Understanding the Soil Test Report

Crops absorb the nutrients required from soil in order to grow, so ensuring that your soil is meeting the crops' needs is critical. Having the proper level of nutrients in the soil will help to produce optimum quality yields. Testing your soil at least every three years, if not annually, is the best way to determine if your soil is in the ideal condition for your crop.

Laboratory Services tests soil samples to determine how effectively the soil can grow the crop. By measuring the soil's pH level and plant-available nutrients, lime and fertilizer recommendations can be given. Specific crops require specific nutrient levels.

The soil test is divided into four main sections, as shown on the Sample Soil Test Report. These are

- information on client, sample and field
- results of soil test
- interpretation ratings for nutrient levels
- recommendations for lime and fertilizer applications

Client and Sample Identification

Client number

This is assigned to the producer the first time samples are taken to Laboratory Services. The client number remains the same for future samples.

Accession number

This is the unique identifier assigned by Laboratory Services to a single sample or a set of samples.

Samples reported

This is the date Laboratory Services produced the soil test report.

Samples received

This is the date Laboratory Services receives the samples for analysis.

Lab number

This is assigned by Laboratory Services to an individual sample for tracking and keeping records.

Sample ID

This is assigned to the sample by the client. It's often a name or a number.

Field size (ha)

This is the size of the farm field in hectares (ha). One ha equals 2.47 acres.

Crop to be grown

Recommendations and interpretation ratings are based on the crop that will be grown. This information was reported by the client on the Field Soil Submission Forms available on the department website at http://gov.ns.ca/agri/

Soil Test Results

pH

The soil's level of acidity, or pH, affects the availability of nutrients to the crop.

- The pH scales ranges from 0 to 14, where 7 is neutral, below 7 is acidic, and above 7 is alkaline or basic.
- Each whole unit (1.0) is a ten-fold difference in the level of acidity. For example, pH 5.5 is ten times more acidic than pH 6.5.
- On average, 65 per cent of applied nutrients are available at pH levels below 5.9, and 35 per cent of applied nutrients are available below 5.5.
- Most crops have optimum growth and make maximum use of fertilizers and soil amendments between 6.0 and 7.0. Laboratory Services recommendations are based on increasing the soil pH to 6.5.

NOTE

pH Level

Soil with a pH of 6.0 to 7.0 is best for crop growth and fertilizer use. Aim for a pH of 6.5.

Organic matter (%)

Organic matter is made of living, recently dead, and very dead plant and animal residues in the soil.

- Living—plant roots and living organisms
- Recently dead—newly dead organisms, crop residues, and fresh manure
- Very dead—humus and final breakdown of organic matter

NOTE

Organic matter

Over 3.5% + content in soil has good organic matter levels.

Organic matter is an important soil health indicator as it contributes to the biological, chemical, and physical properties of the soil.

Organic matter facts

- Organic matter stores energy and nutrients.
- It increases cation exchange capacity (CEC) levels
- It holds 6 times its weight in water.
- It encourages good root growth.
- It helps to reduce soil compaction and crusting.

P_2O_5 – phosphorus (kg/ha)

Phosphorus, potassium, and nitrogen are the three major macronutrients required by crops.

Laboratory Services reports phosphorus as an oxide in test results to match how phosphorus in fertilizers is reported.

NOTE

Phosphorus

It takes an input or removal of 3.5 kg per hectare of phosphorus to change the soil test level by 1 kg per hectare.

Phosphorus facts

- Phosphorus is important for seed germination and root development. Fields with low phosphorus levels may not have well-developed root systems, leading to heavily-stressed plants during droughts. These fields will require re-seeding more often.

- It's important for vegetable, fruit and grain maturity and quality.
- It improves nitrogen absorption by the crop.

K_2O – potassium (kg/ha)

Laboratory Services reports potassium in test results as an oxide to match how potassium in fertilizers is reported.

NOTE

Potassium

It takes an input or removal of 4.0 kg per hectare of potassium to change the soil test level by 1 kg

- Potassium is important for over-wintering ability of perennial crops, overall growth and longevity and disease resistance.
- Potassium is important for legumes. Nodules on legume roots are filled with bacteria that fix, or convert, nitrogen into a form that's usable by the plant. When legumes are grown on low-potassium soils, the bacteria can't fix as much nitrogen for the plant.
- Potassium is important for disease resistance and affects the taste and color of fruit and vegetables.
- Research shows that it takes 4.0 kg of potassium, added through nutrients or removed during harvest, to change the soil test level by 1.0 kg/ha.
- Levels of potassium in soil can decrease much more quickly than levels of phosphorus because crops remove significantly more potassium during harvest.

Ca – calcium (ca/ha)

Calcium is a secondary nutrient and is taken up by the crop in amounts similar to phosphorus. If test results show that calcium is low compared to magnesium, calcitic lime should be used to increase the soil pH.

NOTE

Calcitic vs. dolomitic lime

Both calcitic lime and dolomitic lime can be used to increase the pH of soil, making it less acidic. Calcitic lime contains about 40% calcium and very little magnesium. Use calcitic lime if tests show that calcium is low (below 2500 kg per hectare).

Dolomitic lime contains both calcium and magnesium but has higher levels of magnesium. Use dolomitic lime if tests show that magnesium levels are low (below 225 kg per hectare).

Calcium facts

- Calcium is important for cell nutrition.
- It helps plants respond better to environmental and disease stresses.
- It improves plant absorption of other nutrients.

Mg – magnesium (kg/ha)

Soils in Nova Scotia typically have medium to high levels of magnesium. If test results show that magnesium is low, dolomitic lime should be used to increase the soil pH. Commercial fertilizers report the potassium amount in its oxide form, K_2O.

Magnesium facts

- Magnesium is important for plant photosynthesis.
- It helps legume nodules fix nitrogen.
- It helps move phosphorus within the plant.
- It helps prevent livestock disorders such as grass tetany and milk fever in cattle.

Na – sodium (ka/ha)

Sodium is not an important plant nutrient. The soil's percentage of sodium is used to help calculate base saturation. Sodium toxicity can occur if the pH is very high, above 8.3.

S – Sulfur (ka/ha)

Soils in Nova Scotia usually have enough sulphur for crop growth without needing to add more. Sulfur comes naturally from regional rocks and acid rain. Most sulfur is found in organic matter and must be converted to sulphate for the crop to use it.

NOTE

Sulfur *– A level of over 40 kg/ha of sulphur in soil is considered good.*

Sulfur facts

- Sulfur increases protein levels in grain crops.
- It encourages the formation of nodules in legume crops.
- It is part of the compounds that can give the characteristic smell and taste of onions and garlic.

Al – aluminum (ppm)

Aluminum is not an important plant nutrient. But high levels in the soil reduce the availability of phosphorus, sulphur, and other nutrients. Aluminum can become toxic to crop production by damaging root systems at low pH levels, below pH 5.5. Test results show the total extractable aluminum from the sample, not the available aluminum.

Fe – iron (ppm)

Iron levels are usually adequate in the soil even though it has low crop availability.

NOTE

Iron *– Good levels should be between 50 and 100 ppm.*

Iron facts

- Iron is important for crops that prefer acid soils such as blueberries, strawberries, grain, soybeans, and cole crops such as cabbage and broccoli.
- It's an important part of nitrogen-fixing in legume crops.

Mn – manganese (ppm)

Manganese is naturally high in Maritime acidic podzol soils, typical of boreal forests. High levels of organic matter and high pH reduce the availability of manganese.

NOTE

Manganese *– Normal levels are from 40 to 60 ppm.*

Manganese facts

- Manganese increases seed germination rates and reduces time to harvest because it increases phosphorus and calcium availability to the crop.
- A manganese deficiency can be a problem for soybeans if the field has a low level, high pH, and heavy clays in the soil.
- Crops that have a high response to manganese are beans, cereals, soybeans, and vegetables.

Cu – copper (ppm)

Copper is an important nutrient for all animals except sheep, where it is toxic even at low levels. Copper levels are usually lower in soils that are sandy or have low organic matter.

NOTE

Copper *– Low levels are below 0.6 ppm with high levels occurring over 3 ppm.*

Copper facts

- High pH levels and high levels of phosphorus, zinc, and iron will decrease copper uptake in plants.
- Crops that respond to copper are alfalfa, grain, lettuce, onions, beets, spinach, blueberries, watermelons, and tomatoes.
- Some animal manures have high levels of copper from copper foot baths.
- Toxic affects from applying too much copper can last for years.

Zn – zinc (ppm)

Zinc is important for root development. It can be tied up and unavailable to the crop when soil levels of phosphorus are over 1000 kg/ha.

NOTE

Zinc *– Soil levels below 1.0 ppm can be deficient or marginal for sensitive crops.*

Zinc facts

- Zinc affects the rate of maturation of both seed and stalks.
- Crops that respond highly to zinc are corn, beans, onions, and spinach.

B – boron (ppm)

In sensitive crops, boron is important in reducing nutritional disorders that affect marketability. Boron moves easily in the soil so fields with low boron levels should receive annual applications when growing sensitive crops. Most fields in Nova Scotia have low levels of boron.

NOTE

Boron *– It's a fine line between too little and too much boron in soil from one crop to another. One crop won't have enough while another can be harmed.*
Boron is toxic to peas, beans and cucumbers.

Boron facts

- Plant tissue tests can be a better indicator of boron levels than a soil test.
- Boron is most available to crops when soil has a pH of 5 to 7.
- If levels are too low, below 0.5 ppm, sensitive crops should respond if you apply 1.1 to 2.2 kg/ha.
- Vegetables are sensitive to boron, especially root and cole crops. At levels below 0.7, many vegetables need between 1.1 to 3.3 kg/ha of boron.
- Alfalfa grows and survives longer with higher levels between 1-3 ppm.
- Clovers grow best between 0.5-2.0 ppm.
- Grain, corn, and grass grow best between 0.5-1.5 ppm.

Nitrate-N (ppm) and nitrogen (%)

Nitrate-N is the plant-available form of nitrogen that occurs in the soil. This form of nitrogen is readily leached through the soil.

NOTE

Nitrate N and nitrogen (%) tests
You must request this test from Laboratory Services if you want these tests on your samples. They aren't part of the standard sampling package.

Nitrate and nitrogen percentage testing are not a part of the regular soil package. You can request this test from Laboratory Services. The soil sample must be taken immediately to the lab to reduce the amount of nitrogen that is lost from the sample over time.

CEC – Cation Exchange Capacity (meq/100gm)

The Cation Exchange Capacity (CEC) measures the soil's ability to hold and release positively-charged nutrients, called cations. Cations are simply atoms or molecules with a positive electric charge, such as potassium (K), calcium (Ca), magnesium (Mg), and sodium (Na).

NOTE

Soils with low CEC *(1-10 meq/100g):*
- *sandy soils that have low O.M. or clay content*
- *low water holding capacity*
- *ph levels can easily fluctuate therefore requires less lime to change levels.*
- *nutrients can be easily leached*

Soils with high CEC *(11-50 meq/100g)*
- *higher clay and organic content*
- *high water holding capacity*
- *resists changes in pH therefore needs more lime*
- *less susceptible to leaching*

The soil's ability to hold onto these nutrients depends on the soil texture and the amount of organic matter.
- CEC is affected by soil type, pH levels, and organic matter.
- CEC is lower for sandy soils and higher for clay soil.
- The higher the CEC, the higher the clay and organic matter content in the soil.

Base sat. – base saturation

Base saturation can be used as a general indicator of soil fertility.

Base saturation measures the part of the CEC which is occupied by the basic cations (K, Ca, Mg, Na) and by hydrogen (H) by percent.
- Calcium in base saturation ratios should be between 55 to 85 per cent. Most fields that are above 2500 kg/ha (optimum calcium levels) and have a base saturation of around 60 to 70 per cent is optimal.
- Magnesium ratios should be 10 to 12 per cent, usually 200 to 300 kg/ha in fields.
- Potassium ratios should be between 2–5%. If potassium ratios are signficantly higher (and magnesium levels are low) it could cause a disorder in cattle, grass tetany or milk fever. This disorder can be very serious, even fatal if the blood serum magnesium levels in cattle is low. Signs include staggering, convulsions, coma and ultimately death.

NOTE

Calcium
- *55-85% base sat.*
- *Calcium levels at 2500 kg/ha usually have 60-70% base sat.*

Magnesium
- *Optimum level of 200-300 kg/ha usually have 10-12% base sat.*

Potassium
- *2-5% base sat.*

Base saturation numbers can be misleading

- In the past, many believed that fields needed certain ratios in base saturation rates to ensure proper nutrient uptake for the best crop yields. This isn't necessarily true.

- Research in the 1940s suggested that ideal soil levels contained 65 to 75 per cent calcium, 10 to 12 per cent magnesium, and 2 to 5 per cent potassium. There is considerable debate that calcium:magnesium ratios should be from 2-8:1.
- Research from the 1950s to '80s show these ranges have little or no effect in most agricultural soils if it they have good nutrient levels. Use the Base Sat. as an estimate of soil health.

Ratings

Laboratory Services interpretation ratings are based on applying the right amount of lime and fertilizer just for that crop year, rather than building up nutrients in soil over the long-term. The ratings use the probability of increasing crop yields and quality by adding nutrients to the soil.

Laboratory Services recommendations follow the fertilizing the crop approach for the specific crop that was indicated on the Field Soil Submission Form.

NOTE

Laboratory Services Ratings

L- , L, L+	*levels are low*
M-, M, M+	*levels are sufficient*
H-, H, H+	*levels are high*
E	*levels are excessive*

For more information on the Laboratory Services rating system, please see the fact sheet Soil Test Interpretation Ratings for Nova Scotia Crops.

Recommendations

Required lime (t/ha)

This shows the estimated amount of lime in tonnes per hectare that is required to raise the field pH level to 6.5.

- It can take 6-12 months after application before the soil test level rises. pH levels will increase more rapidly if lime is mixed with the soil.
- It is recommended that if applying more than 7-9 tonnes per hectare (3-4 tonnes per acre), divide the amount into two different applications.

Required nutrient or fertilizer (kg/ha)

The fertilizer recommendations are based on the specified crop you plan to grow, and on the soil test nutrient levels.

- The recommendations reported are for nitrogen (N), phosphorus (P2O5), and potassium (K20) in kilograms per hectare (kg/ha) for the specific crop.
- To convert to pounds per acre (lbs/ac), multiply by 0.89.

Questions?

For recommendations for crops that were not specified on the Field Soil Submission Form, contact Laboratory Services, a Certified Nutrient Management Planner or other qualified Agrologist.