BMPs FOR DETERMINING WHAT NUTRIENTS YOU NEED

Poor sampling methods may make test results unreliable. This chapter will show you how to do it right, and how to interpret results.

TESTING FOR NUTRIENTS AND INTERPRETING TEST RESULTS

✔ **Test for nutrient levels and use this information to set fertilizer and manure rates.**

This chapter will explain why this is so important, as well as:

- how to take and handle samples for nutrients
- more about the different tests
- the advantages and disadvantages of several procedures for interpreting the test results.

Basing your applications on a soil test will:

- improve crop growth and standability
- show how nutrient levels change with time
- improve crop tolerance of insects and diseases
- improve crop maturity and quality
- assure optimum yields
- improve profitability
- protect the environment.

Whether it's soil fertility, pH, nitrate levels, plant tissue, manure, or other organic materials, test first. If you add too little, your yields and returns suffer. If you add too much, you've wasted energy, time, and money – and you risk polluting the environment.

Sampling takes time and costs money, but the tests are relatively inexpensive. For example, if a 20-acre field was sampled once every three years at a cost of $15/analysis, the cost per acre per year would be $0.25.

"Applying fertilizer every year without taking a soil test is like adding a litre of oil to the crankcase before you start the tractor each time. At best, you'll waste some dollars...at worst, you'll damage the engine (your soil), or spill the excess somewhere we don't want it."

– Keith Reid, OMAFRA Soil Fertility Specialist

SOIL TESTING

The best way to estimate the fertility of the soil is through the use of an OMAFRA-accredited soil test. You can't make good decisions for nutrient use without knowing the supply of available nutrients in soil. Soil testing is also the only reliable way to determine soil pH.

✔ **Test every field at least once every three years.** Sandy soils may need to be sampled more frequently, as their nutrient levels and pH change more rapidly.

(The soil test for nitrate-nitrogen is an exception: see page 62).

Soil testing is not an exact measure of soil fertility, but it is the best estimate. In soil testing, chemicals that remove nutrients from the soil sample are used to estimate the nutrients that plants will be able to take up. The procedures used for the basic OMAFRA-accredited soil test (phosphorus, potassium, magnesium, and pH) are well-defined and provide consistent results. OMAFRA-accredited tests for zinc, manganese, and nitrate-nitrogen are also available.

For most other nutrients, soil testing procedures that provide a reliable basis for making fertilizer recommendations for Ontario soils have not been developed.

When fields are soil-tested regularly, changes in nutrient levels over time can be monitored and recorded. If the results of a soil test for a field differ greatly from the trend of previous results, contact the laboratory as soon as the results are received so that your sample can be retested.

Soil testing is a three-stage process.

1. Sample the soil.
2. Get it analyzed.
3. Interpret the results.

Soil testing should be the first step in making a nutrient management plan.

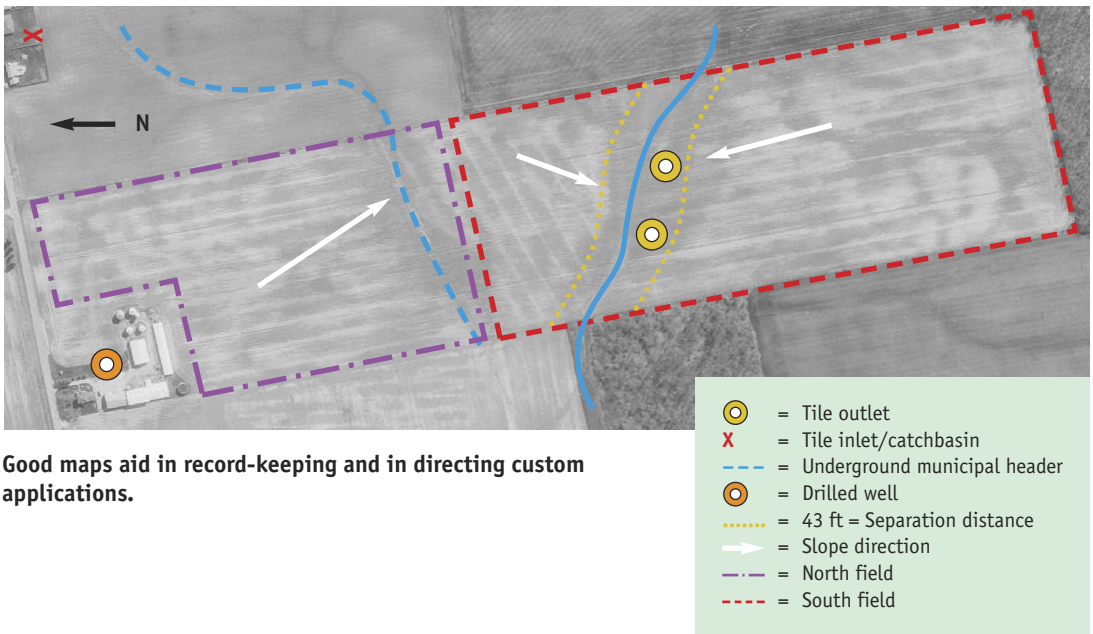
SOIL SAMPLING

Inaccurate soil test results usually occur because samples were taken or prepared improperly. Here's how to do it right.

Planning the Sampling

- ✔ **Prepare a map showing all the areas to be sampled** and assign each a permanent number to use each time the field is sampled.
- ✔ **Where non-agricultural source materials (NASMs) are to be applied, soil sampling locations must be geo-referenced** – you must provide at least the GPS co-ordinates of one corner of the field, and the distance and direction of the area sampled.
- ✔ **Delineate areas that should be sampled separately.**
- ✔ **Prepare maps showing all relevant features to be sampled**, e.g., slopes, watercourses, previous field boundaries.
- ✔ **For each field, maintain a record** of the crops grown each year and the results of previous soil tests.

Maintaining good records of what was grown, where and when, and previous soil test results is well worth the effort in nutrient management.



Good maps aid in record-keeping and in directing custom applications.

Here's how to collect soil samples.

Step 1

Take only 6-inch soil cores. A consistent depth is important.

Step 2

Collect a minimum of one core per acre from random points over the field area. The recommended maximum sampling area is 25 acres (10 ha) to account for variation in soil fertility within and between fields.

Step 3

Use a clean plastic pail.

Step 4

Break up lumps of soil.

Step 5

Place thoroughly mixed samples directly into a clean sample bag in the field.

Step 6

Label samples according to field name.

Taking samples when the soil is dry enough to mix evenly will give more consistent results.

Timing the Sampling

✔ **Take soil samples when soil is dry enough to crumble easily and mix well**
- ► only a few grams of soil are used in the laboratory, so thorough mixing is critical.

✔ **Air-dry any samples that are too wet to be mixed easily, then mix them**
- ► never heat a soil sample to dry it, because this can affect the availability of several nutrients.

✔ **If possible, sample at the same time of the year and at the same stage of the rotation,** where appropriate
- ► on many farms, sampling after wheat harvest in a corn/soy/wheat rotation is easy to do, easy to remember, and gets the results back in lots of time to plan a fertilizer program.

See the soil nitrate section for specific requirements for soil nitrate testing.

Equipment

✔ **Use a sampling tube**
- ► a tube makes it relatively easy to obtain a core of soil, and consistently sample to the proper depth – usually 15 centimetres (6 in.).

Soil sampling tubes are available from many farm supply outlets and some local Soil and Crop Improvement Associations.

✔ **Collect the cores in a clean, stainless-steel or plastic pail**
- ► don't use a galvanized metal pail because the coating wil contaminate the sample with micronutrients
- ► don't use pails that contained chemicals (e.g., cleansers), as phosphates from detergent residue can also contaminate the sample.

Because soil fertility levels can vary a lot within short distances, the larger the area represented by a sample, the less reliable the results.

Samples can be taken with a shovel or trowel, but a tube is much more convenient.

Eroded areas should be sampled separately.

Sampling Pattern

The sample must truly represent the area being sampled.

✔ **Collect at least 20 cores,** even in small fields.

✔ **Take at least 2 cores per hectare** (or 1 per acre), randomly covering the entire area.

✔ **Limit the area per sample to no more than 10 hectares** (25 acres).

Subdivide larger fields into appropriately sized blocks that can be treated separately if required.

✔ **Avoid taking cores from:**
- ▸ fertilizer bands from the previous year and clumps of manure or crop residues
- ▸ areas where manure, fertilizer or lime were stockpiled
- ▸ old fencerows or barnyards
- ▸ dead furrows or highly eroded areas
- ▸ areas close to roads.

Divide large fields into smaller areas for soil sampling.

Sampling in Variable Fields

Fields with large variations in fertility pose a problem for both sampling and fertilization. Samples that represent the average of the whole field could result in over-fertilization of some areas and under-fertilization of others.

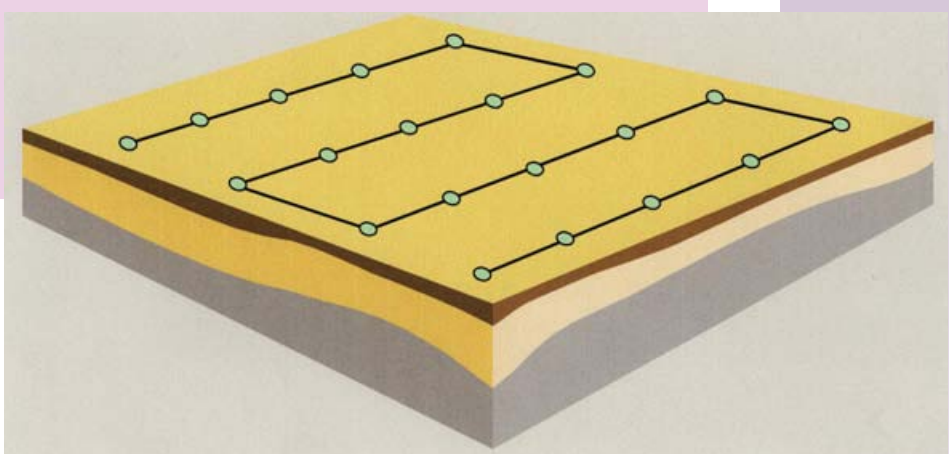
Past fertilizer or manure applications will have the biggest impact on current soil tests, and this usually followed field boundaries.

✔ **In areas that were once several fields, take a separate sample from the area representing each "old" field and submit each separately.**

In variable fields, sample different soil types separately, if possible.

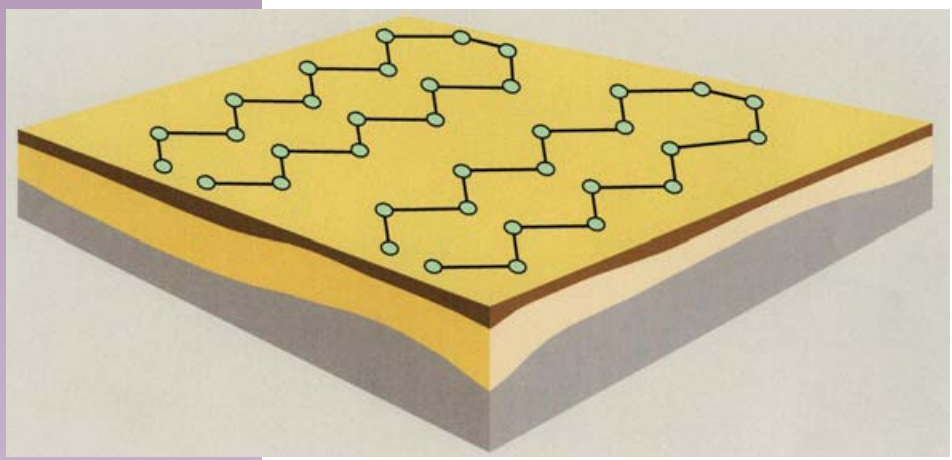
Grid Sampling

In some areas of Ontario, fields are sampled on a grid pattern. Samples are taken at regular intervals and the soil test results are loaded into a computer to generate maps showing fertility ranges across a field. These maps can be used by operators of variable-rate spreaders to apply different rates of fertilizer.



This is what grid sampling looks like in a field.

Natural variability is more difficult to deal with because it's irregular and often unpredictable. Soil pH and soil nitrate-N, in particular, can vary with soil texture and topography. If different zones in a field can be readily identified and fertilized separately, then it's best to take a separate sample from each zone.



Otherwise:

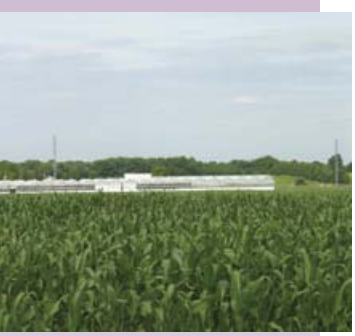
- ► sample the whole area randomly
- ► take separate samples from spots where the crop is doing poorly and submit them separately.

Use a zig-zag pattern to cover evenly the area being sampled.

Submitting Your Samples

Once enough cores have been collected, complete the next steps.

1. Mix the sample thoroughly.
2. Fill the soil sample box with this mixture.
3. Submit the sample to the laboratory of your choice
   - ► information regarding soil testing laboratories can be obtained from your local OMAFRA office or from the OMAFRA website (see back cover)
   - ► for results that are linked to Ontario research and the Ontario fertilizer recommendations, ask for an accredited test from an accredited laboratory.



Testing corn fields for nitrate-nitrogen can help reduce the risk of elevated nitrate levels in groundwater.

ONTARIO SOIL NITRATE-NITROGEN TEST

Soils can vary greatly in their ability to supply nitrogen. The amount of nitrate-nitrogen present in the soil at planting or side-dress time can indicate a soil's capacity to supply nitrogen.

In general, the higher the concentration of nitrate-nitrogen in the soil, the lower the amount of nitrogen required for optimum yields. Soil nitrate levels can be changing rapidly during the pre-side-dress sampling time, so interpretation of sample results should take into account the weather conditions at the time of sampling.

A soil nitrate-nitrogen test is beneficial for:

- ▸ crops that require relatively large amounts of nitrogen
- ▸ crops prone to lodging because of high nitrogen levels
- ▸ fields that have regularly received manure or other materials high in nitrogen
- ▸ fields where nitrogen may be lost through leaching (sands, gravel soils) or through denitrification (imperfect or poorly drained soils).

At time of printing, OMAFRA recommendations based on the nitrate-nitrogen soil test are available only for corn and spring barley.

Sampling Procedures for Nitrate-Nitrogen Soil Tests

Detailed recommendations for taking, handling, and submitting soil samples for nitrate-nitrogen analysis are found in OMAFRA Publication 811, *Agronomy Guide for Field Crops*.

The depth of your sample is important. Nitrate-nitrogen is more mobile in the soil than either phosphorus or potassium. Soil samples taken to a depth of only 15 centimetres (6 in.) are not reliable for nitrate-nitrogen.

✔ **Take a separate, deeper soil sample (30 cm or 1 ft) for the soil nitrate-nitrogen test.**

Caution: microbial action in the sample could change its nitrate content if it is not handled properly.

✔ **Chill or freeze samples** as soon as possible.

✔ **Pack the samples in insulating material when shipping them to the lab**
- ▸ samples may be air-dried by spreading thinly on a plastic sheet and leaving for 1–2 days.

In some situations, nitrogen recommendations based on the soil nitrate-nitrogen test should be modified. The nitrogen in manure, legumes, and other organic matter applied or plowed down in late fall or early spring may not have converted into nitrate and may not be detected by the soil N test. Information will be provided with the test results on how to make appropriate adjustments.

The recommendations based on the soil nitrate-nitrogen test have not yet been adequately evaluated where:

- ▸ legumes or manure were plowed down in the late summer, fall or early spring
- ▸ the crop is to be planted no-till following a perennial legume.

Sampling for nitrate-nitrogen must be deeper than for other soil tests.

In the early spring, soil nitrate-nitrogen tests may not show nitrates from organic materials applied in the fall.

Ontario Accredited Soil Test Laboratories Ltd.

FARM SOIL REPORT

Report 62269 for G Smith
Received 10/09/08
Printed 15/09/08

Soil pH tells you whether you will need lime or not.

Nitrate N is only analyzed on separate, deeper samples.

	Analytical Values					mg/kg	milligrams per
#	Field I.D.	Lab #	pH	BpH	O.M. %	NO_3-N	Phosphorus $NaHCO_3$ Bray P
1	field 1 North half	998701	7.1		3.5		28 H
2	field 1 South half	998702	7.2		3.2		33 VH
3	field 2 North half	998703	6.9		4.0		35 VH
4	field 2 South half	998704	5.7	6.8	2.8		25 H
5	field 3 North half	998705	7.0		3.8		14 M
6	field 3 South half	998706	7.1		3.3		26 H
7	field 1 eroded knoll	998707	7.6		1.8		50 VH

Field ID is critical to match soil test results to the correct fields.

Lime is recommended where the soil pH value indicates it is needed for the crop to be grown. The rate is based on the buffer pH.

		Recommended Application (kg/ha)					Lime Recommendations
Crop to be Grown:	Field I.D.	N	P_2O_5	K_2O	Mn	Zn	(t/ha)
Corn*							
1	field 1 North half	100*	20	0			0
2	field 1 South half	100*	0	0			0
7	field 1 eroded knoll	100*	0	0	0	4	0
Alfalfa (Established)							
3	field 2 North half	0	0	0			0
4	field 2 South half	0	20	0			2
Soybeans							
5	field 3 North half	0	20	30			0
6	field 3 South half	0	0	0			0

Fertilizer recommendations will provide economically optimum results when used with average or above-average management.

**Refer to the Corn N Calculator for specific N recommendations for your soil, yield and previous crop conditions*

litre of soil (ppm)										
K	Mg	Ca	Texture	Mn		Zn		% Base Saturation		
				ppm	Index	ppm	Index	K	Ca	Mg
187 VH	112	2049	M					4.1	8.0	87.9
220 VH	167	2236	M					4.3	10.6	85.1
210 VH	127	1242	M					6.0	11.8	68.9
175 VH	158	897	C					5.2	15.2	51.8
108 VH	118	2710	F					1.9	6.6	91.5
160 VH	120	2814	F					2.7	6.5	90.9
235 VH	150	3257	M	2.5	14	1	14	3.3	6.9	89.8

Most soil tests for micronutrients are unreliable. For manganese and zinc, the soil test is combined with soil pH to index availability.

Base saturation is estimated from the measured cations. It DOES NOT change fertilizer recommendations.

APPROACHES TO MAKING FERTILIZER RECOMMENDATIONS

Growers sometimes receive very different fertilizer recommendations for identical samples sent to different laboratories. Some variation in recommendations can be explained by the use of different testing procedures. Much of it, however, is due to the way in which test results are interpreted. The approach chosen should be appropriate to the yield potential of the crop in question, to the soil, and your farm management.

In this section we'll look at the principles underlying some of the approaches commonly used in Ontario and the strengths and weaknesses of each approach.

There are two major approaches to managing soil-test nutrient levels in fields: **sufficiency** and **build-up and maintenance**.

SUFFICIENCY

The objective of the sufficiency approach is to maximize net returns to fertilizer investments in the year of application. For fertilizer to show a profit, adding it must produce a yield response great enough to more than offset the costs involved in applying it. In other words, the fertilizer must produce additional yield above that possible without an application.

This means that soil tests are generally kept in lower ranges where crop response is expected.

The sufficiency approach carries no long-term financial commitment. The objective is to turn a profit to fertilization in one crop season. It therefore carries a higher risk of losses from under-fertilization.

For this reason, it's a good approach on land that is leased for short terms or when cash flow is limited and no capital exists for longer-term financial investments.

BUILD-UP AND MAINTENANCE

The build-up and maintenance approach seeks to build soil tests to levels where nutrients do not usually limit yields. This is accomplished by adding more nutrients than crops remove. The extra nutrients increase soil test levels. Enough extra is added every year to build soils to desired levels within the desired time frame – typically four years.

This approach accepts reduced or negative net returns to fertilizer additions in the build years in hopes of capturing greater positive net returns in future years, arising from higher, more consistent yields.

Fertilizer is viewed as a long-term investment that carries smaller risk that soil fertility will limit productivity. This approach assumes that as soil fertility levels increase, the probability of crop response to fertilizer declines.

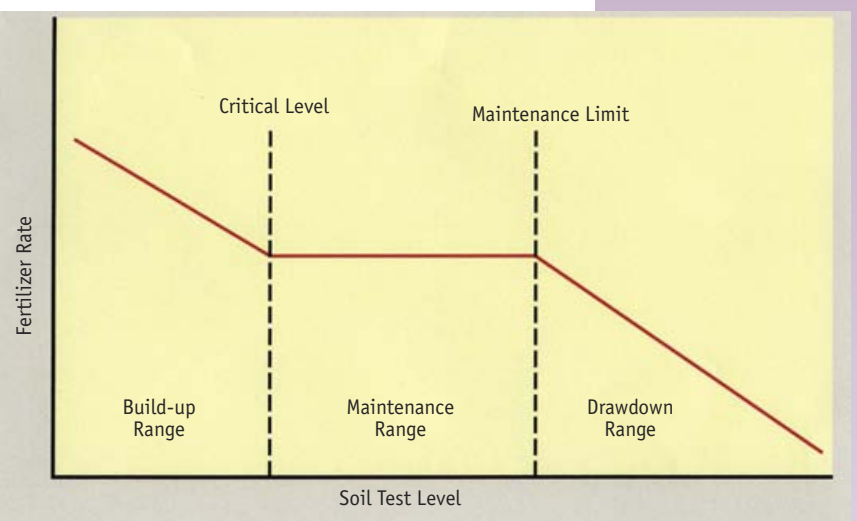
This long-term view is best on land that is owned or under a long-term lease and where cash flow is sufficient to sustain the initial capital investments.

strengths

- maintains soil tests for immobile nutrients at high levels
- ensures the nutrient does not limit crop yields

weaknesses

- rates recommended using this approach during the build-up phase are often higher than the yield increases can pay for in the short term
- not suitable for mobile nutrients (like nitrogen) where the nutrient not utilized in the year of application is subject to loss



In the build-up and maintenance approach, nutrients are applied to meet the crop's annual needs and to raise the soil test into the High rating range. For soils testing in the High range or above, fertilizer is recommended at the rate of crop removal so that soil test levels should not decline.

BASE SATURATION RATIOS

This approach is used mainly for potash recommendations, and occasionally for calcium or magnesium. Nutrients are applied in an attempt to balance potassium, calcium, and magnesium present in the soil within specified proportions.

strength

- recognizes antagonisms that may occur between calcium, magnesium and potassium

weaknesses

- may recommend unrealistically high rates of potassium because many Ontario soils are naturally high in calcium and magnesium
- there is little to no publicly available data to support a specific ratio or saturation percentage to recommend for economic profitability

In well-managed soils, the ratio of potassium:calcium:magnesium can be within a wide range, provided all are adequate, with little or no effect on crop performance.

INTERPRETING THE BASIC ONTARIO SOIL TEST

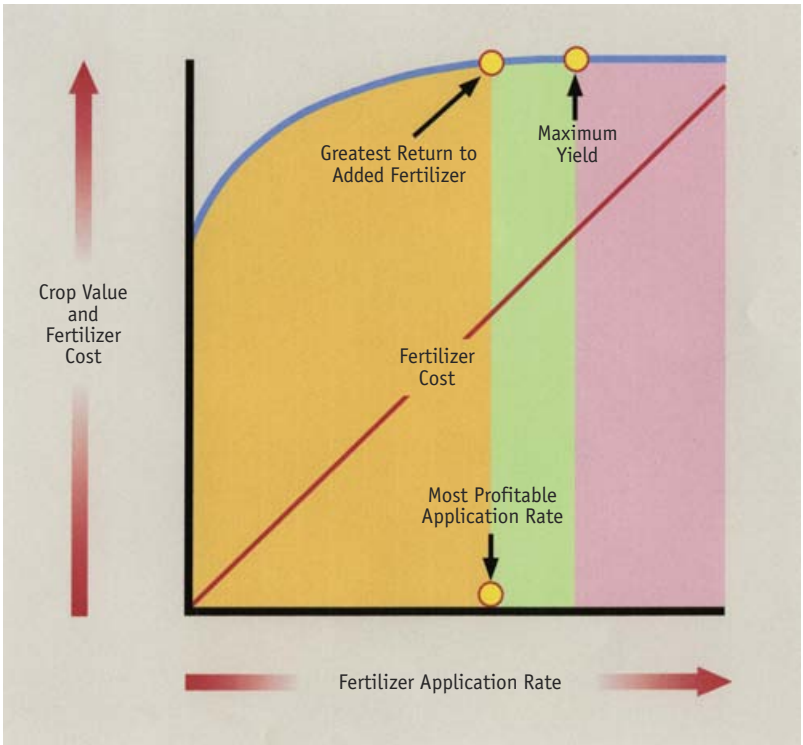
Reports from different soil testing laboratories may vary in format, but most contain the following information:

- **the recommended amount of each nutrient to apply**
  - the suggested rates are expressed in actual nutrients and must be translated into a recommendation for the amount and type of fertilizer material or manure to apply
  - recommendations for lime are usually shown in tonnes per hectare of lime with an index of 75

Results may be presented in many ways. The following units are approximately equal:

- **parts per million (ppm)**
- **milligrams per kilogram (mg/kg)**
- **milligrams per litre (mg/L).**

As the soil test value for a nutrient increases, the application of that nutrient produces less increase in yield, and the most profitable application rate decreases.



The response of crops to added nutrients decreases as the level of fertility is increased.

► **the numerical value of the soil analysis for each nutrient tested**

- ▷ nutrient recommendations are based on this soil test value, using the results from field trials
- ▷ although the soil test value is usually expressed in parts per million (ppm), it is best used as an indicator of the probability of crop response
- ▷ crop nutrient requirements can be determined from tables in OMAFRA crop production recommendations publications, which are listed on page 71
- ▷ by recording soil test values over several years, you can chart changes in soil fertility, as another indicator of the suitability of the rates being applied

► **the soil test rating for a nutrient, as an indicator of how abundant or deficient that nutrient is for the intended crop, and how likely a crop is to respond to adding that nutrient**

- ▷ ratings may change if the crop is changed
- ▷ ratings are also helpful in adjusting fertilizer recommendations, as indicators of whether to increase or decrease application rates from those suggested on the report.

The following chart shows what the ratings indicate for an intended crop.

PROBABILITY OF RESPONSE TO ADDED NUTRIENTS AT DIFFERENT SOIL TEST LEVELS

SOIL TEST VALUE	RESPONSE RATING	PROBABILITY OF RESPONSE	OPTIMUM FERTILIZER RATES ON RESPONSIVE SITES
LOW	High response (HR)	Profitable response in most cases	High
MEDIUM	Medium response (MR)	Profitable response in about half the cases	Medium
HIGH	Low response (LR)	Profitable response rare	Low – starter only may be sufficient
VERY HIGH	Rare response (RR)	Profitable response very rare	Very low – often starter only
VERY HIGH	No or Negative Response (NR)*	Generally not profitable to apply fertilizer*	Nil

* adding nutrients to soils that already have above-optimum levels of nutrients may reduce crop yields or quality by interfering with the uptake of other nutrients

If you're required to complete a Nutrient Management Plan (NMP), you must base your maximum allowable application rate for manure and other organic materials on results from an OMAFRA-accredited soil test. Send your samples to an accredited lab, ask for the accredited tests, and specify the OMAFRA fertilizer recommendations for the report.

Very few fields have uniform nutrient levels. Even with adequate soil test levels, there may be pockets within the field that will respond to added nutrients.

ONTARIO APPROACH

Phosphorus and potassium rates recommended by OMAFRA were developed using a sufficiency-level approach. Research and on-farm experience continue to demonstrate that these rates are sufficient for most situations, even when yield levels are well above average.

The recommendations are based on the results of field trials conducted for each crop to determine the optimum rate for each level of soil fertility. Only the amount that should maximize return to added fertilizer in the current cropping year is recommended.

When nutrients are applied as recommended, this approach will gradually increase soil fertility where recommendations meet or exceed the amount removed by the crop.

Crop yields show a pattern of diminishing returns to increasing rates of applied fertilizer – the amount of extra increase in yield decreases with each extra unit of fertilizer applied, and eventually will not cover the extra cost. The most profitable rate of nutrient application will produce a yield slightly lower than the maximum yield.

On soils with response ratings that are Low Response (LR) or greater, often it does not pay to apply that nutrient. But some growers may consider applying rates up to crop removal, to maintain the High soil test and to cover the possibility that the crop may respond to the nutrient. With a LR rating, you would expect a yield increase less than half the time.

General Recommendations

General recommendations for nutrient requirements for various crops can be found:

- in the appropriate OMAFRA crop recommendation publication (see below)
- through the nutrient management software or workbook (entitled "NMAN") available through OMAFRA, and
- on the OMAFRA website.

These recommendations have been set so that following them will provide the maximum economic return to fertilizer most often.

For greater detail and more crop-specific information, please see these OMAFRA publications:

Publication 611, *Soil Fertility Handbook*
Publication 811, *Agronomy Guide for Field Crops*
Publication 360, *Fruit Production Recommendations*
Publication 363, *Vegetable Production Recommendations*
Publication 370, *Production Recommendations for Greenhouse Floriculture*
Publication 371, *Growing Greenhouse Vegetables*
Publication 384, *Turfgrass Management Recommendations*
Publication 298, *Flue-Cured Tobacco Production Recommendations*
Publication 383, *Nursery and Landscape Plant Production and IPM*
Publication 610, *Production Recommendations for Ginseng.*

For accurate results, it's essential to follow recommended sampling techniques.

TISSUE TESTING

Chemical analysis of plant tissue can be used for diagnosing problems in the field, or for making fertilizer recommendations. While the analytical procedures for each will be the same, the sample collection and the interpretation of the results can be quite different.

Tissue testing can help diagnose and verify site-specific crop performance.

TISSUE TESTING FOR RECOMMENDATIONS

Tissue nutrient levels are affected by:

- **excessive levels of other nutrients**
- **low temperatures**
- **damage from soluble salts**
- **soil acidity**
- **root rot or other diseases**
- **insect damage**
- **compacted soil**
- **drought**
- **flooding.**

Tissue analysis is the most reliable way to estimate the nutrient status of tree fruits or grapes, since these perennial crops have root systems that extend far below the normal depth of soil sampling. A soil sample should be collected at the same time, to relate the nutrient status of the tree to soil conditions like pH.

Tissue analysis is also the most reliable way to identify deficiencies of most micronutrients in crops. It's seldom worthwhile to collect random tissue samples from crops with no noticeable problems, since the micronutrient supply in most of our soils is adequate. Regular tissue testing can be a benefit, however, in areas with a history of deficiencies of a particular micronutrient, or for high-value crops.

This type of test is normally collected at a particular point in the growth of the crop, and the results are compared to tables of "critical" values. Fertilizer is applied if the nutrient concentrations are below the critical value.

Collecting Tissue Samples for Routine Tests

Routine tissue tests are appropriate for many tree fruit crops, where the root system extends far below the top six inches of soil.

Collect samples from across the entire block, segregating different varieties or areas with particular production problems.

Samples must be collected at specific times during the crop's growth to provide meaningful information to guide fertilizer applications.

In some high-value annual crops, regular tissue testing can track nutrient accumulation and identify developing deficiencies so they can be corrected before yield is affected.

Deficiency symptoms often remain on old leaves after the crop has recovered.

To guide nitrogen applications, systems are being developed to use leaf colour or sap nitrate content as indicators of nitrogen status of plants.

TISSUE TESTING TO DIAGNOSE PROBLEMS

Tissue testing is most likely to be helpful where crops are growing poorly, and visual symptoms and the results of soil testing are inconclusive.

Tissue testing only shows the nutrient status of the crop on the day that the sample was taken. It does not indicate whether enough nutrients will be available to maintain the crop through the growing season or if the crop has recovered from an earlier deficiency.

Collect samples from the edge of the affected area. Plants that are slightly affected are often more reliable indicators than are those that are severely stunted or dead.

Interpret the results of tissue tests with caution and only after thoroughly investigating the condition of the crop and soil. Having a nutrient below the Critical level doesn't necessarily mean there will be any benefit to applying a fertilizer containing that nutrient.

Less information is available to help you interpret the results of plant analysis than for soil testing. Sufficient data have been collected for some crops to establish Normal and Critical ranges.

Please note that these guidelines are useful only if the samples have been taken at the same stage of growth and from the same part of the plant as the research samples. Therefore it's essential that the recommended procedures for collecting tissue samples be followed closely.

If a problem appears much before the recommended sampling stage, its cause might be identified by taking separate samples from the problem area and comparing the results with those from a healthy spot some distance away.

Additional information on tissue testing and the interpretation of the results can be found in the OMAFRA publications listed on page 71.

MANURE TESTING

SAMPLING

As with soil testing, proper sampling is the most important aspect of manure testing. The composition of manure can vary significantly from one area or depth of storage to another. Thus, it's essential that the sample represent the entire volume of manure, not just the surface. Be sure to collect sub-samples from several different areas of the storage or load and at varying depths.

Liquid Manure

Step 1

Agitate manure completely before taking samples.

Step 2

Collect a minimum of five grab samples from different parts of the storage. Grab samples can be collected either directly from the storage, or as the storage is being emptied.

Step 3

For large storages, collect at least one additional sub-sample per 200 m^3 of material.

Step 4

Use a clean, non-metallic container (e.g., a 20-litre plastic pail) to collect the samples.

Step 5

Place the grab samples in a larger non-metallic container with a lid (e.g., a plastic garbage can). Keep the container covered except when adding samples.

Step 6

Mix the resulting composite sample thoroughly.

Step 7

Collect the sample to be submitted to the lab from this mixture.

Step 8

Fill sample bottles to no more than one-half to two-thirds capacity, so that there is enough headspace in the bottle to allow for the build-up of pressure and prevent bursting. Normally, one 500 mL sample bottle is sufficient.

Solid Manure

Step 1

Obtain samples from different depths. This is most easily accomplished when the storage is being emptied. If a pile must be sampled at other times, then equipment to take cores from the entire depth of the pile will be necessary.

Step 2

Collect at least 10 grab samples, for piles of 100 m^3 or less. For larger piles, take proportionately more.

Step 3

Place these grab samples in a larger non-metallic container with a lid (e.g., a plastic garbage can), and keep the container covered except when adding samples.

Step 4

Once all the grab samples have been collected, empty them onto a large, clean surface for mixing. Chop and mix the material with a clean shovel, then divide the pile into quarters.

Step 5

Discard two opposite quarters and combine the remaining two. Repeat the process until a composite sample of approximately 1 kg remains.

Sample bottles are available from the laboratories providing manure analysis or from some OMAFRA offices.

SHIPPING

When the sub-samples have been mixed together thoroughly, follow the next five steps.

1. Half-fill a clean, plastic sample bottle and close the lid tightly.
2. Place the bottle in a strong plastic bag and tie bag securely.
3. Pack the bag, bottle, and completed information sheet into a box with sufficient packing to protect them from damage.
4. Keep the sample cool until it can be taken to the lab or shipped by courier
   ► gases produced in samples kept at warm temperatures can cause the bottle to burst.
5. Samples must arrive at the laboratory within two days of shipping
   ► time courier shipments so that there's no risk of the sample being held by the courier over a weekend.