



Sustainable soil health strategies

eBook



You deserve healthy soil.

Soil's nutrient uptake and removal are at the foundation of zone management and fertility strategies. Nature struggles to replenish the nutrients in the soil, however advancements in zone management practices allows for replenishment to help grow healthy crops. The benefit of integrating a soil health program goes beyond just yield. Careful analysis and implementation of fertilizer enables a nutritional value chain as well as optimizing yield potential. Understanding this allows you to build strategic plans and optimize your fertilizer use across the farm.

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

Unearthing a sustainable soil health strategy



Most farmers can agree that although there's no silver bullet to a bumper crop, healthy soil plays a crucial role, from seeding to harvest and beyond. But how much is understood about what really happens beneath the surface of the field?

"Well-functioning soil will retain, provide and recycle nutrients and water, and will support a diverse array of biota in the soil-plant system," explains Jeff Schoenau, professor of soil fertility at the University of Saskatchewan and the Saskatchewan Ministry of Agriculture chair in soil nutrient management. "This contributes to greater productivity and greater yield. Greater nutrient and water use efficiency from applied fertilizers and water reduces input needs, helping profitability."

To really grasp how well soil is functioning, Schoenau says regular soil sampling is a critical step to assess different indicators, like organic matter content – a reservoir of important nutrients like nitrogen, sulfur

and phosphorus. "Microbial populations, including their biomass, diversity and activity, can be measured and supply of available nutrients released over time are part of the soil health picture too," he says.

Schoenau adds that traditional indicators, like pH and salinity, also point to the quality of the soil, as do the physical condition of the soil – especially in regions that experience extreme weather conditions.

"Soil aggregation and aggregate stability are indicators of good soil structure, as is the ability to resist wind and water erosion, which is sometimes included in soil health assessments alongside water infiltration," he notes. "When we lose topsoil, that topsoil is rich in the organic matter and clay that contributes to fertility, biological activity, structure and water holding capacity."

Above all, a good sampling plan must account for variation in soil properties that occurs across a field due to factors like landscape elevation, slope, and surface curvature, water redistribution, residual fertilizer in bands and past management practices. And while extreme conditions like drought will impact soil health, Schoenau says, healthy soil contributes to a resilient crop, acting as a protective shield against environmental stresses and ensuring productivity for years to come.

That's why, for farmers like Pat Kunz, soil health is part of an ongoing succession plan.

Kunz runs a mixed farm in Beiseker, Alta., northeast of Calgary, with his wife, father and some seasonal help. The farm comprises a cow-calf operation, feedlot and several hundred acres in a wheat, canola, barley and pea rotation.

“Everybody talks about sustainability, and that’s the only word to use here,” Kunz says. “This is a family farm that I’m in the process of taking over. I’d eventually like my own kids to be able to farm the same land.”

Soil health for generational sustainability

For more than a decade, Kunz and his family have worked with Garth Donald, manager of agronomy at [Decisive Farming by TELUS Agriculture](#), to develop sustainable nutrient plans for the farm. Like Kunz, Donald says that beyond increasing yield and profitability, healthy soil contributes to the longevity of the family farm.

“This is about handing the soil down from generation to generation,” he says.

To start, Donald says he goes back to the tried-and-true way of measuring soil health by looking at it with his own eyes. “I’ll put a shovel into the soil and see what’s there,” he says, noting he looks for things like earthworm activity and soil tilth.

But, he adds, the human eye fails to dig deeper, and can’t pick up on other soil health indicators that a microscope would see.

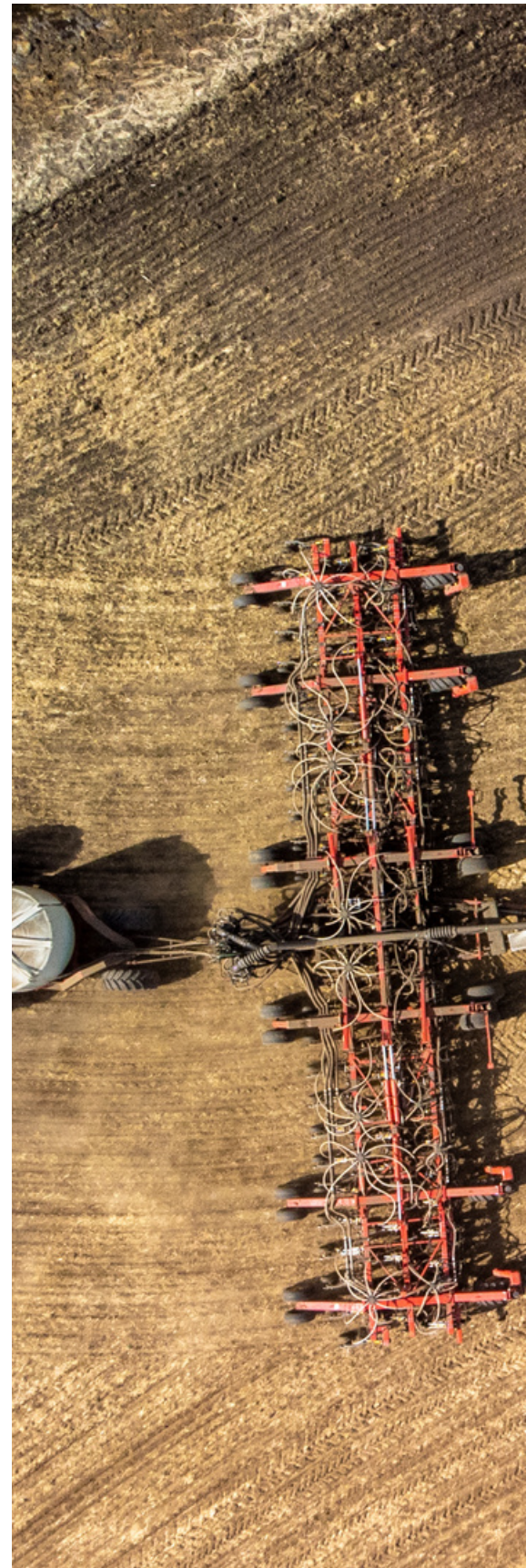
“In years without moisture, like what many parts of Western Canada have experienced, that dry soil slows down microbial activity, meaning the nutrient breakdown doesn’t occur as quickly. On the other hand, wet conditions affect soil structure, which also contributes to soil health.”

Donald echoes Schoenau’s recommendation about regular soil sampling to get a handle of what’s really happening under the ground.

“Without knowing what your starting point is, you’re going in blind,” he says, noting how difficult it is to make agronomic decisions without a data set to back it up. “While soil testing isn’t exact, it’s a snapshot of the soil, and working with producers, we can come up with a plan.”

You deserve healthy soil

A GPS-based soil test, like [Sure Check](#) offered by Decisive Farming, involves a soil technician pulling 12 to 14 cores of soil





from a GPS reference point and sending it to a lab to be analyzed for more than 20 different characteristics. This creates a benchmark dataset to return to and compare against every year. Once the results are back from the lab, the farmer works together with an agronomist to determine the next steps, using the data to tailor fertility and seed plans accordingly.

“Instead of peaks and valleys in your data, this type of test is a gentle wave curve that’s a realistic measurement,” Donald says. “But it’s a narrower view, like looking through a pen, it’s a snapshot, not a full picture.”

In an ideal world, these samples are best taken as close to the time of crop demand as possible, as that leaves little opportunity for nutrient levels to change from the time of assessment until plant growth begins, Schoenau notes. “However, sampling, getting an analysis back and developing a plan in that very short busy time frame right before seeding is not always practical,” he adds. Schoenau says that much of the sampling, analysis and plan development can be done in the fall once the soil has cooled. “A few checks may be done in spring to see if there are any changes, which can be important to know and adjust for, such as nitrate losses in a very wet, early spring period.”

For building long-term data, Decisive Farming’s [Optimize RX](#) uses variable rate technology to collect soil, water and topography data to provide zones within the field, taking samples from a larger area and providing a wider look at a field. Donald emphasizes that this is a multi-year approach, which can include satellite imagery maps to make site-specific plans for fertilizer and seed. He has worked with the Kunz family to use variable rate programs for more than a decade to help boost yield and reduce fertilizer use by using only what’s needed.

To get started, Donald says a farmer should work with his agronomist and decision-making team to determine what solution is best and most efficient for the farm operation. “Variable rate becomes a cost challenge if the farm doesn’t have the right equipment,” he adds, emphasizing the need for collaboration when it comes to soil health. “While an agronomist or sales team can make recommendations, the farmer’s perspective is paramount for adding real-life experience, ensuring the final plan is realistic and achievable for each individual farm.”

Kunz agrees. “It still comes down to logistics – we need to do the best we can with what we have, and every farm is different,” he says, noting small steps to improvement can make a big difference year over year.

“We haven’t reached a pinnacle way of farming – it’s continually evolving. We’re not going to farm the same way in 20 years that we do now,” Kunz says. “But at the very least, you need to put back what you take out of the soil – or ideally, improve it.”

What nutrients are left in your soil?

Knowing, not estimating, means better soil health and greater farm profitability

Farming in Western Canada means working in a climate of extremes—hot or cold, wet or dry. It's a conundrum that drives agriculture innovation, new technologies and precision agronomy practices on behalf of Prairie farmers that's appreciated around the world. Last year, many farmers worked to deal with extreme dryness. This year, its wet conditions, even flooding, in many areas.

On any given year, flooding creates havoc within your nutrient management and fertilizer strategy. Today, as fertility product costs, nitrogen in particular, have skyrocketed, the problem is intensified. This is where turning to progressive practices such as variable rate fertilizer application can make a critical difference to both your soil health and your farm's annual profitability.

Whether you applied nitrogen fertilizer last fall or simply had decent residual levels after last summer's dry-induced disappointing crop production, if you've got waterlogged acres in your fields, it's likely your nitrogen levels and other nutrient uptake have been impacted.

"One of the biggest issues is the denitrification of nitrogen," says Garth Donald, agronomy manager with [Decisive Farming](#).

"When water seals the oxygen off from the ground, it causes the nitrogen to convert into nitrous oxide, which is a gas. That gas then bubbles up out of the ground, through that water, and up into the air, causing you to lose that nutrient."





Up to 45 per cent of nitrogen can be lost through denitrification due to excess water. Some of the nitrogen in your fields may also leach away. “In theory, you can have 40 per cent gas-off and close to 40 per cent leach away for a total of an 80 per cent loss,” says Donald.

Additionally, sulfur levels may be impacted but in a different way. “Sulfur doesn’t gas off, but because it’s a mobile nutrient it tends to leach, going down deeper into the profile,” explains Donald. “For some crops, it can move down deeper than where their root systems are. We’ve seen sulfur go down as deep as six feet in these situations. Can it come back? Yes, but in those areas where it becomes deficient, it has to be addressed.”

Unless moisture is so extreme it causes runoff that takes soil with it, you likely don’t have to worry about your phosphorous or potassium levels as they are non-mobile nutrients and will not gas off. “For the most part, these are relatively stable nutrients and in extreme wet conditions where the water just sits in the fields,

they’re not going anywhere,” says Donald.

Assumptions can cost you, know with certainty what your soil’s nutrient levels are

Loss of residual nitrogen through denitrification has many influences and outcomes. The best way, and really the only way, to know exactly where your soil’s nutrient levels sit, is through good soil testing. “That’s going to give you the most accurate picture,” says Donald. “Because, if water’s been sitting there, there’s no crop to tissue sample. And tissue only shows what’s available in the plant, not what’s left in the soil.”

Determining the ideal distance and depth to test will vary case-to-case and require informed zone management, especially after the last few drier years as farmers have seeded more of their acres including concaved areas that normally tend to carry water. Donald says it’s likely those areas may be impacted, but keep in mind those acres are not usually worked into your typical year’s production. Because every farm is unique, collaboration with your

agronomist can help you establish the best approach to soil testing.

Once you know exactly what’s happening under the surface of your fields, your variable rate fertility program guides you to put down exactly what you need and where your soil needs it. This is an especially valuable tool when fertilizer costs are so steep while commodity prices sit at record highs, too. The stakes are high. “Knowing what you need is the biggest thing,” says Donald. “We came out of last year with super high residuals that meant not overfertilizing this year. Even with the extreme wet conditions, we have quite a difference of material plant growth, so that takes up fertilizer.”

As you use precision agronomy practices and tools to take great care of your soil, replenishing nutrients only where needed, your bottom line also looks better at the end of the season. “Knowing what is in your soil and how to manage that fertilizer dollar to its most efficient manner is key moving forward,” says Donald. “And that’s what variable rate fertility does on the farm.”

MAINTAINING SOIL HEALTH AND INCREASING BUSHEL

Results from the ground up

Soil health is the most important aspect of your farm fields. Without healthy soil, you face a tough challenge each year. When your soil profile is strong and not deficient in any nutrients or minerals, you increase your chance of a successful growing season. More than anything, healthy soil gives you the chance to increase your bushels. If your soil is not healthy, your profits won't be either.

“Good growers have good soil health, that's what makes them good and profitable,” says Garth Donald, [Decisive Farming's](#) agronomy manager.

Variable rate can deliver

Variable rate (VR) is managing your inputs to where they can be best utilized. This has become especially important in a time of sky-high fertilizer prices. Through a successful VR program, you will likely use the same amounts of inputs, not less, however, you will distribute them differently for more effective zone management. No more blanket, “just in case” insurance applications. The practice of VR also ties into soil testing, which means trusting the data that's generated.

“There's been a very large misconception that variable rate fertility, or variable rate in general, both fertility and seed is going to save you a bunch of money and cut everything back,” says Donald. “We have 70 per cent of our growers still using the same amount of fertilizer they did as constant rate, but they're just re-allocating it around the field, and that's where they're getting their yield bump.”

This can be a tall order, and Donald estimates somewhere between five and 10 per cent of growers use VR and only about 30 per cent soil test, adding that fear of change and cultural practices are two primary reasons farmers don't adjust production practices.

By attempting to be as precise as possible with VR, you avoid the headache of overapplying a specific input into one area of the field, or,



similarly, never applying enough to a chronically nutrient deficient area. Your inputs go where they will serve you best.

Increase organic matter

It's important to have high levels of organic matter as this can be a driver for strong plants. To know which options are right for you depends on your location, field history and crop rotation. Don't forget that organic matter is not a one season solution.

"It takes a long time to increase organic matter," says Donald.

"Realistically, manure is the only real way you will have a rapid increase because you are putting more organic back in soil."

Farmers have become progressively interested in cover cropping, yet it is a challenge for most dryland farmers in Alberta. Typically, irrigated farmers are the only ones able to successfully cover crop. If you can, though, it may prove a viable strategy to increase organic matter.

Donald also recommends adopting a no-till or minimum-till strategy with wider tires, not tracks, which are now shown to reduce compaction and produce a low soil imprint.

"Organic matter is helpful, but you still have to look after how you're treating up above," he says. "The more you work your ground, the less organic matter you are going to have. It's the true wildcard in yield potential."

Residue management

You should consider your crop residue and how to best manage it. Having large amounts of leftover material isn't necessarily a positive heading into next spring.

"Peas can produce a decent amount of residue, but it breaks down very quickly," says Donald. "Farmers get excited about corn, and say, 'Wow, nine-foot-tall corn.' Have you ever seen a cornfield after it's been harvested? There's nothing in the leaves and they usually blow away."

A crop such as flax, for instance, produces a great amount of biomass and its thatch creates an insular layer that makes the ground stay colder. Donald says cereals are your best bet to build organic matter and have the ground warm enough come spring. This helps to ensure you don't have ice cold ground, which could critically damage a crop, including canola.

"The least amount of work you can do to that ground the higher your organic matter, the more return you'll have your farm," says Donald. "True soil health is all about having a high organic matter soil because we know that you are promoting that environment for earthworms, for microbial activity and for the good fungus and bacteria that are in the soil."



CROP ROTATION AND SOIL HEALTH

They go together like salt and pepper – which is to say they’re better together

When you have a strong and varied crop rotation, it produces a greater diversity in the soil microbiome, which improves activity both above and below the surface. One of the most critical parts about a healthy crop rotation is bacteria – both good and bad – because when you change crops, you change pathogens.

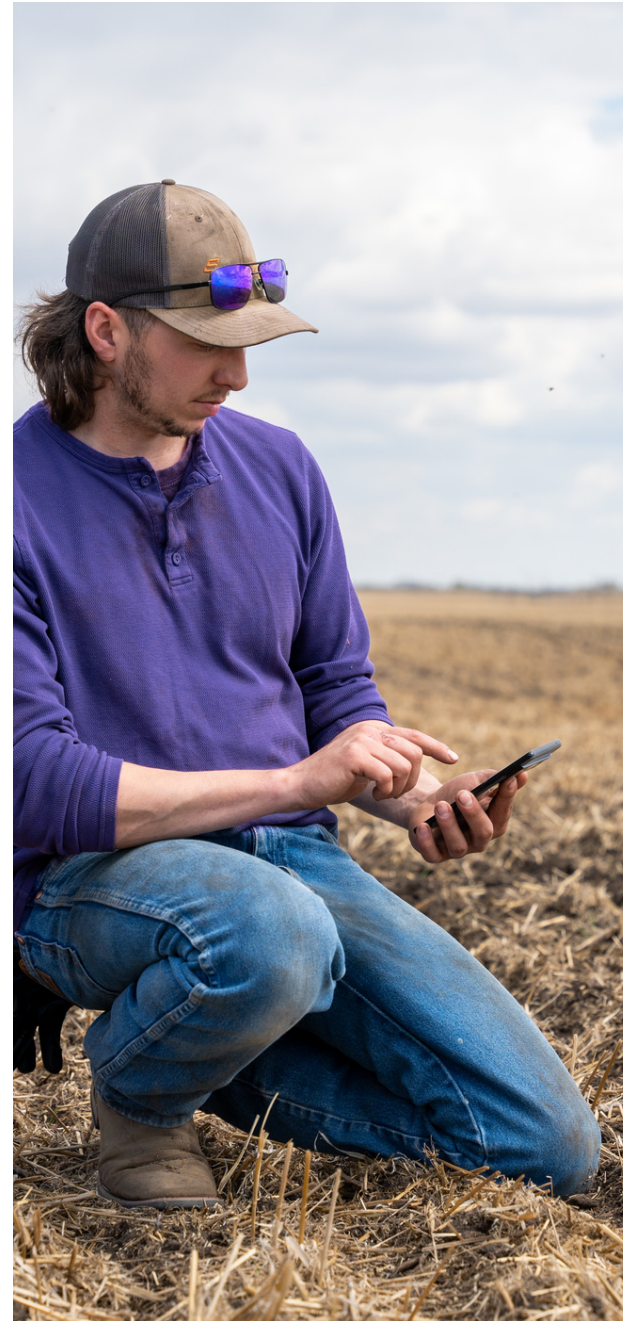
“You have positive and negative fungus and bacteria,” says Garth Donald, [Decisive Farming’s](#) agronomy manager. “The diseases they create are different. Everybody says barley and wheat are the same because they’re both cereals. Yes, but they have completely different diseases that affect them.”

When you eliminate the pathogen within the disease triangle, the cycle is broken for that crop year, which allows the soil to biologically catch its breath. Newly rotated plants help to lower negative bacterial counts from previous crops.

In the Canadian prairies, where you farm uniquely informs the length of your rotation as well as crop types. Donald says you should have minimum three-crop rotation, but four is ideal. It’s common to hear greater returns around seven to 10 per cent on longer rotations versus tighter, two-crop rotations.

Balance financial and plant sustainability

While you need to have healthy soil as part of a strong crop rotation, it must be financially sustainable or else you could be in trouble. Sometimes that causes us to shorten rotations or deal with herbicide carryover, which Donald says is common considering record-high commodity prices.



“Lots comes back to economics,” he says. “Rotation is important, but we also have to be realistic about return on investment and how to manage that sustainably, too.”

Although we sometimes think about chemfallow, Donald says that should be a last resort since it's susceptible to needless erosion. It can also be detrimental if the harvested crop was a pulse.

“Regarding soil health, chemfallow is actually going to hurt you and your soil health, because you see more dirt blowing,” he says.

Pulse power to lower your carbon footprint

If a cereal is planted after a pulse, you will see a noticeable boost due to the pulse's nitrogen fixing ability.

“We see the positives of the relationship of that interaction of different species and crops and what the yield's potential can be based on less disease pressure,” he says.

A solid four-crop rotation, including a pulse, helps drive yield. Donald often hears the argument of applying a fungicide and farmers believing that increased their yield. However, he questions if it only shows its potential, and that yield simply wasn't lost.

As your crops create their own nitrogen, Donald notes that, “it reduces the amount of nitrous oxide that would be placed into the environment”, a big plus for sustainable agriculture.

Digital management – no exceptions

You log gigabyte after gigabyte of data with every pass of the tractor. But how do you store and access this data?

“There's nothing wrong with using paper, but the challenge is when you're gone to Arizona for the winter, let me guess: the book is still in the seeding tractor or sprayer,” says Donald.

With a digital log using farm management software, you can review fields, input rates and create a plan from the comfort of wherever you find yourself.

“There are digital platforms that provide you with knowledge at your fingertips,” he says. “If you are trying to plan, it has to be the digital platform.”



TURN TO TECHNOLOGY

Brad McDougald jokes that farmers can always find something to complain about. “Doesn’t matter whether it’s too warm, too dry, too cold,” McDougald says with a chuckle.



This year was a dry season in Drumheller, Alta., where his 2,500-acre farm produced about 40 per cent of its regular yield of wheat, canola, peas, lentils and barley. But for all the elements outside a farmer’s control, McDougald says such a yield was better than expected for such dry conditions. He credits managing the health of the soil on his farm as crucial to this year’s harvest and the future of his fields. “You see it in these dry years, as we still have a healthy plant,” he says. “The soil is constant and that is the most critical to take care of.”

To keep his fields healthy, McDougald has worked with Garth Donald, [Decisive Farming by TELUS Agriculture’s](#) manager of agronomy, for 17 years – even before Donald co-founded Canadian farmtech startup Decisive Farming in 2011. “I was just about hooked the first year,” McDougald says, after using Decisive Farming’s high-tech and data solutions, acquired by

TELUS in 2019, to optimize the quality and yield of the harvest on his farm.

This exploration of the technology company’s move into agriculture was similar to its evolution into health care, both underscoring TELUS’ commitment to social capitalism and using technology to solve some of the world’s biggest challenges.

Decisive Farming combines [satellite data to measure crop density](#) and agricultural data from historic yields, along with soil sampling to help farmers manage their farm’s soil health and optimize the quality and yield of their crops.

Before Decisive Farming, McDougald says he would order a single type of fertilizer that was broadly formulated to rebalance the nutrients of his soil across all his fields. But even within a single field, the soil’s nutritional needs

can vary. “The field is not flat, it’s rolling,” he explains. “There are different types of soil on top of the hill versus down in the bottom of a little dip,” which affect its nutritional contents and potential for crop output.

Fertilizer Canada lays out the “Four Rs” of contemporary nutrient stewardship: using the right source at the right rate, the right time and the right place. Decisive Farming uses the principles of variable rate nutrition to create custom fertilizer formulas, offering different levels of nitrogen, phosphorus, potassium and sulphur, all based on the needs of the different segments of a farmer’s field, like “a digitized prescription,” Donald says. Then, using the soil samples and topographic data to spot the gaps in a field’s crop density, Decisive Farming shows farmers how much fertilizer to apply to optimize their harvest.

While in the tractor applying fertilizer, McDougald says he can see the zones on his computer screen where he would traditionally speed up or slow down to apply more or less fertilizer. Where more nutrients are needed on his field, he can see where to apply more fertilizer, maximizing the harvest potential of that spot. In nutrient-rich pockets, he can apply less fertilizer, saving on money and reducing emissions. “It’s improved our farm overall,” McDougald says. “Decisive Farming helps you to maximize the potential of each zone in your field without over fertilizing and wasting product.”

Decisive Farming offered its variable rate fertilizer services to 1.5 million acres of farmland in 2022 and its full range services have been used on nearly 6 million acres across Western Canada. “Every year we are seeing a growth within the variable rate fertilizer side of our business, because farmers are looking at how to manage costs,” as well as improve their farm’s sustainability, Donald says.

Farmers are facing financial and environmental pressures, as fertilizer prices, while dropping from their 2022 highs after Russia’s invasion of Ukraine, are still higher than before. Donald says fertilizing an acre of canola costs \$150 to \$180. “When you’re spending that much money per acre, you want to be using it to its greatest potential. So variable rate fertilizing is a way to optimize the dollars invested in the ground,” he says. With greater pressures from the federal government to reduce nitrogen emissions related to fertilizer use, Donald says Decisive Farming provides “a better product, a healthier product, an environmentally healthy product, all while reducing our environmental load into the system.”

Alongside the need to cut costs while being conscious of environmental factors, McDougald says “we need to take care of the soil for the future.” McDougald, a fourth-generation western farmer, wants to ensure his children can keep farming sustainably.

“This spring, my son asked me: ‘What’s going to happen if things change? Do you think we’re going to be able to change farming to keep up with the environment?’” McDougald told him that, like the weather, there is constant change and unpredictability. But, like farmers across Canada, his family has always found a way to adapt.

“It’s changed a lot from the way my grandfather farmed, to the way my dad farmed, to my time,” he said. “When my son and my daughters are farming and they’re showing it to their kids, I’m sure they will have different things from what we’re doing.” But some goals will remain constant. “It’ll all be for the same purpose: to maximize the yield and take care of that soil.”





LET'S GET TO WORK. TOGETHER.

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