A Guide to Homeowner
Soil Testing

Sampling, Understanding Your Test Results, Calculating Garden Size and Augmenting Your Soil.

A soil test will reveal the presence of organic matter, the pH level and nutrients that are present in the soil which contribute to the health and success of your gardens.

This pamphlet is designed to answer basic questions, help you collect a soil sample from your garden, and understand the laboratory results. You will then be able to follow the recommendations for a successful growing season. Soil testing is a crucial factor in planting success. Proper nutrition, pH and fertilization rates are key to obtaining success.

How to Collect and Submit a Sample

1. **Get the soil test kit from our office, or bring soil sample to our office.** The kit consists of a sample box, information sheet and instructions. The testing cost covers the standard soil tests for pH, lime requirement, and various specific soil nutrients and requirements for amendments.
2. **Use the right sampling tools.** Using a spade or shovel, be sure to collect a consistent volume of soil at planting depth. Use a clean plastic bucket to collect the soil. Avoid tools that contain Zinc, Chrome or Brass as they may contaminate the sample.
3. **Avoid sampling when the soil is very wet.** If it is necessary to sample very wet soil, spread the sample in a thin layer on a clean sheet of waxed paper or plastic and allow it to dry at room temperature before sending it to the laboratory.
4. **Take 8 to 10 sub-samples from across the entire area**. (Fig. 1). Sample separately all areas differing in plantings, soil, or past management history. Do not sample unusual areas: low or high spots, old fence lines, wet spots, areas near limestone - graveled roads, and trees. To trouble-shoot a specific area with poor plant growth, a separate sample of that area is needed.

- Scrape away the soil surface (mulches, grass, roots, debris).
- Dig a hole to the planting depth. This is usually 4-6 inches for lawn, 6-8 inches for gardens and 10-12 inches for ornamental trees & shrubs.

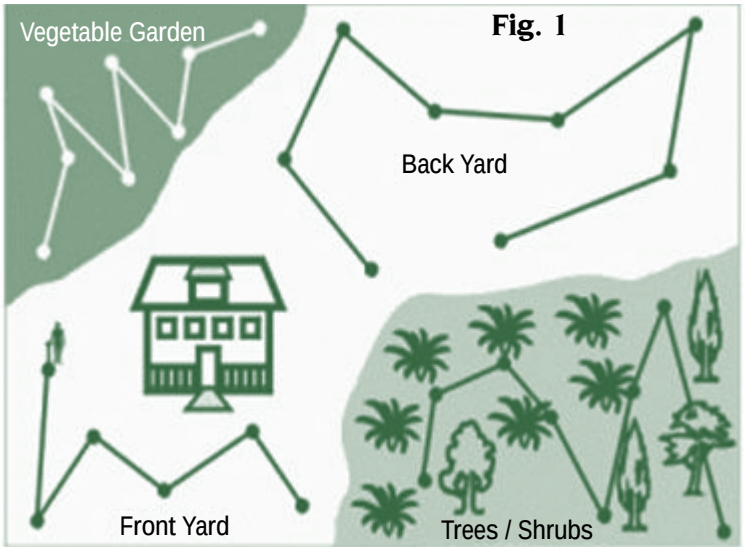

Fig. 1

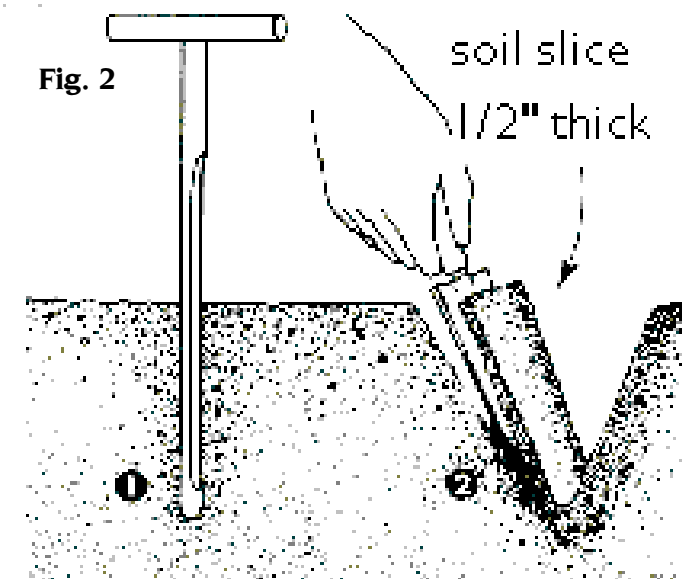

Fig. 2

- Cut a ½ inch-thick slice of soil from the side of the hole that supplies the same quantity of soil from all depths. (See Fig. 2)
- Remove rocks from your sample.

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- Mix all samples thoroughly to form a composite sample. Remove 2 cups as your final sample for submission and place it into your kit's sample box or a plastic bag and bring it to our office.
- Remember that the entire soil testing procedure can never be more accurate than the soil sample you take or the information you supply.

5. **Label the samples.** If submitting more than one sample, name each sample (vegetable garden, front lawn, etc.). (See Figure 1)
6. **Fill out an information sheet for each soil sample.** Follow the instructions. Complete the form fully. (Crop codes are listed on the back of the information sheet). Incomplete or inaccurate information can result in incorrect guidelines or delays. You won't be able to recieve recommendations if you do not use a crop code.
7. **Sending Samples.** There are two options:

- Cornell Cooperative Extension will mail samples brought to our office (fee included in soil test price).
- Mail them yourself. Print your name and complete mailing address on the form and sample box. Place the completed form and sample box into a mailing box. (USPS requires you to box your sample(s) a second time to send through the mail.

8. **Follow recommendations and keep records**. Record-keeping is key to having success with planting over the years.

Your Soil Test Results

The results of your soil test are based on the information you submitted with your soil sample. The results, and our recommendations, are divided into 3 categories. They are explained on the following pages.

1. **Nutrients in your soil.**

Soil should contain 15 nutrients in order to grow healthy plants. 6 of these nutrients are needed in large amounts; 9 of the nutrients are needed in very small amounts. If your soil analysis shows a deficiency in certain nutrients, a fertilizer containing those nutrient(s) will be recommended.

2. **The pH of your soil**

Soil pH determines if the plant can actually absorb the nutrients that are present in the soil. If your soil analysis indicates that your pH is not correct for the plants you wish to grow, either lime or sulfur will be recommended.

3. **Presence of organic matter in your soil.**

Organic matter helps the soil to be more productive. It improves water retention in sandy soils and it improves drainage in clay soils. It makes plants healthier and better able to tolerate drought, insects, and diseases.

Our recommendations for your soil are found on the last page of your soil test report, under comments.

Nutrients in Your Soil

The soil test results show the available plant nutrients in your soil. The nutrients are reported in "pounds per 1000 square feet" or "pounds per 100 square feet." (The standard test results are also shown graphically.) If the soil test determines that fertilizer is needed, the fertilizer application rate will also be given in "pounds per 1000 (or 100) square feet." To determine the square footage of your garden, go to "Measuring the Garden Area" on page 4.

Nutrient Status

A general explanation of "nutrient levels" are as follows:

VERY LOW - The nutrient level is well below normal and requires extra input of nutrients (as fertilizer or a organic nutrient source) for optimum levels over time.

LOW - the nutrient level is below normal. Fertilizer is required for optimum results.

MEDIUM - The nutrient level is sufficient for normal fertilizer rates to produce maximum yields.

HIGH - The nutrient level is adequate for optimum yields. Only a low rate of starter fertilizer at seeding is needed.

VERY HIGH - The nutrient level is higher than required for optimum crop production and no additional fertilizer is needed. Depending on actual test results, high nutrient levels may cause plant injury or interfere with availability or uptake of other nutrients. For phosphorus the probability of phosphorus runoff increases causing pollution.

Fertilizer – How Much to Use

Bags of fertilizer typically contain 3 important nutrients: Nitrogen (N), Phosphorus (P), and Potassium (K). The amount of those nutrients are shown as percentage. For example:

20-10-15

N-P-K

20% Nitrogen 10% Phosphorus 15% Potassium

If it is a 100 lb. bag of fertilizer, there is 20 lb. of Nitrogen, 10 lb. of Phosphorus and 15 lb. of Potassium.

From your soil test recommendations, you can calculate how many pounds of fertilizer you need to apply to an entire area.

$$\frac{\text{Amount of Fertilizer Recommended}}{\text{\% Fertilizer}} \times 100 = \text{Amount of Fertilizer to Apply per 1000 sq. ft.}$$

For example, if the recommendation is 3 lb. of N per 1000 Square ft. and your fertilizer is 20-10-15, you have to divide the 3 lb. N by 20. Next, multiply that result by 100. The result is the amount of 20-10-15 to apply per 1000 square ft. to get 3 lb. N per 1000 square ft.

3/20 x 100= 15 lb/1000 square ft of 20-10-15

If you also want to know how many lbs. of P and K you are applying, you have to multiply the amount of fertilizer to apply (15 lbs.) times the percentage of P (10), and K (15), then divide the result by 100.

15 x 10/100 = 1.5 lb. of P

15 x 15/100 = 2.25 lb. of K

Fertilizer – When to Apply It

The comments section on the soil test results you receive includes suggested quantities of the more common fertilizer types that may be used. In addition, timing of application necessary to maximize both nutrient utilization and production are given. Where micronutrients or other tests are requested, specific recommendations for these nutrients are printed only if a potential problem exists. No comments are made when the micronutrient level is in the normal or adequate range.

The fertilizer recommendation made for the first year may differ from the second and third year for the same crop. This is because of expected changes in the soil nutrient levels from the recommended fertilizer / lime applications.

Fertilizer recommendations are for the entire year. Typically in lawns that is divided into 2 applications. It is easy to remember this based on Holidays. Memorial Day and between Labor Day and Columbus Day are the best application times for lawn fertilizer.

Correct pH: The Key to Soil Success

Healthy soil contains most or all of the nutrients that are needed for plants. However, in order for plants to actually absorb the nutrients, the soil pH level must be correct. pH indicates the acidity or alkalinity of the soil. It is measured on a scale from 1 to 14 (see the pH scale).

pH Scale

1 2 3 4 5 6 7 8 9 10 11 12 13 14

strong acid (H+) — neutral — strong base (OH-)

Some plants, for example blueberries, do well in acidic soil (at a pH level of 5 or less). Most plants prefer a more neutral soil (at a pH of around 6.2 - 7.2). If the pH of your soil does not meet the pH requirements of the plants you wish to grow, then a soil amendment may be recommended. Adding lime to the soil will make it less acidic, or "sweeter" (more alkaline). Adding sulfur to the soil will make it more acidic. It is important to add only the recommended amounts of lime or sulfur. More is not better!

Lime – How Much to Use

Lime (Calcium carbonate – $CaCO_3$), is a material that decreases soil acidity, making it more alkaline. The source of the lime, depending if it is fast or slow acting, and the type of soil you are applying the lime to, are factors that determine how much lime you have to apply to the soil. Because clay soils have tiny particles, lime will have more particles to react with. Therefore, more lime is needed, for an equivalent reaction, if soil has clay in it.

Lime is available in different forms. It is very important to know which type of lime you are using.

Liming Materials and Neutralizing Value

Source	Calcium Carbonate Equivalent Neutralizing Value (ENV)	Rate of Change
Burned Lime	180	very fast
Hydrated Lime	140	fast
Pelletized Lime	75-95	fast
Limestone	75-95	slow
Dolomitic Limestone**	75-95	slow

** High Magnesium (Mg) levels. Use if Magnesium is low.

Liming power is based on ENV (Equivalent Neutralizing Value) or the liming ability of calcium carbonate.

Soil test results base recommendations on 100% ENV. Based on your choice of liming material, you may have to add more or less of that material to meet what is recommended.

Amount of Lime

$$\frac{\text{Amount of Lime Recommended}}{\text{ENV (\%)}} \times 100 = \text{Amount of Lime to Apply per 1000 sq. ft.}$$

An example would be a recommendation of 50 lbs. of lime/1000 sq ft. at 100% ENV. You select hydrated lime which has an ENV of 140. To meet the recommended rate, follow this formula: (50/140) x 100 =35.7 lbs. per 1000 square ft. On the reverse, if you use lime with an ENV smaller than 100, you will have to add more than recommended.

Lime – When to Apply It

Lime should be applied only when soil testing indicates it is needed. If you make applications yearly, the soil can become very alkaline with time. The best time of the year to apply lime is fall or early spring. It should be applied when soil has been prepared for planting; and although water is required for lime to work in the soil, applying lime into a very wet soil, can be difficult to distribute over the entire area. Lime application rates should never be more than 50 lbs. at any one time, even if more is required. Two applications spring and fall can be done to meet the yearly requirements.

Organic Options

Fertilizer products supplement the nutrients already in the soil. Man-made (non-organic) fertilizers are concentrated and quick acting. When fertilizers are applied to the soil, they act as a short-term nutrient availability for plant uptake. Organic fertilizers release nutrients slowly and usually contain many trace elements your plants need that are not found in most chemical formulations.

If you want to keep nutrients in the soil so that they will be available for long-term plant uptake, you may incorporate organic amendments into the soil. These organic amendments increase soil organic matter content and offer many benefits. They help to make the soil more productive. They improve water retention in sandy soils and they improve drainage in clay soils. They make plants healthier and more able to tolerate drought, insects and diseases. They may also improve the chemical, physical, and biological characteristics of soils. Examples of organic amendments are aged manure, compost and peat.

Manure and compost are good choices. When applying manure, make sure the manure is aged for at least one year and composted if being used on fruits and vegetables. Fresh manure is too high in ammonia and burns plant roots. Compost is also a great organic amendment. It can be purchased or made at home by recycling yard weeds, prunings and clippings.

In general, organic amendments may be applied every year. They may be applied at the time of planting. "Digging in" the amendments is not necessary. Putting a top layer on the soil is found to be effective also.

The application of organic fertilizers, such as compost, manure, and peat moss can be helpful to maintain pH. They can help to avoid the loss of nutrients such as calcium and magnesium which help to maintain the alkalinity of the soil.

Not all organic fertilizers are useful to plants immediately. The soil must be warm enough for organic fertilizers to break down and nutrients to be released. For a quick response, try fish emulsion or seaweed extracts. These are water soluble and instantly available to plants. For early season feeding use foliar (leaf) sprays.

Too much fertilizer can burn plants and leach into the groundwater, causing pollution problems. Organic fertilizers are safer to use because they are not as concentrated as chemical fertilizers.

Measuring the Garden Area

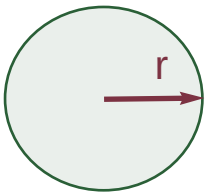
Our recommendations may include the application of fertilizer and/or lime. In order to apply the correct amount of these amendments, you need to calculate the "area" (the square footage size) of the garden or lawn to be amended.

Be sure that all measurements are in the same unit. Using a "foot" (12 inches) as your measuring unit is the easiest; the calculation results will be in "square feet," which is the unit used for fertilizer and lime application rates.

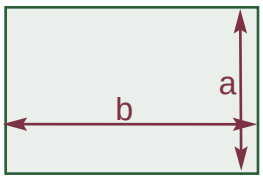
When calculating the "area" of lawn, be sure to subtract the areas that will not receive fertilizer or lime applications, such as any buildings, ponds or roadways.

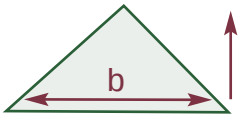
Examples of How to Calculate Garden Size: Remember π is equal to 3.14

Area of a Circle = $\pi \times r^2$
3 ft. radius garden would be
3.14 x 3 x 3 = 28.26 sq. ft.

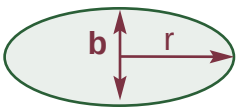


Area of a Square/Rectangle = a x b
3 ft. x 5 ft. garden would be
3 x 5 = 15 sq. ft.





Area of a Triangle = 1/2 b x h
5 ft. wide x 3 ft. tall garden would be
2.5 x 3 = 7.5 sq. ft.



Area of an Ellipse/Oval = π x r x b
3 ft. tall x 5 ft. radius garden would be
3.14 x 5 x 3 = 47.10 sq. ft.