Soil Sampling Procedures

Soil sampling occurs to:

- To develop fertilizer and lime requirements
- To diagnose problem areas
- To monitor nutrient levels

Soil can be sampled at any time that is convenient and field conditions are suitable, but it is often performed in the fall after harvest. This provides a window of opportunity to receive test results, consider recommendations, and make plans fertility plans for the next season. For consistency, it is good practice to sample soils at about the same time each year and following the same crops in the rotation.

Sampling every three years is frequent enough for most soils. However some choose to sample sandy soils or those with high crop removal more frequently. This is particularly true with crops that remove large quantities of potassium such as tomatoes, silage corn and alfalfa.

You can plan to sample one third of the fields each year so that the whole farm is done once every three years, such as after wheat harvest for farms that have a rotation of corn-soy-wheat.

Where visual symptoms occur, sample the area each year until the problem is corrected. Sample the good areas of the field separately from the poor areas to reveal relative differences in fertility, pH or organic matter.

Sampling can be as intensive as economically practical, and within management capabilities. For example, a variable field with high-value crops may benefit from a sample every acre, as long as the ability to provide variable fertilizer rates to every acre exists. Or, a field that is flat and consistent may be best represented by a composite sample taken across 25 acres, that will have a flat rate nutrient application across the whole area. The number of samples required to characterize a field depends on the type of farm and the soil variability and the number and type of crops grown.

Taking Samples

Take separate samples from fields that will be planted into different crops.

In fields containing more that one soil type, sample each type individually. Problem areas should be sampled separately.

Avoid sampling:

- Headlands where overlap from fertilizer applicators is likely
- Field edges along treed areas that may be biased due to annual leaf-fall
- In areas close to gravel or paved roads, since dust will influence soil test values
- In dead furrows, on highly eroded knolls, or where organic waste or lime has been piled, since samples will not be representative of the field.

If you are interested specifically in any of these areas, take a separate sample.

Use Stainless Steel:

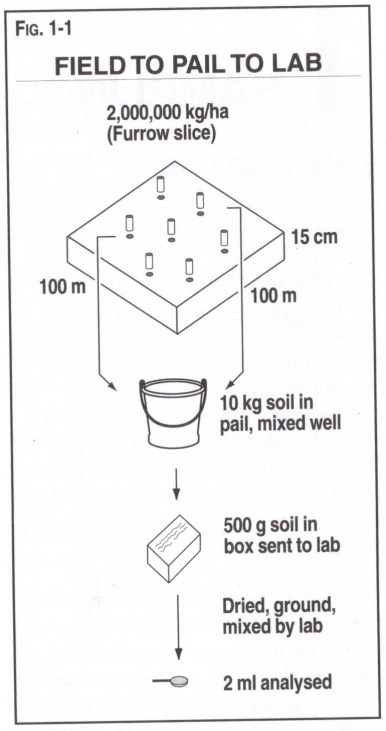
Use a commercial soil probe or auger that is stainless steel rather than galvanized. Pails should be clean and made of plastic or non-galvanized metal, especially if you are sampling for micronutrients. This will avoid contaminating the sample.

The labs prefer to work with a full sample box, so collect enough soil to get a composite sample that will fill the box. (Fig.1-1)

The samples should be taken to a depth of 15 cm (6 in), regardless of the tillage system.

Mix:

Mix the cores together thoroughly in the pail, crushing clods and removing stones and crop residue. Fill the sample box or bag with a representative sample from the soil.



NOTE: It is impossible to split a sample of moist soil into two identical sub samples without special equipment. Much of the variation in results between samples sent to different labs occurs because the samples really are different.

EXCEPTION

Nitrate Samples

Soil nitrate is not included in some regular soil test packages. The nitrogen recommendations included on most soil test reports are based on your crop type and yield goal.

Timing of nitrate samples is critical, as soil nitrate levels will vary throughout the year because of soil temperature and mineralization rates, leaching and microbial tie-up.

You can take samples at planting time for corn or barley or before side-dressing corn. The sample at planting time is slightly more accurate in the absence of manure or legumes, but the sample at side dressing will detect more of the nitrate from organic sources. The choice of sampling before planting or side dressing depends on your time rather than on differences in accuracy.

Nitrate samples must be taken to a greater depth, usually 30 cm (1 ft). Sampling pattern across a field and mixing procedures are the same as any other soil sample.

You must handle nitrate samples with care. If not delivered directly to the laboratory, they should be cooled below 4ºC (40ºF) for transport. This will stop biological activity that converts organic nitrogen or ammonium to nitrate and prevent biased test results.

Keeping Records

Label all soil samples for the lab, and be sure to identify them in such a way that you can later relate the analyses to a particular field represented by the sample. Keep a record for yourself of the samples you have taken and where they were taken on the farm.

Also, keep records on the crops grown in each field, fertilizer applied, weather conditions and final yields. Put this information together with the soil sample analyses. These records will help you detect trends from year to year, make management decisions and pinpoint trouble spots.

No-till and Ridge-till

Fertilizer recommendations are based on the nutrient content of the top 15 cm (6 in) of soil. Therefore, sampling depth for nutrients is the same in reduced tillage systems as in conventional tillage.

The exception to this is pH. Where nitrogen is surface-applied in a no-till system, a shallow layer of acidic soil may develop. A separate, shallow sample (5 cm or 2 in.) can be taken to check for this.

Ridge-till fields pose special problems because nutrient additions are concentrated within the ridges. A sample taken diagonally into the side of the ridge will be most representative of the soil the plant can access.

Sampling Strategies

Take one composite sample for every 10 ha (25 ac) or less. The number of cores in each composite sample should be at least 20, no matter how small the area. This will average out small-scale variations.

Variations in fertility can have a big effect on sampling, since a core taken in a fertilizer band can raise the average of that sample far above the average of the field.

Large or rapid variations in soil fertility over a bigger area can affect crop growth, but it may not be practical to manage this. In an area of 18 m (60 ft) by 30 m (100 ft), nutrient content may vary greatly, but it is smaller than the area covered by one pass of the spreader. In other words, it is smaller than the minimum management area. In general, this variation is important in deciding the number of cores required for a representative sample.

While soil type has an influence on variation, the over-riding factor is management, particularly the amount and type of fertilizer and manure applied to each field over the years. It is impossible to predict what nutrients might be limiting yield in a particular field without a soil test.

The goal of a soil sampling program is to predict the most profitable rate of fertilizer for the field or part of a field. To design a good program, you must know the potential for economic return to management, the probable variability within each field, and the resources available.

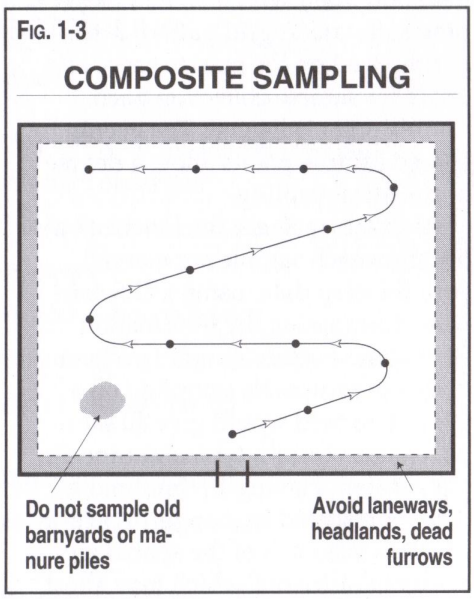
Composite Samples

The most common strategy is to take one composite sample from each field. Because of the historical pattern or crop reduction and past fertilization on most farms, it is inappropriate to include a block larger than 10 ha (25 ac) in a sample. (Fig. 1-3)

This strategy is appropriate where the value of the crop is low or there is a low potential for return to variable fertilization, where there is little variation in soils fertility, or where the entire field is high enough in fertility that no response to fertilizer is expected.

In the case of very low soil test levels from a field, it is generally safe to assume that the entire field will respond to fertilization.

If the test levels of the composite sample are very high, it is likely that while there will be considerable variation, the whole field will be high enough so that even the lowest-testing areas will not respond to added fertilizer.



Sub Samples

In fields with soil tests in the medium to high range, there is more potential for response to variable rate fertilizer application. The challenge is to find an inexpensive way to identify the areas that are responsive.

The most common method of sub sampling fields is to take uniformly spaced samples from within the field and use geo-statistical software to predict the values between the samples. This approach assumes that the samples adequately describe the average value at the point where they were taken and the samples are taken close enough together to produce an accurate picture of the pattern of variability.

Cost, not the amount of variability, has been the driving force in dictating sampling intensity. A 1 ha (2.5 ac) grid has become quite common on Ontario, with some high value crops sampled more intensively.

What Causes Soil to Vary?

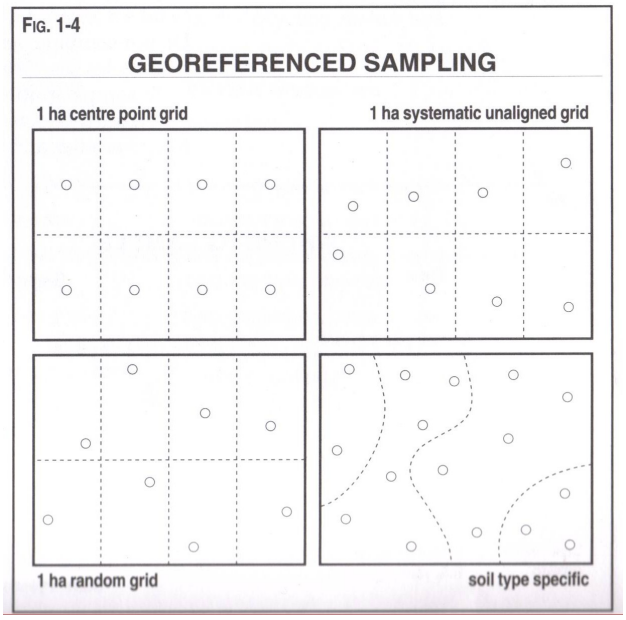
The variability stems from the soil forming factors (parent material, topography, biological activity, climate and time) as well as from tillage and fertilization.

Tillage-induced variation is created when the mouldboard plough and other implements pull soil off the tops of knolls and deposit it downslope. This creates areas on the knolls of low organic matter, low fertility and generally higher pH.

Several years of applying fertilizer and manure unevenly may also create variability in soil fertility. The consolidation of small fields into larger ones makes the variation greater.

Georeferencing

Georeferencing, or systematic soil sampling, uses global position system (GPS) technology and geographic information system (GIS) techniques to collect soil sample data and present it in a map form. (Fig 1-4)



This technique has been called grid sampling. The most common spacing between sample sites has been 1 ha (2.5 ac). Although this data may not fully represent all the detail in a given field, management zones may become evident when the data is combined with other data such as a yield maps or topographic maps.

A common practice is to create a field boundary with GPS and mapping software. A grid pattern is superimposed on the map to serve as a guide for sample collection. Each sample point is logged. The evenly spaced sample points allow a degree of statistical validity.

After lab analysis, the nutrient values from each sample are merged with the map data, using GIS software. Comparing the information from a one-hectare sampling scheme to that of a composite sampling on a 40-hectare field would give 40 sample values versus a typical composite plan of four. Having 10 times more data represented in a map form heightens the awareness of the spatial variability of nutrients, which may affect management decisions.