Soil
Analytics

ATP

RESTORE THE BALANCE

Restore the **Balance**

At ATP, we believe a proactive, science-based approach to restore the balance between plant and soil health is the single most effective way to deliver the genetic potential of the crop. We challenge the status quo by utilizing agtech to monitor and drive productivity.

Nutrition + Biostimulants + Analytics = **Restoring the Balance**

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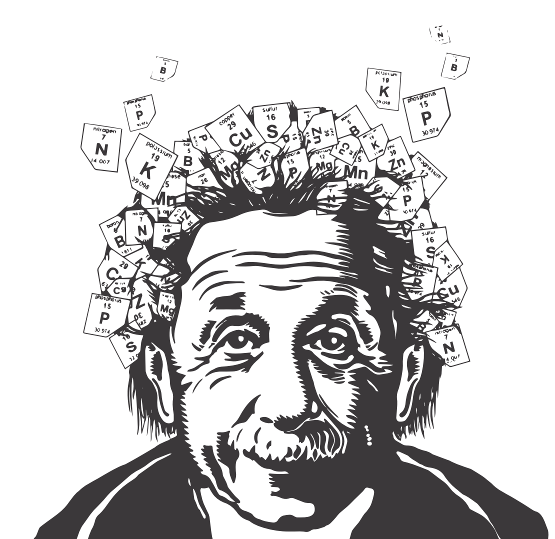


Soil **Analytics**

It all begins with a soil test. To maximize the genetic potential of your crop and to get the most from your fertility budget, you need to know a few things:

- What level of nutrients are in the soil?
- How much of each nutrient is required to achieve your target yield?
- How to implement a full season nutrient management plan to address deficiencies and imbalances within the soil?

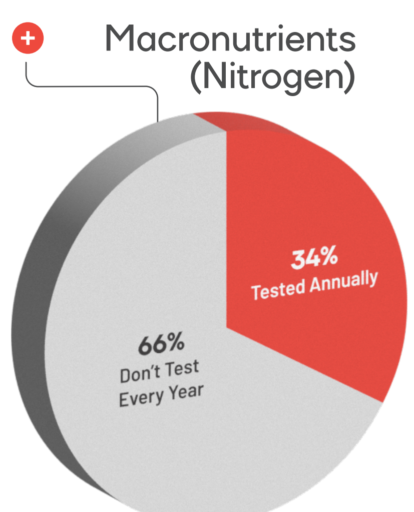
Soil testing is the foundation of a sound agronomic plan.

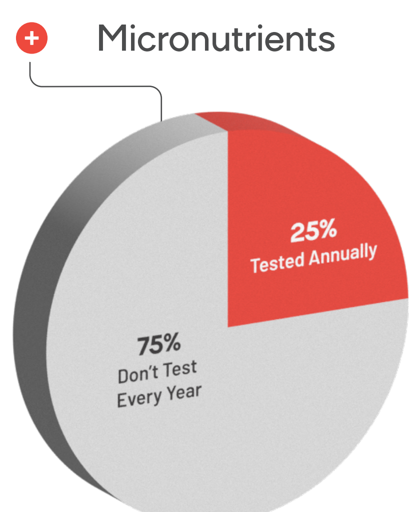
The International Plant Nutrition Institute (IPNI) maintains that on average we achieve **only 20% of the genetic yield potential** with our major crops. In what other scenario would we be satisfied with that return?

We know that using proper plant nutrition can positively influence 60% of a crop's genetic yield potential. To close this yield gap, we can invest in the latest seed genetics, but to extract the maximum value we need to use the most powerful tool available – **a soil fertility program based on soil testing.**

Surveys reveal that only **34% of fields in North America are soil tested annually** for the single nutrient - Nitrogen **and only 25% of the fields have a complete (macronutrient and micronutrient) analysis done**.

Frequency of Soil Testing





Stratus Report Canada (2021)
% of total respondents = 637

Why are so few fields **Soil Tested?**

Even though the number of fields annually soil tested increased from 19% in 2015 to 34% in 2021, it still means 2 out of every 3 fields remain untested on an annual basis. Listed below are the key reasons why growers don't soil test every year and the rationale as to why growers may want to start soil testing.

If you don't soil test annually, it's time to rethink your approach.

Reasons for not soil testing	Rationale for annual soil testing
Too expensive	Fertilizer is the largest single crop input expense on the farm. A misapplication of fertilizer is far more expensive than the cost of a soil test. According to IPNI (International Plant Nutrition Institute), 60% of a crop's yield is influenced by proper plant nutrition. It only takes a couple of bushels across the entire field to cover off the cost of a soil test.
Takes too much time to sample, ship and wait for the results	Soil testing is evolving! Real-time soil diagnostic technologies like near-infrared (NIR) spectroscopy can be used in-field and give you a complete soil nutrient status in just minutes. Technologies like NIR spectroscopy are a game changer in soil testing. Soil testing can be done any time of the year – in the fall to get a gauge of where the nutritional status of the soil is at and in the spring just prior to seeding.
Don't trust the results	Soil test values from analytic labs can be different due to differing extraction methods used. However, the recommendation is usually aligned. Using a consistent, well calibrated soil testing service every year can provide a trustworthy indication of nutrition trends of the sampled area of the field.
Don't think soil tests are useful	Due to the complexity of a soil test report, it is sometimes difficult to interpret the report. Many analytical reports have been simplified to provide clear and concise nutritional recommendations.
Soil tests are not required every year	Previously it was standard to only test a field once every three years. Annual soil testing has been on the rise due to: • Increased cost of fertilizer. • Volatile environmental conditions increasing perceived production risk to the grower. • New technologies available for soil testing. • Government legislation mandating improved fertilizer stewardship.
Use technologies other than soil sampling	Even though systems like satellite imagery have their benefits, they rely on algorithms to determine the nutrient status of the field rather than an actual measurement to ground truth every year. Basing your crop nutrition plan on an actual soil measurement will ensure you only apply what the plant and soil truly require.

Source: Stratus Report Canada (2021)

Why
Soil Test?

Irrespective of crop type, a well designed fertility program leads to a significant increase in yield

8 Reasons to
Soil Test

Soil testing is a best management practice (BMP) and a foundational step in preserving a crop's genetic yield potential. With a robust soil testing program, you can gain a greater understanding of:

1. Economics

- Aids in determining the required nutrients for efficient and economical crop production.
- Helps establish the amount of carry-over nutrients already in the soil.
- Aligns soil nutrient levels with the needs of the plant while factoring in fertilizer prices. This allows the grower to make informed decisions as to how much fertilizer they should apply to achieve their crop's targeted yield potential.

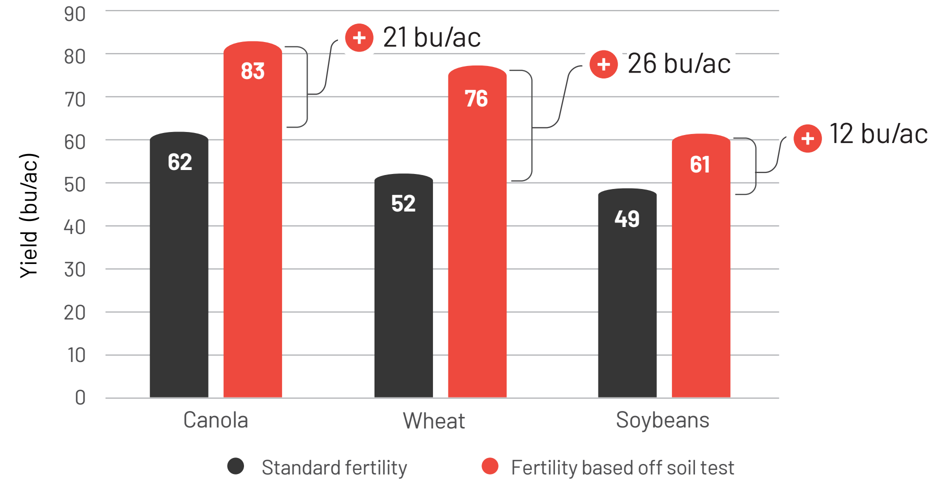
The value of a complete soil test and robust nutrient management is displayed in the chart. At the ATP Research Farm, every new product screening study was performed under 2 different nutrient management regimes.

(1) A standard fertility program the producer did on their field.

(2) A nutrient management plan based off a complete soil test to achieve maximum yield potential of the growing region.

The average increment yield benefit from a complete nutrient management plan was 21 bu/ac, 26 bu/ac, and 12 bu/ac for canola, wheat and soybean respectively.

Impact on Yield – Nutrient Management Plan Based on Complete Soil Test



Summary of 162 plots per crop

2. Proper Plant Nutrition

- Plants require specific quantities of every essential nutrient. Too much or too little of any nutrient can be detrimental. Soil sampling ensures the plant is supplied with balanced nutrition.

3. Soil Nutrient Stewardship

- Regular soil testing tracks fertility history allowing confirmation that soil nutrient mining is not occurring.
- Plants remove a predictable amount of nutrients per amount of biomass grown. If these nutrients are not returned to the soil, via fertilizer application, the overall nutrient status will decline, leading to a potentially less fertile and productive land.

4. Environmental Stewardship

- Prevents over fertilization and potential environmental contamination. When farmers do not soil test, they run the risk of over or under applying fertilizer. When over application occurs, these nutrients are more likely to leach or run-off into waterways and become a source of contamination.
- Geo-referenced soil sampling and variable rate application allow for precise nutrient distribution and placement.

5. Animal and Human Nutrition

- Soil testing helps to attain optimal nutrient density in animal feed as well as into the human food chain.

6. Water Use Efficiency

- Soil testing aids in the identification of soil type to provide a better understanding of a soil's Water Use Efficiency (WUE).
- Soils are not all uniform. They can vary in color, pH, mineral composition, Organic Matter (OM) and texture.
- The inherent capacity of a field/zone to produce a crop can be limited by the soil's physical and chemical properties which include OM, pH, Electrical Conductivity (EC), Cation Exchange Capacity (CEC) and texture.
- Texture quantifies the amount of sand, silt, and clay in a soil. Sandy soils allow water to drain more rapidly than soils with smaller particles such as clay.

7. Reduced Pesticide Dependence

- Weeds and pests are opportunists, meaning they grow in areas of low fertility and can compete with the crop.
- By providing suitable fertility, farmers give their crop a competitive edge against weeds.
- Unhealthy plants tend to attract pests and are potentially more susceptible to damage.
- By providing plants with proper nutrition they are better equipped to defend themselves against pests.

8. Soil Health

- Research has shown that beneficial microbes prefer to colonize in the root rhizosphere of plants grown with balanced nutrition.
- Poor nutrition will invite harmful microbes, while proper nutrition will allow beneficial microbes to thrive.

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What growers have learned from **Soil Testing:**

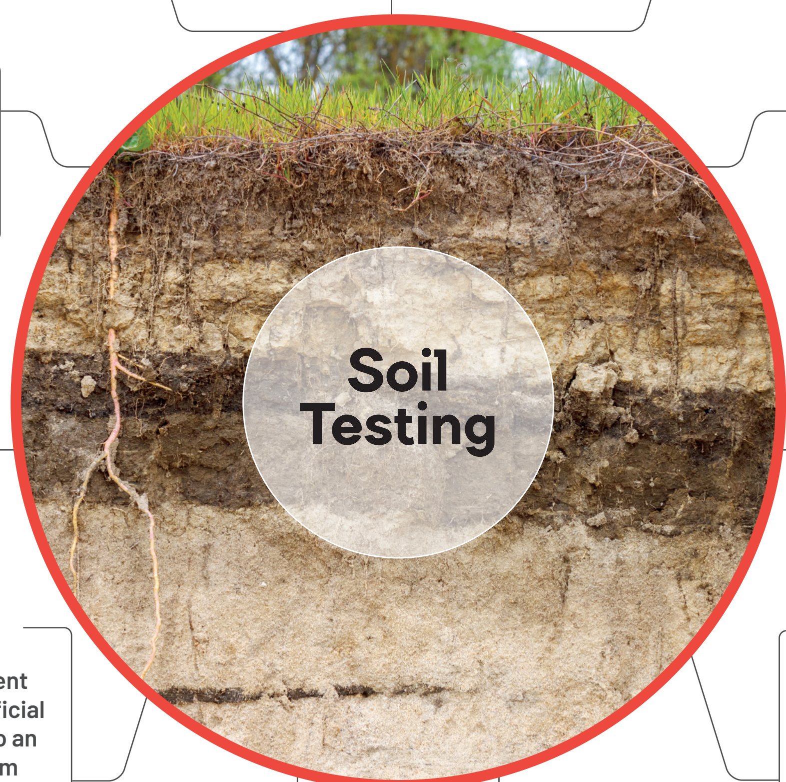
Lack of a proactive balanced fertility program can result in money being spent on the wrong crop inputs, giving a reduced return on a grower's nutritional investment.

Upward movement of soluble salts was limiting yield, making water and variety management critical.

More consistent crop quality was achieved i.e., malt and/or high protein levels.

Fertilizer investment increased slightly or remained the same but better yield and quality results were achieved.

Identified soil zones within a field having less profitability per acre; whereby, returning these areas to perennial crops made the most economic sense.



pH levels (potential soil acidification) supported a change in Nitrogen and/or Sulphur applied products.

Manure has tipped the nutrient balance. There is a need to increase other nutrients (e.g., Manganese) to take advantage of the benefits of manure.

Increased cost from over application of a single nutrient (e.g., Nitrogen) was not beneficial when yield was limited due to an unbalanced fertility program (e.g., low Sulphur levels).

Plants start to get effected by nutrient deficiencies even before expressing any visual symptoms. This "hidden hunger" can lead to significant yield losses.

pH levels dropped over time, creating zones where liming was needed to return to profitable crop productivity.

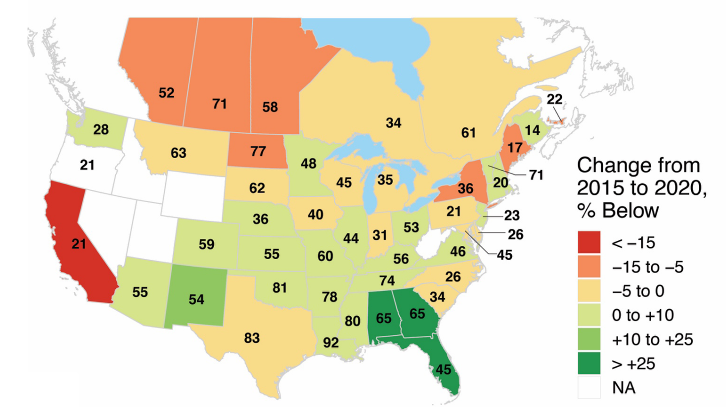
Stratification of Potassium or other nutrients can cause an issue with late season availability.

Nutrient **Stewardship**

Being a good steward is important to growers striving to leave a farm in better shape, both financially and environmentally, than when they were acquired.

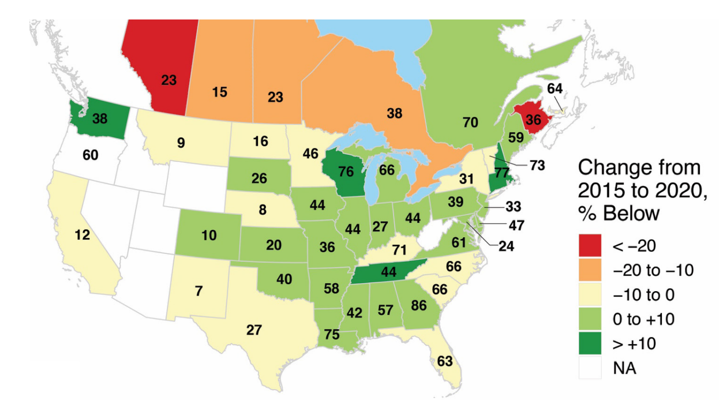
However, a 2020 compilation of 7.7 million soil tests from across North America shows that we are mining our soils of key elements (TFI, 2020)*.

Percent of Samples Testing Below Critical Levels for Phosphorus



Soil Test levels in North America 2020 - TFI Report

Percent of Samples Testing Below Critical Levels for Potassium



** Soil Test levels in North America 2020 - TFI Report*

The key findings are:

- 46% of soils tested below critical levels in Phosphorus in 2020, an increase of 5% since 2001.
- 44% of soils tested below critical levels in Potassium in 2020, an increase of 4% since 2001.
- From 2005 to 2020, more samples tested lower in Sulphur – a trend consistent with lower deposition of Sulphate from the atmosphere.
- Comparing 2010 to 2020, approximately 6% more samples tested low in Zinc.
- Soil Acidity - From 2001 to 2020, soil samples with pH below 6 increased by 2%.

**Only states with 2,000 samples or more are shown on this map*

**Soil Test Levels in North America - 2020 Summary Update. (The Fertilizer Institute)*

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Nutrient Use **Efficiency** (NUE)

is the ability of the crop to take up and utilize nutrients for maximum yield. NUE depends on nutrient uptake efficiency and utilization efficiency by the plant.

Nutrient uptake efficiency is the ability of plant to absorb nutrients from the soil.

Nutrient utilization efficiency is the ability of a plant to assimilate and mobilize nutrients (Anas et al., 2020).

Doing more with less **Nutrient Use Efficiency**

Even with crop nutrient removal exceeding the application of fertilizer to the land, the government is challenging the producer and agronomist to reduce fertilizer use even more.

> “The Government of Canada released "A Healthy Environment and a Healthy Economy" plan that pledges to reduce green house gas (GHG) emissions generated from fertilizer use by 30% below the 2020 level. The way in which they intend to do this will essentially put a cap on the total emissions allowable from the use of fertilizer to 30% below the 2020 levels... effectively putting a ceiling on Canadian agricultural productivity to well below the 2020 levels.”

Therefore, in order to replenish our soil with the essential nutrients while abiding by environmental legislations, fertilizer applications are going to have to become more strategic and science based to match the crops needs, while using a balanced nutrient program to optimize NUE.

Depending on the crop type, environment and management practices, NUE of the crop ranges between 25% and 50% (Hofmann et al., 2020). Fertilizer cost is the biggest operational investment in modern farming and a 1% global increase in NUE could save farmers approximately $1.1 billion annually in their fertilizer investment (Li et al., 2020).

Anas, M. et al. 2020. Fate of nitrogen in agriculture and environment: agronomic, eco-physiological and molecular approaches to improve nitrogen use efficiency. Biol Res 53, 47. https://doi.org/10.1186/s40659-020-00312-4.

Hofmann, T., Lowry, G.V., Ghoshal, S. 2020. Technology readiness and overcoming barriers to sustainably implement nano-technology-enabled plant agriculture. Nat Food 1, 416–425. https://doi.org/10.1038/s43016-020-0110-1.

Li, M., Xu, J., Gao, Z. 2020. Genetically modified crops are superior in their nitrogen use efficiency-A meta-analysis of three major cereals. Sci Rep 10, 8568 https://doi.org/10.1038/s41598-020-65684-9.

Nutrient Stewardship **4R's**

THE RIGHT SOURCE

To help growers mitigate risks and unpredictability in their seasons, the Right Source recommends specific enhanced efficiency fertilizer (EEF) for grower's crops that reduces loss and improves yield during adverse weather, equipment breakdown etc.

PERCENTAGE OF GROWERS CHOOSING TO USE AN EEF: **24.9%** OF GROWERS

THE RIGHT RATE

To ensure that a responsible rate of Nitrogen and Phosphorus is used, growers are using soil sampling to determine their rate. In this year's survey we found that growers in the high yield categories are soil sampling every three years to determine their fertilizer rates.

LOW YIELD: 54.8%
MODERATE YIELD: 55.6%
HIGH YIELD: 65.8%

THE RIGHT TIME

Timing is everything. 4R guidance helps ensures growers are avoiding high risk times in the year, where they are at risk of losing fertilizer to Green House Gas (GHG) emissions or run off.

The majority of growers implementing the 4R's apply fertilizer at spring planting or as an in-season application to avoid the risk of loss in the fall.

THE RIGHT PLACE

By implementing the Right Place, growers are able to place fertilizer where it is less likely to leave the soil and provide the best nutrient available to the plant through banding and seed placement recommendations. This is great news for protecting water ways and reducing environmental impacts.

76.7% of growers are applying Phosphorus by banding or seedplaced, a practice shown to **reduce Phosphorus runoff by up to 60%**

Source: Fertilizer-Canada-4R Stewardship Report

As an industry, we need to build from the 4R' s program and extend it across all 18 essential nutrients to maximize NUE while driving the genetic yield potential, stewarding to the environment, and abiding by legislation.

So, how do we get a better handle on the "right rate" for all 18 essential elements?

By soil sampling.

How do we move the needle from only 34% of the fields having a basic annual soil test to 80% of the fields being tested every year for all of the essential nutrients? We need to overcome all of the current grower objections with today's soil sampling by using new technologies like the NutriScan real-time near-infrared (NIR) soil scanner.

We can attain better NUE by implementing the 4R's Nutrient Management protocol :

- Right nutrient source,
- At the right rate,
- In the right place,
- At the right time.

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Evolution of
Soil Testing

Even though traditional wet chemistry soil analysis has been around for many years, using this method of soil testing has its limitations.

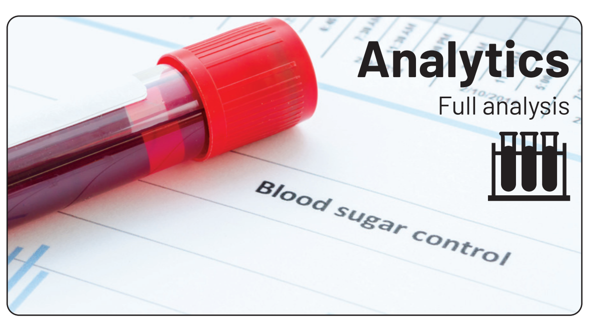
- Collecting a soil sample, preparing it, and shipping it to a wet chemistry lab can be very time consuming.
- Growers need to wait multiple days to get their results back and design their fertility plan.
- Testing a high number of samples/fields for precision agriculture is very expensive.

These limitations of traditional soil analytics have limited the number of fields being tested and has opened the doors to an evolution in soil diagnostics. The introduction of real-time soil diagnostic technologies like near-infrared spectroscopy can be used in-field to get a complete nutrient analysis in just minutes.

Difference between Diagnostic and Analytics

What does diagnostic mean:

The most effective way to explain the meaning of diagnostic is to reference a person who is a diabetic and uses a portable glucose monitor to measure and manage real-time blood glucose. NutriScan, near-infrared technology gives you real-time monitoring of soil nutrient levels. It is quick, accurate, consistent and provides you an easy to understand report and recommendation.



What does analytics mean:

In comparison to a blood glucose test, analytics for a diabetic is a visit to a doctor who performs a complete blood and other lab tests that might be needed. Similarly, in most cases, a NutriScan test will be sufficient to provide you with enough information to design a good fertility program and track soil nutrient trends. For a deeper analysis or to identify outliers in your soil data, you might need to get your samples analyzed by a wet chemistry lab every few years.

Just like the blood glucose monitor is not meant to replace a doctor (lab test). NutriScan is not meant to replace a wet chemistry lab; but rather it will complement it. NutriScan is a fast, easy to use, economical way to provide a consistent and accurate report on the nutrient status of the soil.

Real-time NIR technology
NutriScan

NutriScan is a game-changing diagnostic technology that gives you access to real-time, in-field monitoring of soil nutrient status using an easy to use, handheld tool, all in a matter of minutes with these few steps.

To generate the report, NutriScan uses near-infrared (NIR) spectroscopy, prediction models, artificial intelligence, and machine learning to deliver an accurate and consistent soil analysis.

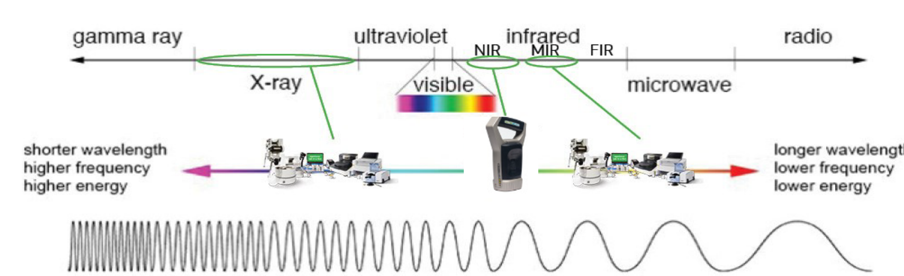
1 SCAN	2 CONNECT	3 ANALYZE	4 ACT
Scan your Soil	Upload data via the app	Let the database interpret the results	Receive your report

What is Near-Infrared (NIR)

Near-infrared (NIR) spectroscopy is specific to the near-infrared region of the electromagnetic spectrum (from 780 nm to 2500 nm) and is the wavelength used by the NutriScan technology.

One of the greatest advantages of using near-infrared spectroscopy for soil analysis is the simple, hazard-free sample preparation, and quick analysis that can be done both in the field and the lab.

The combination of using multiple wavelengths via various technologies to test soil can make it as accurate as a wet chemistry lab. The combination of the near-infrared (Nutriscan, in-field) along with the mid-infrared (MIR) and X-ray spectroscopy (LiaB- Lab) has been developed to give reading as precise as wet chemistry lab.



What exactly is **Spectroscopy?**

Spectroscopy is the study of the absorption and emission of light and other radiation by matter, such as soil and plant material.

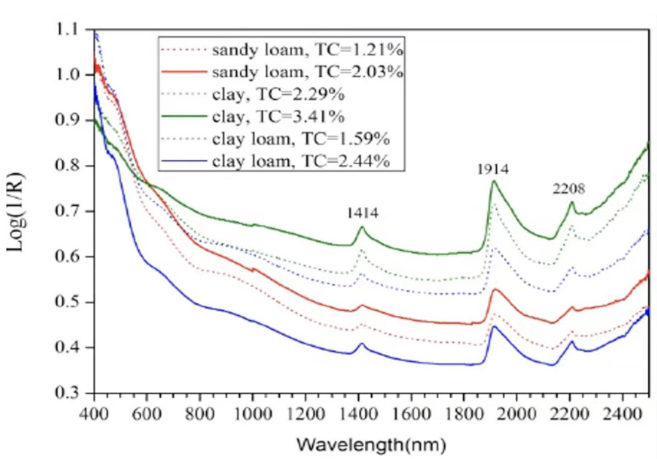
How Does Spectroscopy work?

When spectrometers emit light on a soil sample, each soil parameter absorbs and reflects a different amount of near-infrared light, thereby giving a unique wavelength spectrum. The result is a spectral absorption curve, also referred to as a spectral signature, with highly characteristic shape that is used for soil analysis and property predictions.

Near-infrared light spectrum is most useful in detecting molecules containing C-H, N-H and O-H bonds. Prevalence of these bonds within Organic Matter, Nitrogen and various mineral components makes near-infrared spectroscopy very useful for determining the presence of various chemical forms of carbon and nitrogen in soils.

The figure below is an example of the spectral signature from the near-infrared light source for 3 different soil types.

Even though researchers and industry have been using infrared spectroscopy for decades on feed and soil analysis, not until recently has there been technological breakthroughs. Currently, this technology is used extensively to check food, agricultural and pharmaceutical ingredient quality.



When it comes to soil spectroscopy, in the last few years, the technology has advanced significantly in terms of speed, resolution, and energy throughput. In combination with robust machine learning and prediction algorithms have turned this from a concept into a commercial product.

Machine learning and Prediction algorithms

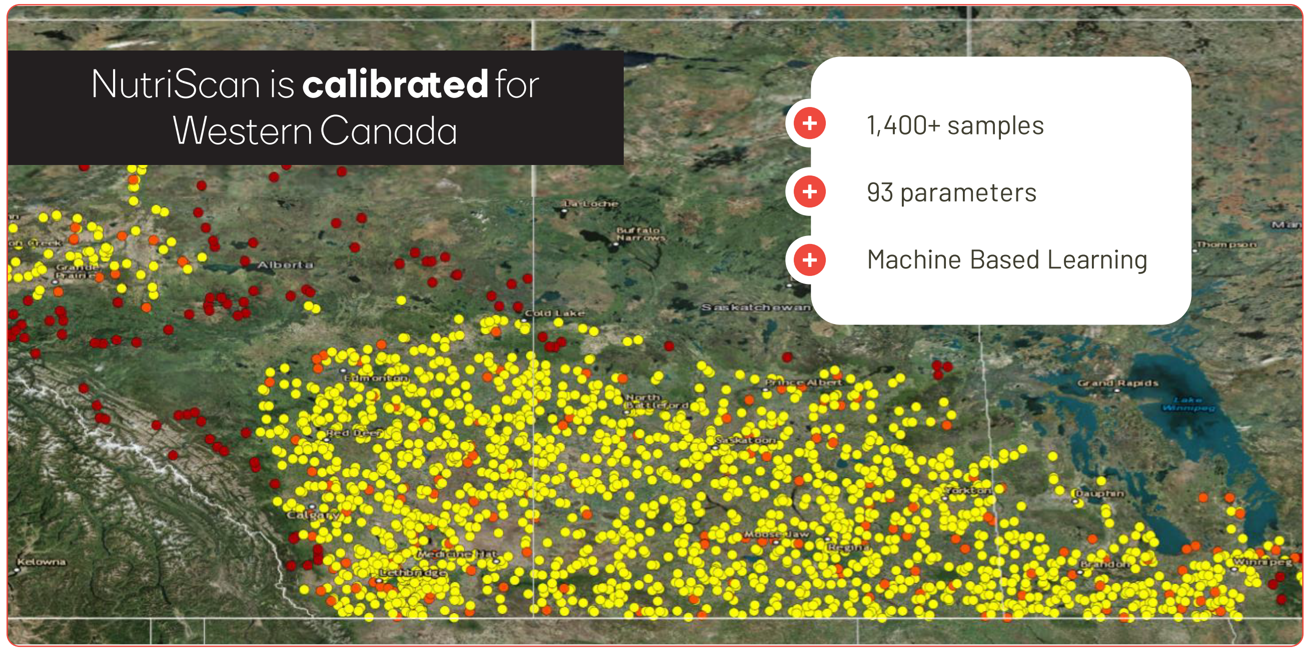
Machine learning uses models and algorithms that learn from and make prediction on data. The most common method to translate spectra into meaningful numbers is by using chemometrics. This is the way to extract information from spectra, by statistically relating it to chemical data. The result is empirical prediction models for chemical elements, compounds or properties that translate the spectral curve into useful values with various degree of accuracy. The higher the number of samples, the more accurate the prediction models are.

Calibration. Converting Spectroscopy into a product

To calibrate NutriScan for a specific geographic region we need to perform a thorough analysis on the soil. To get a complete analysis of the soil, 93 different measurements are performed using 4 different extraction techniques (Gold Standard Lab). In addition, parent material spatial imagery and historical yield maps are integrated into the database to thoroughly understand the soil system. This database is the foundation for near-infrared prediction models and the spectral curve generated from the NutriScan. Thanks to the power of computing, we could link both databases to produce powerful prediction models. The end result is quick spectrometer tests combined with our prediction models to generate accurate soil measurements.

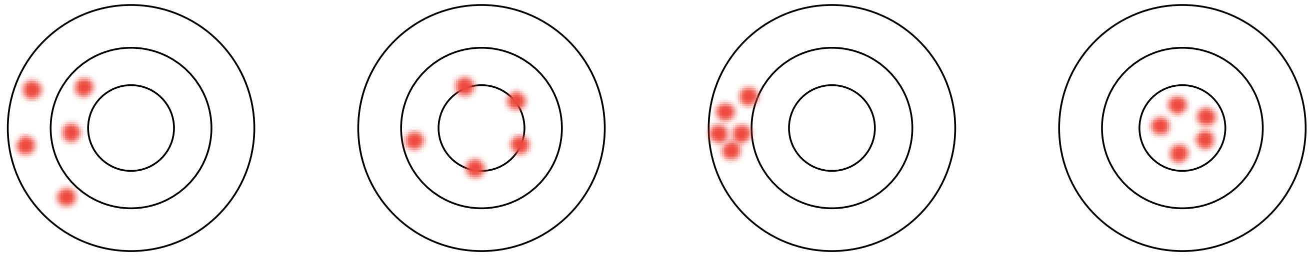
Prediction models get more accurate every time samples are added to the database. In order to predict the content of an element in a soil sample, the model reaches into our database of all our previous sample tests, chooses the most similar experiences, combines them, and uses the combination to make a prediction.

NutriScan **Prediction models** were calibrated using over 1,400+ Western Canadian soils analyzed with wet chemistry at the Gold Standard Lab in the Netherlands.



Accuracy and Reproducibility

For a technology to be reliable, it must be both precise and accurate. This means it should provide good results with high consistency. It is very difficult to achieve 100% accuracy and precision in real-world situations. e.g., it is acceptable for most chemistry labs to work within a 10% ± range. In our testing, we have seen that NutriScan has consistently produced results within the acceptable margin of error, making it a reliable diagnostic tool for soil testing.



LOW PRECISION LOW ACCURACY | **LOW PRECISION HIGH ACCURACY** | **HIGH PRECISION LOW ACCURACY** | **HIGH PRECISION HIGH ACCURACY**

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Highs and lows

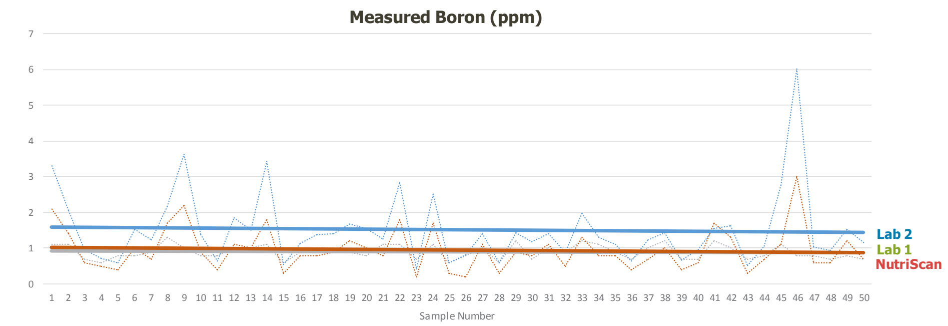
This chart shows the consistency in the high and low values for soil Potassium levels between the NutriScan and two wet chemistry labs. In addition, the table compares the actual measurement of Potassium with the attention levels and the rating between the NutriScan and the wet chemistry labs. Although the measured values and attention levels differ, the rating of Potassium is consistent.

Correlated to provide **Consistent Results**

Since individual labs do not necessarily use the same extraction methods, the nutrient analysis of one lab may not be directly comparable to another lab. Consequently, the reported results from different labs can and frequently do differ. However, if both labs use reliable methodologies, sound interpretation and the same philosophy about fertilizer recommendations, the recommended nutrients should be consistent. Similarly, even though NutriScan attention levels are different from wet chemistry labs, its interpretation and recommendations align very closely.

To make sure there is a strong consistency in the results from NutriScan, soil samples were scanned with NutriScan and sent to two prominent soil labs. Results were statistically analyzed for the variance between the real-time diagnostic tool and the wet chemistry labs. Even though NutriScan measured values and attentions levels varied from those of wet chemistry labs, they followed the same trends. As indicated by green (wet chemistry lab 1), blue (wet chemistry lab 2) and red (NutriScan) lines, NutriScan and both wet chemistry labs consistently reported high and low concentration of nutrients, respectively.

Example of Micronutrient - Boron

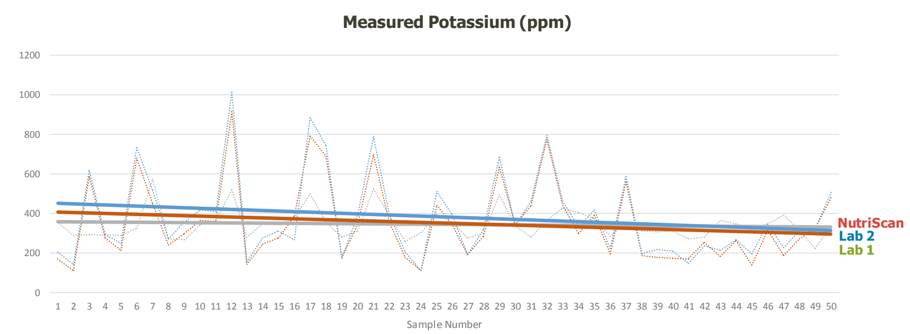


Boron	NutriScan	vs. Wet Lab (A)	vs. Wet Lab (B)	
Measured Values	0.70 ppm	0.40 ppm	0.65 ppm	Different Numbers
Attention Levels	1.4 -2.0	1.0 - 2.0	0.81 - 1.2	Different Thresholds
Rating	LOW	LOW	LOW	Same Rating

In terms of micronutrient correlation, this chart and table show the consistency with soil Boron (micronutrient) level between the two labs and NutriScan.

Example of Macronutrient - Potassium

Different soil testing technologies will produce different, but consistent, measured values

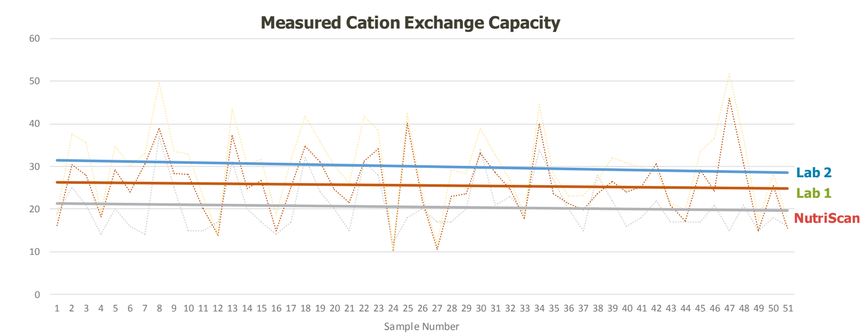


NutriScan attention levels were created to ensure they are consistent with wet chemistry lab ratings

Potassium	NutriScan	vs. Wet Lab (A)	vs. Wet Lab (B)	
Measured Values	270 ppm	172 ppm	146 ppm	Different Numbers
Attention Levels	200 - 400	160 - 320	81 - 150	Different Thresholds
Rating	ADEQUATE	ADEQUATE	ADEQUATE	Same Rating

Example of Soil Property - Cation Exchange Capacity

Different soil testing technologies will produce different, but consistent, measured values



NutriScan attention levels were created to ensure they are consistent with wet lab chemistry ratings

CEC (meg/100g)	NutriScan	vs. Wet Lab (A)	vs. Wet Lab (B)	
Measured Values	37.0 meq/100g	38.9 meq/100g	49.6 meq/100g	Different Numbers
Attention Levels	12.0-32.0	15.0-35.0	15.0-35.0	Different Thresholds
Rating	HIGH	HIGH	HIGH	Same Rating

In terms of Soil Properties, this chart and table highlight the consistency in Cation Exchange Capacity (CEC) between NutriScan and the two wet chemistry labs.

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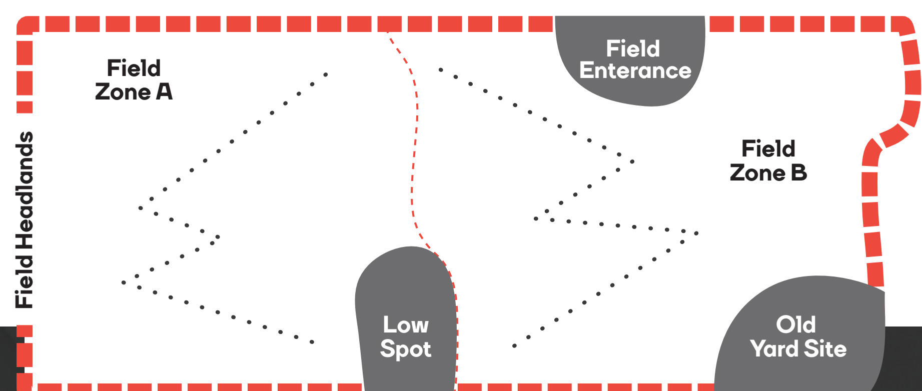
Getting started with **Soil Testing**

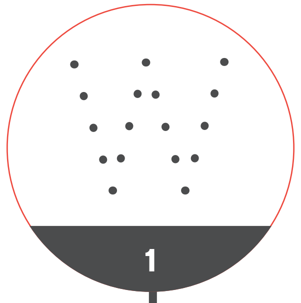
Collecting a Soil Sample

- Consistency - collecting each sample in a uniform manner between years and within the course of a sampling event will greatly improve the quality and reliability of your result (may it be randomized, benchmark or grid/zone sampling techniques). Nutrient levels may vary within the year due to leaching, moisture conditions, soil temperature and biological activity resulting in soil pH changes. Therefore, the time of soil sampling for a field should be consistent from year to year to ensure consistent historical data.
- Use visual clues, technology (e.g., geo-referencing) and common sense to select core sites - i.e., take all samples from mid-row and use a benchmark system where sample spots are marked on GPS and returned to year after year.
- Field zones with different soil types, appearance and crop growth should be sampled separately.
- Avoid hotspots - field entrances, old yard sites, low spots, saline seeps, corners of fields, end rows, etc. Do not sample within 50 ft. of field boundaries.
- Take 16-20 cores per field (160 acres) - not less than 12 per zone regardless of size.
- Sample in 6-inch increments (e.g., 0 – 6 inches, 6 – 12 inches, etc.).
- Mix cores thoroughly in a plastic pail to ensure a completely homogenous composite sample.
- Testing with NutriScan can be done in the field or back in the office:
  - Remove as much trash and root material as possible before scanning, as this may alter the final soil results.
  - Be sure the contact between the NutriScan unit and soil is tight to ensure no external light seeps in as this may alter the final soil results.



Steps for **Soil Testing**

Choose 16-20 equally spaced points in field. These should be ideally in a 'W' shaped pattern to take representative composite soil samples.



Remove any straw from the soil surface.

Use soil probe or an auger to take a soil core from the respective 6 inch sampling depth at each sampling point.

Remove the soil core from the probe into a plastic bucket.

Remove big pieces of root, straw etc. from composite sample and mix thoroughly to produce a consistent sample.

Scan three different areas of sample using the NutriScan, to ensure consistency in the soil test result.

Receive results within minutes.

Soil Test Interpretation –
What do the numbers mean?

Soil test interpretation can be a daunting task; however, we have broken it into small bite-sized sections. Along with the actual soil parameter values, we have also provided a simple traffic light system to help you easily identify problem areas.

The Traffic light system – green represents numbers in the optimal range, yellow is above optimal range, and red is below the optimal range. Results are given in parts per million (PPM) unless otherwise indicated. If needed, this table can be used to convert ppm to lb/ac for each 6-inch sample depth.

Conversion to pounds per acre

NutriScan Nitrate PPM x **2** = #/ac of available Nitrate N
NutriScan Phosphorus Olsen PPM x **2.48** = #/ac P_2O_5 (Alkaline Soils)
NutriScan Phosphorus Bray PPM x **1.36** = #/ac P_2O_5 (Acidic Soils)
NutriScan Potassium - (exch.) PPM x **1.85** = #/ac K_2O
NutriScan Total-Sulphur PPM x **0.6** = #/ac of available Sulphate

Soil Physical and Chemical Properties

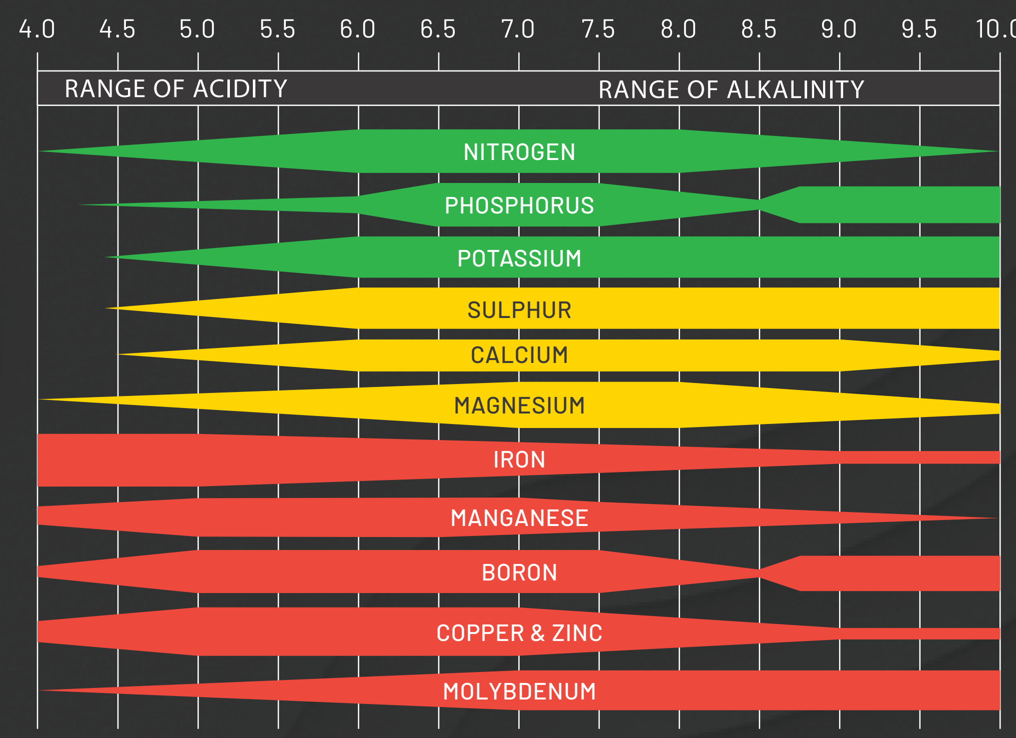
Test	Low	Optimum	High
pH	0 - 6.1	6.2 - 7.1	7.2 +
CEC	0 - 11.9	12.0 - 32.0	32.1 +
%OM	0 - 2.3	2.4 - 9.2	9.3 +
EC	-	-	-

*Note: Numbers referenced above are NutriScan Attention Levels (2024)

This grouping of the physical and chemical properties helps us to understand the soil's inherent ability to grow crops. Fields with greater inherent productivity should have higher yield goals than lower productivity fields. The more green lights, the more inherently productive your field; the more red/yellow lights, the more factors that are limiting yield potential regardless of the nutrients amounts applied.

We can use these factors to compare fields or zones and to answer why one field consistently perform better than another in terms of yield, quality, maturity, etc. Some properties such as pH, Electrical Conductivity (EC) and Organic Matter (OM) can be improved through management over time; however, Cation Exchange Capacity (CEC) remains the same.

Effect of Soil pH of Nutrient Availability



This figure shows that if soil pH is not within the proper range – 6.2 to 7.1 for most crops – nutrient uptake can be inhibited. The wider the bar the more available a nutrient is at a specific pH. This doesn't mean the nutrient is not in the soil, it just means the soil chemical environment is not suitable for uptake of that nutrient (narrow bar). This usually takes place in highly alkaline (greater than 7.5) or highly acidic (less than 5.5) situations. Outside the desired pH range, it is also possible for some non-essential nutrients to become more available, which can lead to nutrient toxicities. Aluminum (Al) is best known for this at lower pH.

pH – pH affects crop selection and nutrient availability. Nitrogen, Potassium, and Sulphur are less directly affected by soil pH while Phosphorus is directly affected. At higher pH (>7.9), Phosphate tends to become quickly immobilized with Calcium and Magnesium to form less plant available Phosphorus. At low pH, Phosphate reacts with Aluminum and Iron to become immobilized as well. Most of the other nutrients (micronutrients especially) tend to be less available when soil pH is above 7.9 and are optimally available at a slightly acidic pH, 6.3 to 6.8. The exception is Molybdenum, which is unavailable under low pH and more available at moderately alkaline pH values. As pH drops below 5.5, root growth is significantly reduced by toxic Aluminum and Manganese levels.

CEC – Cation Exchange Capacity reflects a soil's nutrient and water-holding capacity. It is influenced by soil texture and Organic Matter levels. Higher Cation Exchange Capacity soils contain more clay, while lower Cation Exchange Capacity soils are sandier. The higher the Cation Exchange Capacity, the better the soil is at retaining water and nutrients.

OM - Organic Matter is made of living and dead plant, animal, and microbial residues in the soil. It stores nutrients, increases Cation Exchange Capacity levels, holds 6 times its weight in water, encourages root and biological growth and helps to reduce soil compaction and crusting.

EC - Electrical Conductivity is a proxy for salinity. Salts in the soil can limit crop selection and reduce crop water use efficiency.

Nitrogen (N) and Sulphur (S)

Test	Low	Optimum	High
Nitrate (ppm)	**	**	**
Potential Mineralizable Nitrogen	**	**	**
Total Sulphur (ppm)	0 - 99	100 - 200	201 +

*Note: Numbers referenced above are NutriScan Attention Levels (2024)

** Nitrogen fertilizer rates are calculated based on yield goal, crop nutrient requirements, soil test Nitrogen, Nitrogen release from Organic Matter and PMN.

Soil Test Nitrogen - Nitrate (NO_3^-) – Nitrate is an inorganic form of Nitrogen (N) which can be directly absorbed by the plant. Soil Nitrate can be released by decomposing plant residues and animal manure/compost, added through synthetic fertilizers and/or directly fixed from atmospheric Nitrogen. Soil Nitrate concentration can vary a lot from year to year. In addition, the time of year the sample is taken will vary Nitrate concentrations due to differing levels of soil moisture, temperature and microbial activity.

Potential Mineralizable Nitrogen (PMN) – Potentially Mineralizable Nitrogen (PMN) is an indicator of the capacity of the soil biota community to convert (mineralize) Nitrogen tied up in organic residues into the plant available form.

Organic Matter (OM) – Nitrogen, Sulphur and Boron are released from the Organic Matter over the growing season, contributing to the total amount of nitrogen provided by the soil.

Estimated Nitrogen Release (ENR) – ENR is an estimation of the Nitrogen released per %OM over the growing season. This is based on local climate, soil type and cropping system. On average, 1% Organic Matter contributes 6 lbs. of Nitrate Nitrogen (e.g., For a 3% Organic Matter soil its ENR = 3% OM x 6 lbs. Nitrate N = 18 lbs. Nitrate N).

Total Sulphur (S) – Sulphur can be extremely variable across the field and some areas contain extremely high levels but are not necessarily plant available. A soil core from one of these areas could alter the results leading us to a false conclusion that Sulphur is not needed. Therefore, even if soil test Sulphate is high from your sample, your field may still have Sulphur deficient spots. Currently, NutriScan generates a Sulphate recommendation using yield goal, crop nutrient uptake and crop removal. Due to high Sulphur variability, the N:S ratio can be a better base to build a soil recommendations from. It is recommended to maintain a N:S ratio of 5-6:1 for canola and 8-10:1 for cereals.

Phosphorus (P)

Test	Low	Optimum	High
Olsen P (ppm)	0 - 25	26 - 45	46 +
Bray - 1 (ppm)	0 - 57	58 - 88	89 +

*Note: Numbers referenced above are NutriScan Attention Levels (2024)

We use pH to determine which P test to use:

- pH>7, use Olsen P
- pH<7, use Bray
- pH 7, either

Unlike the straight calculation used for Nitrogen, we use the "likelihood of response" to determine Phosphorus rates. The lower the soil Phosphorus level, the more likely the crop will respond to a Phosphorus application.

The rate of Phosphorus needed is calculated based on yield goal, crop nutrient removals and soil test Phosphorus levels.

Continuous application of rates below removal will result in mining of soil Phosphorus. It can take 4-20 lb/ac of actual Phosphate, above total crop uptake to build soil level by 1 ppm. The heavier the soil, the more Phosphate is required to build levels.

Soil Test Level	Olsen pH>7	Bray[1] pH<7	Likelihood of response to Fert
VL	0 - 9	0 - 25	**VH**
L	10 - 25	26 - 57	**H**
M	26 - 45	58 - 88	**M**
H	46 - 80	89 - 115	**L**
VH	81 +	116 +	**VL**

*Note: Numbers referenced above are NutriScan Attention Levels (2024)

ATP

RESTORE THE BALANCE

The Cations – Potassium (K), Magnesium (Mg) and Calcium (Ca)

Test	Low	Optimum	High
Potassium (ppm)	0 - 199	200 - 400	401 +
%K	0 - 2.9	3.0 - 6.0	6.1 +
K:Mg ratio	0 - 0.26	0.27 - 0.33	0.34 +
Magnesium (ppm)	0 - 239	240 - 320	321 +
%Mg	0 - 10	11 - 18	19 +
Calcium (ppm)	0 - 2945	2946 - 4419	4420 +
%Ca	0 - 69	70 - 85	86 +

*Note: Numbers referenced above are NutriScan Attention Levels (2024)

Potassium (K) - We use 3 parameters to determine the likelihood of a crop response to additional Potassium.

- Amount of soil K (ppm)
- % K
- K:Mg ratio. The K:Mg ratio is calculated by dividing the base saturation of Potassium by the base saturation of Magnesium. It indicates how available the Potassium and Magnesium are in the soil. If the ratio is less than optimal, Magnesium floods the system making it difficult for the plants to take up Potassium. If the ratio is higher than optimal, plants may have trouble accessing Magnesium.
- If one or more of these factors are not optimal, the greater the likelihood of a response to Potassium application. NutriScan uses a combination of yield goal, crop nutrient uptake or removals, soil test Potassium levels and K:Mg ratio to build a Potassium fertilizer recommendation.

Magnesium (Mg) - For Magnesium, we look at 2 factors when determining if we need to apply this nutrient.

- Amount of soil Mg (ppm) - above the optimal (green) range, Magnesium starts to interfere with the uptake of Potassium.
- % Mg - above the optimal (green) range, we start to see soil structure problems - hard, compacted soil causing poor water and root penetration.

Calcium (Ca) - For Calcium, we look at 2 factors when determining if we need to apply this nutrient.

- Almount of soil Ca (ppm) - above the optimal (green) range, Calcium starts to interfere with the uptake of Phosphorus.
- % Ca - below the optimal (green) range, we may start to see the need for a lime application.

The Micronutrients

Micronutrients are vital for the function of the plant, every crop varies in their micronutrient requirements and response. The nutrient responsiveness table below shows the probability of a response of main crops to nutrient application.

Test	Low	Optimum	High
Zinc (ppm)	0 - 3.3	3.4 - 5.0	5.1 +
Manganese (ppm)	0 - 39.9	40.0 - 78.0	78.1 +
Copper (ppm)	0 - 1.7	1.8 - 3.0	3.1 +
Boron (ppm)	0 - 1.3	1.4 - 2.0	2.1 +
Iron (ppm)	0 - 3.3	3.4 - 6.8	6.9 +

*Note: Numbers referenced above are NutriScan Attention Levels (2024)

- As pH increases, micronutrient availability decreases, with the exception of Molybdenum. (Refer to Nutrient Responsiveness chart below).
- To determine if a micronutrient application is required, check:
  - Soil Nutrient levels
  - Yield goal
  - Crop responsiveness to a specific micronutrient

A recommendation and application based upon crop uptake and removal guidelines is not feasible. Therefore, based on the amount of micronutrients in the soil, and the crop responsiveness, NutriScan recommends micronutrients in increments of 1 lb/ac. Micronutrients can be applied to the crop through soil or foliar application.

Nutrient Responsiveness

		Canola	Cereals	Soybean	Pulse	Corn
N	Nitrogen	high	high	medium	medium	high
P	Phosphorus	medium	high	high	high	high
K	Potassium	medium	medium	high	high	high
Ca	Calcium	medium	low	medium	medium	low
Mg	Magnesium	high	high	high	high	high
S	Sulphur	high	medium	high	high	medium
Zn	Zinc	high	high	medium	high	high
Mn	Manganese	high	high	medium	high	high
Cu	Copper	medium	high	medium	medium	medium
B	Boron	high	low	high	high	low
Fe	Iron	high	medium	high	high	medium
Mo	Molybdenum	high	high	medium	medium	high
Ni	Nickel	medium	medium	high	high	medium
Cl	Chloride	medium	high	medium	medium	high

Go to **ATPag.com** to access the Nutrient Uptake and Removal Tool

Nutrient uptake is the total amount of each nutrient required by the crop to complete its life cycle at a given yield goal. This includes nutrients contained in both the straw and harvested portion (grain) of the crop.

Nutrient removal is the amount of each nutrient in the harvested material removed from the field.

NutriScan **Recommendation Philosophy**

NutriScan recommendations are based off yield targets, crop nutrient uptake and removal guidelines from the International Plant Nutrition Institute (IPNI); while attempting to either build or maintain optimal nutrition levels in the soil.

If soil test values are low, crop uptake values are used plus an additional amount to help increase soil nutrient levels. If soil test values are high, then crop removal numbers are generally used.

Crop Nutrient **Uptake and Removal**

		Pounds of Actual Macronutrients						Grams of Actual Micronutrients				
Crop System		N	P	K	S	Ca	Mg	Zn	Mn	Cu	B	Fe
GRAINS												
Spring Wheat (Per Bushel)	Uptake	2.32	0.88	2.00	0.25	0.19	0.17	3.46	2.03	0.24	1.67	8.48
	Removal	1.65	0.65	0.48	0.13	0.002	0.09	1.55	1.07	0.12	0.48	3.58
Winter Wheat (Per Bushel)	Uptake	1.90	0.68	1.42	0.20	0.16	0.08	2.96	2.96	0.29	1.67	10.70
	Removal	1.20	0.50	0.34	0.14	0.002	0.08	1.33	1.56	0.14	0.48	4.51
Barley (Per Bushel)	Uptake	1.53	0.61	1.46	0.18	0.11	0.08	1.24	0.62	0.19	1.34	3.53
	Removal	1.06	0.46	0.34	0.10	0.003	0.05	0.86	0.48	0.14	0.67	2.05
Oats (Per Bushel)	Uptake	1.17	0.45	1.60	0.14	0.13	0.07	0.99	1.04	0.15	1.04	9.12
	Removal	0.68	0.28	0.20	0.05	0.02	0.04	0.69	0.69	0.10	0.54	6.95
Corn (Per Bushel)	Uptake	1.68	0.69	1.41	0.16	0.07	0.16	1.22	1.10	0.20	0.47	3.02
	Removal	1.07	0.48	0.30	0.07	0.001	0.07	0.96	0.12	0.06	0.15	0.76
Fall Rye (Per Bushel)	Uptake	1.70	0.82	2.33	0.29	0.26	0.14					
	Removal	1.14	0.45	0.36	0.09	0.06	0.08					
OILSEEDS												
Canola (Per Bushel)	Uptake	3.51	1.63	2.54	0.60	1.22	0.35	3.58	1.67	0.60	3.70	20.53
	Removal	2.11	1.14	0.57	0.34	0.13	0.15	1.31	0.95	0.12	1.07	14.32
Flax (Per Bushel)	Uptake	3.16	0.92	2.00	0.63	0.55	0.36	3.15	1.76	0.88	3.02	5.54
	Removal	2.33	0.71	0.67	0.25	0.14	0.22	2.39	0.63	0.25	0.76	2.65
Sunflower (Per LB)	Uptake	0.0410	0.0140	0.0220	0.0045	0.0370	0.0190	0.0265	0.0421	0.0168	0.0626	0.1203
	Removal	0.0300	0.0090	0.0065	0.0025	0.0020	0.0033	0.0180	0.0084	0.0084	0.0096	0.0180
PULSE CROPS												
Peas (Per Bushel)	Uptake	3.36	0.92	3.00	0.28	0.93	0.16	1.65	0.76	0.34	1.58	4.60
	Removal	2.58	0.76	0.78	0.14	0.05	0.06	1.24	0.27	0.14	0.48	1.99
Lentils (Per LB)	Uptake	0.0627	0.0138	0.0433	0.0050	0.0123	0.0025	0.0220	0.0127	0.0077		
	Removal	0.0420	0.0105	0.0183	0.0028	0.0007	0.0008	0.0165	0.0045	0.0032		
Chickpeas (Per LB)	Uptake	0.0607	0.0113	0.0400	0.0060	0.0260	0.0120	0.0230	0.0317	0.0052		0.3940
	Removal	0.0425	0.0093	0.0175	0.0033	0.0013	0.0037	0.0172	0.0102	0.0022		0.1233
Soybeans (Per Bushel)	Uptake	5.80	1.32	4.40	0.35	2.04	0.67	1.77	4.54	0.49	2.47	13.41
	Removal	3.00	1.00	0.88	0.11	0.11	0.17	1.18	0.69	0.30	0.79	7.10
Dry Beans (Per LB)	Uptake	0.0467	0.0139	0.0395	0.0034	0.0307	0.0071	0.0235	0.0605	0.0034	0.0235	0.2623
	Removal	0.0350	0.0112	0.0188	0.0022	0.0037	0.0022	0.0168	0.0101	0.0024	0.0067	0.0336
SPECIALTY CROPS												
Potatoes (1 - CWT)	Uptake	0.63	0.18	0.82	0.30	0.12	0.09	0.36	2.04	0.16	0.31	3.54
	Removal	0.35	0.10	0.60	0.05	0.001	0.03	0.08	0.1	0.13	0.14	1.46
Sugarbeets (Per Tonne)	Uptake	10.5	3.4	19.25	1.65		3					
	Removal	4.45	2.05	7.25	0.65							
OTHER (Dry Basis)												
Alfalfa	Removal	60	15	63	6.6	30	7					
Grass	Removal	37	11	47	4.67	16.25	4					
Barley Silage	Removal	40	13.33	29.33	4.67							
Corn Silage	Removal	34	14	44	2.8	5	3.25					

Interpreting a NutriScan Report and **Building a Fertilizer Recommendation**

In the soil test results below, you will see a typical NutriScan report. In this section, we will break this soil report down, by nutrient, to help explain and build a fertilizer recommendation.

Fertilization and Management Advice

NUTRISCAN

Company Name
Address
Canada
+1 000-000-0000
00.000000, -0.000000

User : Xxxxxxxx Xxxxxxx

General Information

Sample Number : 000000
Field Name : xxxxxxxxxx xxxxxxx xx
Date : 20XX-00-00
Crop Name : Spring wheat
Field Size : 1 acre

Soil Fertility Status

Parameter	Unit	Analysis Result	Range Low	Range High	Low	Adequate	High
pH (water)	pH Value	7.0	6.2	7.1		■	
Organic matter	%	3.5	2.4	9.2		■	
Organic Carbon	%	2	1.7	4.5		■	
Cation Exchange Capacity	meq/100g	23	12	32		■	
EC	mS/cm	0.13	-	-			
Nitrate	ppm	27	-	-			
Nitrate	lb/acre	55	-	-			
Potentially Mineralizable Nitrogen	ppm	71	-	-			
Phosphorus (Olsen)	ppm	15	26	45	■		
Phosphorus (Bray-1)	ppm	29	58	88	■		
Potassium-(exch.)	ppm	276	200	400		■	
Total Sulphur	ppm	76	100	200	■		
Calcium (-exch.)	ppm	4621	2946	4419			■
Magnesium (-exch.)	ppm	617	240	320			■
% K of CEC	%	2.4	3	6	■		
% Mg of CEC	%	17.6	11	18		■	
% Ca of CEC	%	79.9	70	85		■	
K/Mg	-	0.14	0.27	0.33	■		
Zinc (1M HCL)	ppm	2.8	3.4	5.0	■		
Manganese (1M HCL)	ppm	220.1	40	78			■
Copper (1M HCL)	ppm	2.2	1.8	3.0		■	
Boron (hot water)	ppm	1.6	1.4	2.0		■	
Total Iron	g/kg	21	3.4	6.8			■
Total Aluminium	g/kg	37	87	107	■		
Soil Moisture	%	16.1	10	30			

Soil Physical and Chemical Properties

Macronutrients

Secondary Nutrients

Base Saturations

Micronutrients

Building the Fertilizer **Recommendation**

Yield target = 70 bu/ac
Crop = Spring Wheat

Multiply the targeted yield goal by the uptake and removal values to generate the total amount of each nutrient required to grow the crop.

	lbs/ac					
	N	P_2O_5	K_2O	S	Ca	Mg
Uptake	162	62	140	18	13	12
Removal	116	46	34	9	0	6
Straw	47	16	106	8	13	6

From this table, we can see that to grow a 70 bu/ac spring wheat crop, it will take a total of 162 lbs. N/ac. The soil test will show us how much we can expect the soil to supply. The shortfall is the fertilizer recommendation.

Determine Soil Physical and Chemical Properties

Parameter	Unit	Analysis Result	Range Low	Range High	Low	Adequate	High
pH (water)	pH Value	7.0	6.2	7.1		■	
Organic matter	%	3.5	2.4	9.2		■	
Cation Exchange Capacity	meq/100g	23	12	32		■	
EC	mS/cm	0.13	-	-			

These parameters are all green lights - meaning there are no soil chemical or physical soil properties limiting yield. A 70 bu/ac yield goal is achievable.

Should any of these parameters show a red light, then the targeted yield goal might need to be reduced or steps need to be taken to mitigate the yield limiting parameter.

Determine Nitrogen (N) and Sulphur (S) Needs

Parameter	Unit	Analysis Result	Range Low	Range High	Low	Adequate	High
Nitrate	ppm	27	-	-			
Nitrate	lb/acre	55	-	-			
Potentially Mineralizable Nitrogen	ppm	71	-	-			
Organic Matter	%	3.5	2.4	9.2		■	
Total Sulphur	ppm	76	100	200	■		

Nitrogen

Available Nitrogen = Nitrate (N lb/ac} + ENR.

Nitrogen fertilizer recommendation = IPNI crop uptake - available Nitrogen.

Sulphur

- Check available Sulphur (ppm) - soil test Sulphur is low (red light).
- Determine the likelihood of a response - there is a high likelihood of response, so use IPNI uptake value.
- Sulphur fertilizer recommendation = IPNI uptake value - soil available Sulphur.

Determine Phosphorus Needs

Parameter	Unit	Analysis Result	Range Low	Range High	Low	Adequate	High
Phosphorus (Olsen)	ppm	15	26	45	■		
Phosphorus (Bray-1)	ppm	29	58	88	■		

- pH >7, so we use the Olsen test.
- Check Available Phosphorus - soil test levels are very low (red light).
- Determine likelihood of a response - there is a high likelihood of response, so use IPNI uptake values.
- Phosphorus fertilizer recommendation = IPNI uptake number - available Phosphorus.

Determine Potassium, Magnesium and Calcium Needs

Parameter	Unit	Analysis Result	Range Low	Range High	Low	Adequate	High
Potassium- (exch.)	ppm	276	200	400		■	
Magnesium - (exch.)	ppm	617	240	320			■
Calcium - (exch.)	ppm	4621	2946	4419			■
%K of CEC	%	2.4	3	6	■		
%Mg of CEC	%	17.6	11	18		■	
% Ca of CEC	%	79.9	70	85		■	
K/Mg	-	0.14	0.27	0.33	■		

Potassium

- K (ppm) - adequate (green light)
- % K - low (red light)
- K:Mg ratio - low (red light)

Determine likelihood of a response - With 2 out of 3 parameters low, the likelihood of a response to Potassium fertilizer is high so IPNI uptake value is used.

Potassium fertilizer recommendation = IPNI uptake value - available Potassium.

Magnesium

- Mg (ppm) - high (yellow light)
- % Mg - adequate (green light)

Determine likelihood of a response - With 2 out of 2 parameters adequate to high, the likelihood of response to Magnesium fertilizer is low - so no additional Magnesium is required.

Calcium

- Ca (ppm) - high (yellow light)
- % Ca - adequate (green light)

Determine likelihood of response - With 2 out of 2 parameters adequate to high, the likelihood of response to Calcium fertilizer is low - no additional Calcium is required.

Determine Micronutrients Needs

Parameter	Unit	Analysis Result	Range Low	Range High	Low	Adequate	High
Zinc (1M HCL)	ppm	2.8	3.4	5.0	■		
Manganese (1M HCL)	ppm	220.1	40	78			■
Copper (1M HCL)	ppm	2.2	1.8	3.0		■	
Boron (hot water)	ppm	1.6	1.4	2.0		■	
Total Iron	g/kg	21	3.4	6.8			■
Total Aluminium	g/kg	37	87	107	■		

- Zinc is low in this test.
- The recommendation to add a specific micronutrient is crop specific.
- Wheat is responsive to Zinc, so the recommendation includes 1 lb/ac.
- While Copper is adequate on this soil test report, wheat is very responsive to Copper.
- The recommendation includes 1 lb/ac of actual Copper.

Soil Test Recommendation for a 70 bu/ac Wheat Crop

Summary recommendation (actual nutrients):

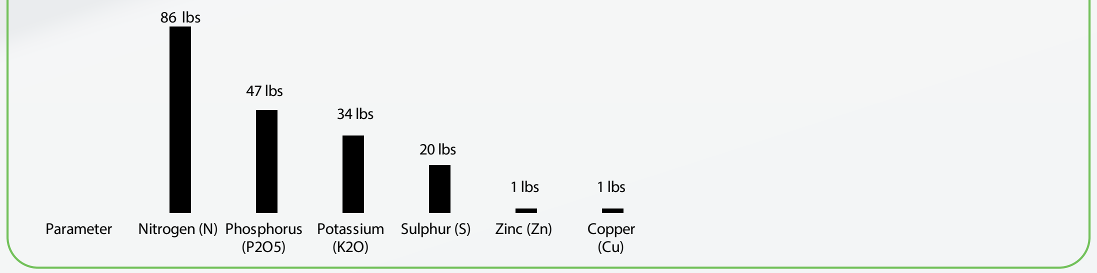
- N = 86 lb/ac
- P_2O_5 = 47 lb/ac
- K_2O = 34 lb/ac
- S = 20 lb/ac
- Zn = 1 lb/ac
- Cu = 1 lb/ac

To be in alignment with the 4R's stewardship program, the next steps would be to look at the right nutrient source, placement, and timing to ensure that the crop has the nutrients it requires when they are needed. This will ensure efficient use of nutrients while reducing the amount potentially lost to the environment and maximizing the return on the nutritional investments.

NutriScan
Fertilizer Recommendation

Yield Target = 70 bu/ac
Crop = Spring Wheat

Actual Nutrient Need for Target Yield per acre (in lbs)



Actual Nutrient Need for Target Yield per acre (in lbs)

Parameter	Recommended Amount
Nitrogen (N)	86 lbs
Phosphorus (P2O5)	47 lbs
Potassium (K2O)	34 lbs
Magnesium oxide (MgO)	0 lbs
Calcium oxide (CaO)	0 lbs
Sulphur (S)	20 lbs
Zinc (Zn)	1 lbs
Iron (Fe)	0 lbs
Copper (Cu)	1 lbs
Manganese (Mn)	0 lbs
Boron (B)	0 lbs

Questionnaire

Question	Answer
What is your yield level?	70 bu/ac

Soil Testing has Never Been This Easy!

Knowing what nutrients are in your soil is fundamental in determining what to invest in, to drive productivity. Today, for a number of reasons, only 34% of the fields in North America are sampled annually, and only 25% of the fields have a complete (macronutrient and micronutrient) analysis performed on them.

To evolve soil testing to support increased crop production, NutriScan is a game changing diagnostic technology that gives you access to real-time, in-field monitoring of your soils nutrient status. This hand-held tool gives you the complete assessment of the nutrient status of your soil in a matter of minutes.

Key Benefits:

- **Timely** - Real-time, in-field results in 5 minutes
- **Complete -** Measures soil properties, macronutrients and micronutrients
- **Simple -** Easy-to-use, handheld tool
- **Proven -** Only sensor technology (near-infrared) calibrated for North American soils
- **Economical** - Fixed cost solution with an annual subscription

Soil Parameters Measured

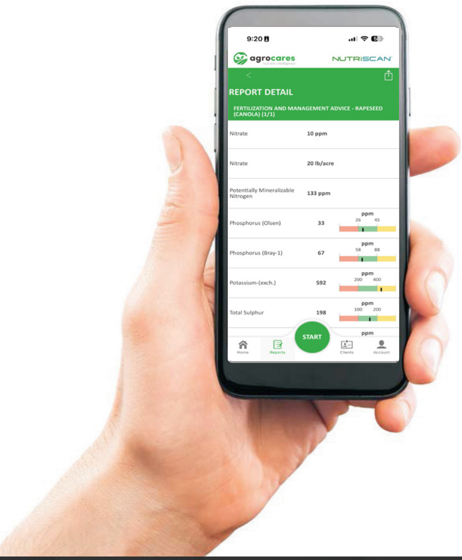
Soil Characteristics	Macronutrients	Micronutrients	Base Saturations
Organic Matter	Nitrogen	Boron	K
Organic Carbon	Phosphorus	Zinc	Mg
pH	Potassium	Manganese	Ca
CEC	Sulphur	Copper	K/Mg
EC	Calcium	Iron	
Soil Moisture	Magnesium	Aluminum	
		Soil Moisture	

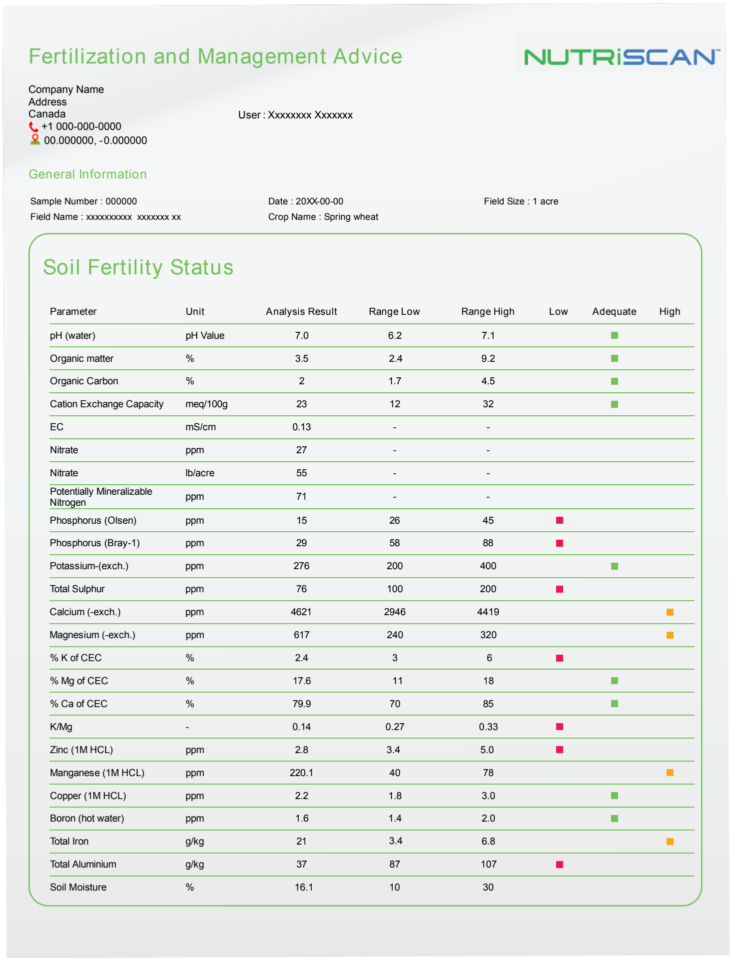
NutriScan Reporting

Reports summarizing the soil fertility status and fertility recommendation can be viewed on the NutriScan app using a compatible smart phone, or online through the NutriScan portal as a PDF or downloaded to Excel.

Each report includes:

- Soil fertility status for soil characteristics, macronutrients and micronutrients
- Organic carbon which can be used to measure carbon sequestration
- Fertility recommendations for target yield
- Summary of the field and crop details
- All soil samples are GPS referenced





Fertilization and Management Advice

NUTRISCAN

Company Name
Address
Canada
+1 000-000-0000
00.000000, -0.000000

User : Xxxxxxxx Xxxxxxx

General Information

Sample Number : 000000
Field Name : xxxxxxxxxx xxxxxxx xx
Date : 20XX-00-00
Crop Name : Spring wheat
Field Size : 1 acre

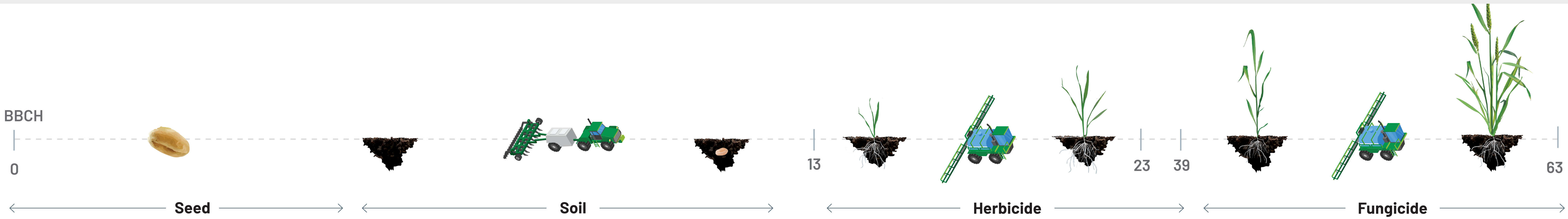
Soil Fertility Status

Parameter	Unit	Analysis Result	Range Low	Range High	Low	Adequate	High
pH (water)	pH Value	7.0	6.2	7.1		■	
Organic matter	%	3.5	2.4	9.2		■	
Organic Carbon	%	2	1.7	4.5		■	
Cation Exchange Capacity	meq/100g	23	12	32		■	
EC	mS/cm	0.13	-	-			
Nitrate	ppm	27	-	-			
Nitrate	lb/acre	55	-	-			
Potentially Mineralizable Nitrogen	ppm	71	-	-			
Phosphorus (Olsen)	ppm	15	26	45	■		
Phosphorus (Bray-1)	ppm	29	58	88	■		
Potassium-(exch.)	ppm	276	200	400		■	
Total Sulphur	ppm	76	100	200	■		
Calcium (-exch.)	ppm	4621	2946	4419			■
Magnesium (-exch.)	ppm	617	240	320			■
% K of CEC	%	2.4	3	6	■		
% Mg of CEC	%	17.6	11	18		■	
% Ca of CEC	%	79.9	70	85		■	
K/Mg	-	0.14	0.27	0.33	■		
Zinc (1M HCL)	ppm	2.8	3.4	5.0	■		
Manganese (1M HCL)	ppm	220.1	40	78			■
Copper (1M HCL)	ppm	2.2	1.8	3.0		■	
Boron (hot water)	ppm	1.6	1.4	2.0		■	
Total Iron	g/kg	21	3.4	6.8			■
Total Aluminium	g/kg	37	87	107	■		
Soil Moisture	%	16.1	10	30			

ATP
RESTORE THE BALANCE

ATP

Product Recommendation by Growth Stage for All Crops



PreCede®

Timing: Seed Treatment **Nutrient Type:** Macronutrient, Micronutrient **Formulation:** Liquid

Canola	5-19-4-4.0Zn-1.0B + Transit-S + Cellburst
Cereal	1-6-0-5.0Zn-2.5Mn-0.125B + Transit-S + Cellburst
Rhizo	Transit-S + Cellburst + TE

Legend

Timing
- Seed Treatment
- Soil
- Foliar

Nutrient Type
- Macronutrient
- Micronutrient

Formulation
- Liquid
- Granular
- Water Soluble

BA = Biological Activator
TE = Trace Elements

Ruffin-Tuff™

Timing: Soil **Nutrient Type:** Micronutrient **Formulation:** Granular

Zinc 10%	10.0Zn-7.0S	**Manganese 8%**	8.0Mn-6.0S	**Cereal**	4.0Zn-4.0Cu-1.0Mn
Copper 5%	5.0Cu-6.0S	**Crop Mix II**	6.0Zn-3.0Mn-1.5Cu-1.5B-8.0S	**Canola Pulse**	6.0Zn-3.0B-3.0Mn
Iron 10%	10.0Fe-8.0S				

MicroStart

Timing: Soil **Nutrient Type:** Micronutrient **Formulation:** Granular

Boron 10%	10.0B	**Copper Sulphate 25%**	25.0Cu-17.0S
Boron 15%	15.0B	**Manganese Sulphate 32%**	32.0Mn-15.0S
Copper Sulphate 12%	12.0Cu-6.0Zn-13.0S	**Zinc Sulphate 35.5%**	35.5Zn-17.5S
Zinc 20%	20.0Zn-3.0S	**EZ20**	2-0-0-20.0Zn-14.0S

Micro-Che™

Timing: Soil **Nutrient Type:** Micronutrient **Formulation:** Liquid

Zinc 9% Citrate	5-0-0-9.0Zn, 27.3% Citric Acid	**Boron 10%**	4-0-0-10.0B
Zinc 9% EDTA	9-0-0-9.0Zn 40.6% EDTA	**Calcium 3% EDTA**	2-0-0-3Ca, 30% EDTA
Copper 7.5% EDTA	7-0-0-7.5Cu, 34.5%EDTA	**Crop Mix**	5-0-0-6.0Zn-2.0B-1.0Cu
Manganese 6% EDTA	3-0-0-6.0Mn, 35.0%EDTA		

SoyGreen®

Timing: Soil, Foliar **Nutrient Type:** Micronutrient **Formulation:** Liquid, Granular

Liquid	1.8Fe, ortho-ortho EDDHA	**Granular**	2.4Fe, ortho-ortho EDDHA

Soil Macronutrients - Liquid

Timing: Soil **Nutrient Type:** Macronutrient **Formulation:** Liquid

Arise	7-22-4	**Blocker**	5-15-0 + BA
Liquid Potash	3-10-10		

Soil Macronutrients - Dry

Timing: Soil **Nutrient Type:** Macronutrient **Formulation:** Granular

SuperCal 98G	36.0Ca0.5Mg	**SuperCal SO4**	21.0Ca-17.0S

ReLeaf®

Timing: Foliar **Nutrient Type:** Macronutrient, Micronutrient **Formulation:** Liquid

Canola	5-20-5-0.5B-0.2Mn + Transit-S + Cellburst + TE
Cereal	6-18-5-0.1Zn-0.1Mn-0.05Cu-0.05B-0.2Fe + Transit-S + Cellburst
Rhizo	4.0Ca-1.0Mg + Transit-S + Cellburst + TE
Corn	10-14-5-0.05Zn-0.025Mn-0.025Cu-0.025B-0.1Fe + Transit-S + Cellburst
Soybean	2-23-2-0.6S-3.0Mn-1.0Zn + Transit-S + Cellburst + TE

42PHI®

Timing: Foliar **Nutrient Type:** Macronutrient, Micronutrient **Formulation:** Liquid

Canola	2-0-15 - 1.5B + Cellburst
Cereal	0-16-20-0.3Zn + Cellburst
Rhizo	0-26-4-5.0Zn-2.0Mn + Cellburst

NRG™

Timing: Foliar **Nutrient Type:** Macronutrient **Formulation:** Liquid

N	13-10-5 + MicroPak + BA	**CaB**	7-0-0-10.0Ca-2.0B
P	6-26-5 + MicroPak + BA	**Mg**	0-29-5-4.0Mg
KS	10-5-15-6.0S + MicroPak + BA	**Mn**	12-8-4-3.4S-5.0Mn

Kinetic™

Timing: Foliar **Nutrient Type:** Micronutrient **Formulation:** Liquid

Zinc	9.0Zn-3.8S + Transit-S + Cellburst	**Copper**	5.0Cu-2.5S + Transit-S + Cellburst	**Manganese**	5.0Mn-3.0S +Transit-S + Cellburst	**Boron**	10.0B + Transit-S + Cellburst + TE

Water Solubles

Timing: Foliar **Nutrient Type:** Macronutrient **Formulation:** Water Soluble

MKP	0-52-34	**Epsotop**	13.0S-10.0Mg	**Sodium Molybdate**	39.6% Mo

Other Products

N-Fluence	20-0-0 + Transit-S + TE	**ModiphY**	Utility Modifier (Water Conditioner)

Biostimulants

Timing: Seed Treatment, Soil, Foliar **Formulation:** Liquid

Synergro M²	Biological Metabolite	**Convey**	Dissolved Organic Matter (DOM)
Synergro G³	Synergro M² + Humic Acid + $CaSO_4$	**Convey RxZn**	Dissolved Organic Matter (DOM) + 5.0Zn
Cellburst	Ecklonia Maxima	**Convey ACX**	Dissolved Organic Matter (DOM) + Antidusting Agent

Learn more at **atpag.com** or **1.877.538.5511**

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