,” Andrea Bilodeau, senior agrologist with Decisive Farming, says. “If you don’t know what’s in the ground, you won’t know what to fertilize for. You can determine what you’re going to grow when you know.”

The benefits are numerous:

- ✓ **Yield potential:** We are primarily managing risk so we can create a prescription to determine what your yield goals are,” Bilodeau says. “Farmers have different goals. Some simply want to up their yields overall. Many want the best yield they can produce out of a specific area, but at a specific price point.”

Other yield goals may be based around quality, including increased protein levels or even maturity. In many cases these goals are either met or exceeded.

In cases where they’re not, it opens up a conversation around using agronomy to find a solution.

- ✓ **Decision making:** knowing the various soil conditions across your farm, you’ll make more informed decisions and predictions from rotational changes to yield expectations. For example, you may plan to plant a pulse in a particular field, but soil testing can reveal conditions, such as high residual nitrogen, that indicates you will not get your expected return. In this case, an agronomist can recommend a more appropriate crop for better results.
- ✓ **Return on investment:** “The two most cost-effective solutions you can get for your farm to be making decisions every year are soil testing and seed testing,” Bilodeau says. “These solutions give you a wealth of information considering the amount of ground you’re going to cover.”
- ✓ **Environmental impacts:** for one, when you understand your soil’s variable qualities, you can prevent losing applications to volatilization, denitrification and leaching.

Better understanding the variability in your soil also informs salinity, tillage and compaction management. “These are things we deal with on an ongoing basis for farmers,” Bilodeau says. “Soil tests will strongly show us these issues and how to manage these kinds of ground. There are different ways to address each that can be very successful or not.”

As farming continues to advance, these types of understandings have helped the industry improve soil management techniques from maximum to almost zero tillage. Now, conversations are increasingly common in different regions about compaction and soil texture, which can lead to better on-farm practices that reduce related issues.



Best management practices

As you work with a better understanding of your farm's soil variability, remember that [4R Nutrient Stewardship](#) can guide you to achieve your production, profitability, environmental and sustainability goals. "4Rs have given us a wonderful framework to look at these four key elements," Andrea Bilodeau, Decisive Farming senior agrologist says. "They are fundamental to what we do."

- ✓ **Right source** – It's all about matching the right fertilizer type to crop needs. Knowing your soil means you can take a close look at the available sources of nutrients and make informed decisions about the bioavailability of products.

For example, using nitrogen inhibitors can ensure your nitrogen doesn't convert to an unusable form and become available to the air or groundwater, thus protecting your investment for the crop, as well as caring for the environment.

- ✓ **Right rate** – Matching the right fertilizer amounts to your crop needs is key and depends on both the prior state of the soil and which crops are being grown.

A prescription might recommend very low amounts of a product in lesser producing areas, while using more in higher producing areas to push yields. Interestingly, those lower producing sections are often the places where groundwater leaching is more prevalent. "By pulling back in our nutrient values there, where the crop is not going to use it, we're using a better way of rate and place," Bilodeau says.

- ✓ **Right time** – We want to make nutrients available right when crops need them. This involves calculating the interplay of crop uptake, soil supply, nutrient loss risk and field operation logistics.

Bilodeau says timing ties into nitrogen inhibitors as well. "We're pretty specific in our advice to folks about the timing and the weather they should be watching for."

- ✓ **Right place** – The goal is to keep nutrients right where crops can use them. This involves analyzing and tracking the interplay between roots and soil to see nutrient movement and mitigate nutrient loss from the field.

"Years ago, a lot of growers broadcast everything and would lose it to the air or the groundwater," Bilodeau says. "This isn't so common today. Fertilizer is typically either side-banded or seed-placed in a logical manner so that it's available to the plant, in the exact place it needs it."

As the future of agriculture continues to push producers to balance economics on the farm with environmental sustainability, knowing your soil provides a solid foundation for success.





Understanding crop nutrients

Farming today is an increasingly complex business. However, when you break down the simplest function of agriculture, it's all about nourishment. With the global population expected to reach nearly 10 billion by mid-century, nourishing your soil to meet this demand is increasingly essential to what you do.

How often does crop nutrient uptake and removal inform your soil management practices and fertility strategies? Using the [4Rs of Nutrient Stewardship](#) – right source, rate, time and place – Canadian farmers are implementing precision agronomy practices and other ag tech systems to achieve important objectives, from economic targets, to environmental goals, to food security measures.

Nutrient efficiency

Achieving ideal nutrient levels is a balancing act. If you have too much or too little, it can have a substantial impact on yield, crop quality and ultimately, your profitability. One way to look at a proper balance is to consider nutrient use efficiency, or the proportion of all the nutrients applied to, and taken up by, the crop.

Nutrient efficiency is monitored using a calculation of the output/input ratio, or the proportion of the applied nutrients taken in by the harvested product. Low ratios, those below 50 per cent, typically reflect nutrient loss to the environment. High ratios, over 90 per cent, often indicate nutrient removal during harvest, also called nutrient mining practices, which reduce soil fertility over the years.

These high and low ratios are not sustainable practices. The best crop productivity occurs in the “green zone” where the nutrient output/ratio sits between the high and low ratios. It's also specific to each cropping system and nutrient.

Using modern technology, you can overcome nutrient-related limitations, improve nutrient availability to your crops and enhance the health of your soil.

Further to this, you can increase productivity while reducing the risk of nutrient-related environmental impacts based on those high or low nutrient ratios.

You can maintain or improve soil fertility by adding nutrient inputs that offset nutrient loss.

Keeping an optimal balance can pay off in major ways.

- ✓ **Improved productivity:** good nutrient management increases your potential crop yield and builds more resilient crops. It also means you will reduce waste and maximize profits as you deal with price fluctuations in both inputs purchased and products sold.
- ✓ **Environmental impact:** helping you grow more yield per acre, good nutrient and soil management keep nutrients within desired boundaries, so plants utilize what they need with minimal loss to the air or water.
- ✓ **Sustainability:** efficient fertility practices help your farm achieve economic, environmental and social goals as you look to future generations.

Implement a fertilizer strategy

With all the advantages it brings and risks it mitigates, having an effective fertilizer strategy for each growing season is key. Soil and fertilizer mismanagement can cost your farm in many ways. These include possibly using the wrong product or blend, negatively impacting soil health by depleting non-added nutrients, and/or acidifying soils already low in pH.



It can also decrease your potential yield, so implementing a systematic approach to effective fertility management for each nutrient, field and time of year is a worthwhile investment.

Make the most out of each farmable acre

Understanding the variable yield potential across the soil on your farm is the first step to strategically managing your fields. Next, you can take this further and improve your overall crop input efficiency by using a proven VR program. VR technology enhances the way you farm by using precise nutrient information to get optimal performance from all your crops.

For instance, a VR prescription might recommend using more nutrient applications in higher producing areas to push yields while prescribing less amounts in lower producing areas. Interestingly, those lower producing sections are often the places where groundwater leaching is most common, so it makes sense to pull back nutrient values there considering the crop is less likely to use them.

VR technology provides you soil and crop specific nutritional information and practices you can use to boost nutrient uptake, maintain or increase soil's organic matter and decrease loss to the environment. Because production potential varies by numerous factors including location, climate, soil, crop and nutrient application, having one reliable management system can ensure you feel confident every time you hit the field.

Why integrate variable rate?

- ✓ **Invest where it matters most:** While you're trying to maximize your yield on every acre, you're also controlling costs and getting the most of every dollar spent on inputs and seed.

- ✓ **Improve overall crop input efficiency:** When you use VR technology to apply the right amount of nutrients combined with the ideal seeding rate, you can produce more from every acre of your land.
- ✓ **Increase crop quality:** Using VR increases understanding around all the ways you can achieve better quality, increased protein or more uniform establishment across all your acres.
- ✓ **Better standability:** That uniform establishment also delivers a more uniform plant stand. This may help reduce lodging and improve harvest timing as well as fungicide timing and control of disease management.
- ✓ **More sustainable field management:** While you're protecting your investment using VR, you're also protecting the environment and farming sustainably. When you understand and adapt to your soil's variable qualities, you'll prevent application loss to volatilization, denitrification and leaching.
- ✓ **Traceability of crop production:** VR's digitized information and memory cards, where your prescriptions are installed, make it easy to trace the history of everything applied to your fields. This provides the traceability and transparency the industry is increasingly demanding, so you'll be ahead of the game.

When you're balancing farm, industry and government expectations and improving your efficiency, productivity, economic and environmental goals, you're looking out for the future of your farm while you help feed the world.





LET'S GET TO WORK. TOGETHER.

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