How is your soil? Perhaps one of these amendments or conditioners is what your plants need for healthy growth.

BY LORRAINE FLANIGAN

PLANTS ARE grounded in the soil-they depend on it for support, oxygen, water and nutrients. How well certain soils supply these vital requirements hinges on the interaction of physical, chemical and biological factors. While you don't have to be a soil scientist to know what plants want, it's helpful to understand how soil gives them what they need-and how well your soil dishes it up. Your soil profile is determined by texture, structure, and pH.

TEXTURE

The easiest soil characteristic to determine is texture, which is based o mineral particle size. Texture runs the gamut from sand to silt to clay and everything in between. Each of these extremes has its ben-efits and drawbacks. Sandy soils are coarse-textured, which makes them quick-draining and nutrient-poor, but they're easier to till and, because they warm up quickly in spring, can give plants an early start. Clay is the second important class of soil particles that determine soil texture. Clay particles are fine, which enables these soils to hold water and nutrients well; but this same quality makes it difficult for plants to absorb what nutrients they need. Also, soils high in clay can harden into dense clods, making (hem difficult to work. Silty soils are made of particles that lie somewhere in the middle-coarser than clay but finer than sand. They're rich in nutrients that absorb water well and drain better than clay-based soils.

"The ideal soil texture," says Darrell Bley, an instructor at the Niagara Parks School of Horticulture in Ontario, "is one-third of each-sand, clay and silt-and that texturally is called loam." Although the goal might be to amend your soil to achieve this loamy texture, Bley adds that soil with up to 50 per cent clay content still makes good garden soil, so it's not critical to get the proportions exact.

STRUCTURE

Although texture affects the rate at which water flows through the soil and how easily plants are able to take up nutrients, there's another important component to good soil, and that's structure. Each type of mineral particle-clay, sand and silt-needs to combine with the others to form aggregates and the size, shape and patterns of these aggregates determine a soil's structure. When these aggregates remain stable, the soil is said to be "friable," or crumbly. In this condition, the soil is well drained and well aerated because air and water move efficiently within the spaces (pores) between the aggregates, and plant roots can penetrate the soil easily.

This friable structure is all too easily damaged by walking on or working in soil when it's wet, for exam These activities break down the soil aggregates - and more importantly, pores-compacting clay soils, which blocks the flow of air and water, degrading the water-holding capacity of sandy soils.

What holds these aggregates together and stabilizes them is organic matter, Bley says. As microbial activity in the soil breaks down organic matter, sugars and starches are released as by-products. These act like glue to bind soil particles together to improve structure, increasing soil porosity making nutrients more available roots.

Because of its ability to improve porosity, organic matter-from hoi made compost to leaf 'mould composted manures-is an excel] amendment for both clay and sandy soils. In the former, it improves flow of water, while in sandy soil increases the water-holding capacity

Because organic matter is being continuously broken down, it must be replenished regularly to maintain good soil structure, Bley adds.

PH

The third soil characteristic that affects plant health is pH. The pH scale measures acidity or alkalinity levels and runs from 0, which is the most acidic, to 14-the most alkaline. The ideal range for most plants is near neutral, between 6 and 8. At these levels, nutrients are the most soluble, and therefore better able to be absorbed by roots.

Kits for testing pH are readily available at garden centres. Donna Balzer, horticulturist and author of *Serving Up* No *Cuff Vegetable Gardening,* says, "They are general, but good enough for the home gardener." More precise information may be available from com-mercial soil-testing labs, which generally include pH levels in their reports.

Adding amendments to modify soil pH permanently is very diffi-cult, advises Bley. "As organic matter breaks down, it releases vari-ous acidifying by-products, which gently contribute to a temporary change in the pH. This lasts only until the natural buffering capacity of the soil starts to neutralize the effects Fof the amendmentsl."

WHICH TEST IS FOR YOU?

Once you have your sample (see "How to take a soil sample") you can decide whether to send it to a soil-testing lab for analysis, buy a soil-testing kit at a garden centre or try a few simple soil tests at home.

TESTING FOR TEXTURE

Balzer says the most important thing to sort out is texture-the ratio of sand, silt and clay in the soil-because that will help you under-stand your soil. Commercial tests are available, but they're designed for agriculture and can be expensive.

There's also a home test that's easy and fun to do.

1. Add one cup (250 mL) of soil to a two-cup (500-mL) glass jar. Fill
the jar with water to between two-thirds and three-quarters full. Then, add about one teaspoon (5 mL) of liquid dish detergent.
2. Screw the top on the jar and shake well.

3. Allow the suspended soil to settle. After one minute, sand particles
will settle at the bottom of the jar. Mark the level of the sand with masking tape.
4. After 45 minutes, the silt will settle. Mark the level of silt with an-other strip of masking tape.
5. Within two or three days, the clay particles will settle. (If there's no
change in the level after two days, chances are that most of the clay
has settled.) Mark this level with another strip of masking tape.

To find the percentages of sand, silt and clay, first measure the total height of the soil, from bottom to top. Then, measure the depth of each layer. Divide each of these numbers by the total height of the soil sample. Or, simply eyeball the percentage of each to arrive at a rough ratio of sand, silt and clay.
What's left floating in the water is organic matter. Roughlygauge the amount present in your soil at a glance, or request a report from a soil-testin~ lab, which will provide more precise data if required.

TESTING FOR DEFICIENCIES OR CONTAMINANTS
If your plants are doing poorly, you may want to get your soil tested at a laboratory. The cost is reasonable, and sending a sample to a soil-testing lab can provide useful information about its nutrient makeup, pH levels and percentage of organic matter. (See Sources on page 78 for information on finding soil-testing labs near you.)

If you suspect your soil is contaminated, specialized environmental tests are also available. Nick Schrier, supervisor of the Soil Nutrient

How to take a soil sample
Before amending your soil, it makes sense to know what you're starting with. Whether testing for texture, nutrients or pH, and no matter if the tests are done at home or in a lab, follow these steps for taking soil samples

- Take samples from at least three-and as many as 10-sites on your property.

- With a trowel, dig down between six and eight inches (15 and 20 cm); go deeper if planting trees and shrubs.

- Take a slice of soil from each hole and place them in a bucket Thoroughly mix them together.

- Remove one cup (250 ml) of soil from the bucket and let the sample dry out.

- Seal the dried soil in a plastic bag.

- Repeat drying and bagging for as many samples as you wish to take.

The abbreviation pH stands for "pouvoir Hydrogen," or the power of hydrogen. The pH scale was developed in 1909 by Soren Sorensen, then director of chemistry at Carlsberg - yes, the beer company!

Soil amendments that enhance fertility

In addition to improving soil texture and structure, some soil amendments also add nutrients or make them more available to plants. Here's a selection of these products often found at garden centres

PRODUCT	USES	WHAT IT IS	HOW IT WORKS	COMMENTS
Compost (commercial or homemade)	Increases soil porosity, water retention in sandy soils and drainage in clay soils; excellent mixed into compacted soils; makes nutrients available to plant roots; adds trace elements such as iron, manganese, copper, zinc and boron.	Decomposed organic matter. Municipal com-post may be leaf mould and/or composted, recycled, organic waste.	Binds nutrients to soil, making them available over longer periods; provides food for micro-organisms, contributing to the soil food web.	More municipalities are recycling and composting kitchen waste, which is pasteurized to meet Canadian Council of Ministers of the Environment Guidelines for Compost Quality. While this ensures safety from harmful elements such as heavy metals, it doesn't address suitability for plant health. Look for compost labelled with a CQA (Compost Quality Alliance) logo, which means it complies with plant safety guidelines and is safe for garden use.
Composted manures, including sheep, cow, chicken, horse and "zoo poo"	Improves soil structure; adds nutrients.	Aged animal manure.	Adds organic matter to soils, contributing to the soil food web.	Manures that have not been aged and composted can harm plants; use these only on empty beds, and apply in fall so by spring, the bed will be safe for planting. Manures vary in N-P-K: rabbit, 5-3-2; cow, 3-0.5-2; sheep, 3.5-0.5-2; chicken, 3-1-1
Worm castings	Improves soil structure and water retention.	Ground, dried earthworm manure.	Bacteria in worm's digestive system unlock nutrients bound by chemical interactions in soil, releasing and making them more available to plants.	Vermicompost may be seven times richer in phosphates than is soil and have five times the nitrogen

Soil conditioners that improve soil texture

Walk through any garden centre or nursery and you'll see a dizzying array of soil improvement products. Most are bagged, but some are sold in bulk, too. Here's a roundup of these products, their uses, what the amendments consist of and how to apply them safely and effectively to your garden soil. Over-application can be as problematic as a deficiency.

AMENDMENT	USES	WHAT IS IT	HOW IT WORKS	COMMENTS
Aluminum sulphate	Lowers pH; ben-efits acid-loving plants; changes colour of hy-drangea fldwers to blue.	Powdered bauxite treated with sulphuric acid.	In contact with water, forms aluminum hydroxide and dilute sulphuric acid.	Application rates depend on existing soil pH and the degree it needs to be lowered; apply strictly according to package directions. Over-applying can result in toxic levels of aluminum.
Coir	Improves soil structure.	Processed pith from coconut fibres.	Like any woody, organic matter, it's broken down by bacteria and soil micro-organisms to produce humus; has greater water-holding properties than peat moss; main-tains good air porosity.	Often marketed as a substitute for peat moss. As a woody organic material, it takes longer to break down and may deplete the nitrogen content of the soil during the decomposition process. Darrell Bley recommends using it with compost to offset nutrient deficiencies.
Gypsum	May improve drainage and aeration in clay soils; improves structure in soils with excess magnesium and sodium; mild acidifier; source of calcium.	Powdered rocks or pellets con-taining calcium sulphate.	Pores are created through the chemical exchange of sodium for calcium ions, thereby improving soil structure, especially in sodic soils (where salt content is greater than 15%).	Pellets are easier to apply than powdered form; in either form, must be dug and mixed into soil.
Horticul-tural sand; builder's sand	Aerates and improves drainage.	Coarse, washed, sifted sand. Look for igneous rather than the more commonly sold limestone sand; avoid play sand and beach sand.	Promotes soil aggregation and the formation of small and large pores for the efficient flow of water and air.	Often recommended to amend clay soils, but Bley cautions that adding sand can turn the soil concrete-hard. If using to amend clay, he suggests using igneous, washed and sifted sand combined with organic matter such as compost to stabilize soil particles. A more effective and less expensive way to amend clay soil is to add organic matter. Horticultural sand can be mixed with potting soil and used for rooting and grow-mg succulents.
Iron sulphate; ferrous sulphate	Soil acidifier (in non-chelated form); corrects iron chlorosis.	Granular form for soils; liquid form used as foliar spray.	Enhances production of chlorophyll.	Chelated iron can be used to correct chlorosis without affecting soil pH.
Agricultural or horticultural lime	Calcium carbon-ate acts as a soil sweetener to raise pH in very acidic soils; improves soil structure in clay soils.	Ground limestone available in powdered, pelleted or granular form; when mixed with magnesium, sold as dolomitic limestone	Neutralizes soil acidity, enabling micro-organisms to break down organic matter more efficiently.	Ap~y only if a pH test indicates high soil acidity; lime pellets are easiest to use. Breaks down slowly, so apply in autumn and at no more than a rate of five pounds (2.3 kg) per square foot (0.09 sq. m). Avoid slaked, or hydrated, lime; builder's lime and quicklime are not suitable for the garden and may damage soils and harm plants. Adding organic matter can be as effective in neutralizing soil acidity as lime.
Peat moss	Soil acidifier; improves water retention in sandy soils; aer-ates clay soils.	Decomposed herbaceous matter, compressed and bagged; most common is "short fibre"; "long fibre" is coarser and has a longer term benefit.	Like other organic material, it binds and stabilizes sand, silt and clay particles, promoting the formation of aggregates, which improves soil structure. Provides a food source for soil micro-organisms, contributing to the soil food web.	Thoroughly moisten before applying to prevent leaching of moisture from soil. It is commonly suggested to use peat moss when planting rhododendron, azalea and other acid-loving or ericaceous plants. A mix of equal parts long-fibre peat, coarse, washed sand and chunky bark mulch.
Sulphur	Soil acidifier; improves soil structure.	Available in granular or powdered form.	Lowers pH by breaking down into sulphuric acid; bonds with calcium carbonate to create calcium sul-phate, which helps break up clay soils, making them friable.	Caustic and can be toxic; apply strictly according to directions and at a rate of no more than one pound (450 grams) per 100 square feet (9.29 sq. m) at a time. Jo prevent burned foliage, water thoroughly into soil.