

Improving the soil

The ideal vegetable garden soil is deep, friable, well-drained, and has high organic matter content. Proper soil preparation provides the basis for good seed germination and subsequent growth of garden crops. Careful use of various soil amendments can improve garden soil and provide the best possible starting ground for your crops.

Tilling the soil

It was once assumed that garden soil should be turned over completely every year, mostly for weed and pest control. More recent findings show that this practice is actually detrimental in some cases, causing soil compaction, upsetting balances of microorganisms, and often causing layers of course organic material to be buried below the influence of insects and microbes that would otherwise cause breakdown of the material.

Rotary tilling (roto-tilling) is sufficient for most home gardens as long as plant debris accumulation is not out of hand. Rotary tilling mixes the upper layers of soil rather than completely turning the soil over, and the effects produced are generally desirable. One possible harmful effect of roto-tilling is the formation of a compaction layer just beyond the reach of the tines. Use of deep-rooted cover crops or double-digging can do much to prevent or alleviate this problem. Of course, small gardens can be worked entirely by hand using a spade or garden fork.

Gardeners often wonder whether to till in the spring or fall. Working the soil in the fall has several advantages. It allows earlier spring planting, since the basic soil preparation is already done when spring arrives. Turning under large amounts of organic matter is likely to result in better decomposition when done in the fall since autumn temperatures are higher than those of early spring, and there is more time for the process to take place. Insects, disease organisms, and perennial weeds may be reduced by killing or inactivating them through burial or exposure to harsh winter weather. The physical condition of heavy clay soils may be improved by the alternate freezing

and thawing, which breaks up tightly aggregated particles. Also, snow is trapped between the hills of ploughed soil, so more moisture is retained than on flat, bare ground. Incorporation of limestone or rock fertilizers in the fall gives them time to become integrated with the soil and influence spring plant growth.

Fall tilling alone is not recommended for hillside or steep garden plots, since soil is left exposed all winter, subject to erosion when spring rains come. If a winter cover crop is grown to improve soil and prevent erosion, the ground will have to be tilled in the fall to prepare the soil for seed and again in spring to turn under the green manure. Spring cultivation is better for sandy soils and those where shallow tilling is practiced.



Roto-tilling is usually sufficient for most gardens, and saves labour. However, be careful not to over-till, as this can destroy soil structure. © Lana Bos, Dalhousie.

Whatever the method or timing of tillage, it is extremely important to work only when soil moisture conditions are right. To test, pick up a handful of soil and squeeze it. If it stays in a ball, it is too wet. If it crumbles freely, it should be about right. Excessively dry soil is powdery and clumpy and may be difficult to work. If soil sticks to a shovel or if when spading, the turned surface is shiny and smooth, it is still too wet. Working wet soil can destroy structure, which may take years to rebuild. Ploughing with a tractor when the soil is wet is especially damaging, causing the





This soil stayed in a ball when it was squeezed. It is still too wet to work! © R. Campbell, Dalhousie.

formation of a compaction layer that will inhibit root growth.

Just prior to planting, break up large clods of soil and rake the bed level. Small-seeded vegetables germinate



A final raking breaks up large clods and levels the soil. © Lana Bos, Dalhousie.

best in smooth, fine-surfaced soil. Do not pulverize the seedbed by over tilling. This destroys the structure and promotes crusting and erosion.

Research into 'no till' gardening systems indicates benefits to soil flora and fauna and increases in crop yields. If you are interesting in learning more, try an internet search on 'no till' or 'no dig' gardening.

Improving soil pH

Check soil pH and fertility by having your soil analyzed at least once every three years. See 'Soil science basics' for details on soil sampling.



Pelletized lime is usually more expensive, but easy to apply. © R. Campbell, Dalhousie.

Lime, sulfur, and gypsum are common amendments used to change soil pH. (An 'amendment' is any addition to the soil that improves its physical or chemical condition). The correct soil pH is essential for optimum plant growth. Dolomitic limestone adds calcium and magnesium as it increases pH. Gypsum adds calcium and some sulfur. Sulfur itself may acidify alkaline soil. The amount to add depends on the current and desired pH, one good reason to have garden soil checked periodically.

Wood ashes are often used as a soil amendment. They contain potash (potassium), phosphate, boron, and other elements. Wood ashes can be used to raise soil pH with twice as much ash applied as limestone for the same effect. See 'Plant nutrition' in this guide for more information on correcting soil pH.

Improving soil nutrient levels

Nutrients can be applied in the form of organic materials such as compost, manure, green manure, plant residues, and wood ash. Additional natural source supplements can be purchased at garden centers and by mail-order. These include rock phosphate, Sul-Po-Mag, seaweed, fishmeal, greensand, bone meal, blood meal and feather meal. Check product labels for the type and quantity of nutrients and how they are best applied. These natural source amendments are particularly useful where a minor element deficiency exists, while synthetic fertilizers are generally more concentrated, less expensive, and have quicker results. See 'Plant nutrition' in this guide for more information.



Synthetic fertilizers are concentrated sources of nutrients, but do not improve the soil's physical or biological properties. © R. Campbell, Dalhousie.

Improving soil qualities

In special cases, coarse sand or perlite are added to clays to help improve soil texture (the ratio of sand:silt:clay). However, these inert materials can be expensive and large quantities are needed to do any good. If too little is added, sand can cause clay to react much like concrete.

Compost, manures, and other amendments usually serve the purpose better and more economically by improving the soil structure, that is, the way the soil particles bind together.

Organic matter is a great soil improver for both clay and sandy soils. Good sources of organic matter include manures, leaf mould, and straw. These materials are decomposed in the soil by soil organisms. Various factors, such as moisture, temperature, and nitrogen availability, determine the rate of decomposition through their effects on the organisms. Adequate water must be present, and warm temperatures will increase the rate at which the microbes work. The proper balance of carbon and nitrogen in the material is needed to ensure adequate nutrient availability both to growing plants and the microbes. Adding nitrogen may be necessary if large amounts of undecomposed leaves, straw, or other high-carbon substances are used.

The use of compost is one way to get around the decomposition problem. Compost is usually made by the gardener from plant and/or animal wastes. The basis of the process is the microbial decomposition of mixed, raw, organic materials to a dark, fluffy product resembling rich soil, which is worked into the garden soil (see 'Composting' in this guide).

Animal manures are commonly used as a garden soil amendment. The nutrient content of manure varies. Fresh horse, sheep, rabbit, and poultry manures are quite high in nitrogen and may even burn plants if



High quality compost is decomposed before it is added to the soil.
© Andy Hammermeister, Dalhousie.

applied directly to a growing garden. They are best applied in early fall and tilled under. Manure usually has fewer total nutrients than synthetic fertilizers in terms of N, P and K, but is a valuable soil builder. Unfortunately, manures may be a source of weed seeds; if this is a problem, composting in a hot pile may help. In urban areas, manure can be purchased as a bagged product sold at garden centers.

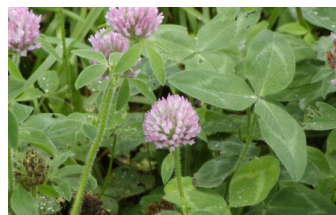
Another source of inexpensive soil builder is the cover crop. Green manures, or cover crops, such as annual rye, ryegrass, buckwheat, and oats, are planted in the



Composted manure can be purchased in bulk by a community garden or a group of gardeners.
© R. Campbell, Dalhousie

garden in the late summer for incorporation in the spring. For best results, seed should be sown four to six weeks before the first frost. In a fall garden, plant cover crops between the rows and in any cleared areas. Cover cropping provides additional organic matter, holds nutrients that might otherwise be lost over winter, and helps reduce erosion. Legume cover crops can increase the amount of nitrogen in the soil and reduce fertilizer needs. A deep-rooted cover crop allowed to grow for a season in problem soil can help break up hardpan and greatly improve tilth. Incorporate green manures at least two weeks before planting vegetables. They should not be allowed to go to seed before incorporation or you will have a weed problem.

The regular addition of manure, compost, cover crops, and other organic materials can raise the soil



Legumes such as clovers add nitrogen and help build the soil. © Andy Hammermeister, Dalhousie.

nutrient and physical level to a point where synthetic fertilizers are no longer needed. This happens through the intrinsic fertilizing value of the amendment, but also through the increased action of microorganisms on soil and humus particles; humic acid (and other acids) helps to release previously locked-up nutrients present in the soil, and the extra surface area provided by humus serves as a reserve, holding nutrient elements until they are needed by plants. This highly desirable soil quality does not come about with a single or even several additions of organic material but rather requires a serious, long-term soil building program. Soil is the base for plant growth and much attention should be paid to getting and keeping it in the best condition possible.

Activity

Familiarize yourself with soil improving products

Use the table to list five of the soil amendments presented in this factsheet, particularly those that address issues you may have in your garden soil. Note what soil condition(s) the amendment is used for. Look for sources of these amendments; gardening stores, catalogues, websites, local farmers, etc. Also note the cost of each amendment.

Amendment	Use	Available from	Cost
1.			
2.			
3.			
4.			
5.			