



Soil Preparation

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

Soil Testing

Check the soil fertility and pH level by having your soil analyzed at least once every three years. Soil pH measures the degree of soil acidity or alkalinity. Vegetables vary to some extent in their requirements, but most garden crops will do well with a soil pH of 6.2 to 6.8. This is a little below neutral or slightly acid (sour). If soil pH is too high or low, poor crop growth will result, largely due to the effects of pH levels on the availability of nutrients to plants. A soil test also gives you an idea of relative soil nutrient levels.

Once you know your soil status in basic nutrients and pH levels, make adjustments by adding required fertilizers and lime (or sulfur). In new garden spots, remove sod with a spade, and use it to patch your lawn or put it in a compost pile to decay. Plow, spade, or rototill the soil. Work only when the soil moisture conditions are right. To test, pick up a handful of soil and squeeze it. If it stays in a mud ball, it is too wet. If it crumbles freely, it should be about right. Too-dry soil is powdery and clumpy and may be difficult to work. Take samples at the surface and at a 2 to 3 inch depth in several locations in your garden plot. If the soil sticks to a shovel, or if the turned surface is shiny and smooth when spading, it is still too wet. Working excessively wet soils can destroy the soil structure, which may take years to rebuild. Plowing wet soil with a tractor is especially damaging, causing the formation of a compaction layer that inhibits root growth. Soils with adequate humus levels generally allow more leeway because of their improved structural qualities.

Just prior to planting, break up large clods of soil and rake the bed level. Small-seeded vegetables germinate best in smooth, fine-surfaced soil. Do not pulverize the seedbed soil; this destroys the structure and promotes crusting and erosion problems.

Tilling the Soil

It was once assumed that gardens should be turned yearly with a moldboard plow, mostly for weed and other pest control. While garden plowing is still a common practice, turning the soil completely over has been found in some

cases to be detrimental, causing soil compaction, upsetting balances of micro-organisms, and often causing layers of coarse organic material to be buried below the influence of insects and microbes which would otherwise cause breakdown of the material. Chisel plowing, which does not have this disruptive effect, is one alternative, but it is limited to sandy or loamy soils, and many farmers who work gardens do not have chisel plows. In addition, gardeners in less-than-rural areas have trouble finding a farmer who will come to plow and disk the garden for a reasonable price, if at all. Rototilling most home gardens is sufficient, as long as plant debris accumulation is not excessive. Rototilling 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 rototilling is the formation of a compaction layer just beyond the reach of the tines. This also occurs at a somewhat deeper level when a moldboard plow is used to the same depth every year. Use of deep-rooted cover crops (see later) or double-digging can do much to prevent or alleviate this problem when it exists. Small gardens can be designed using raised beds which may be worked entirely by hand if the area is small enough.

Gardeners often wonder whether to have plowing or tilling done in the spring or fall. Working the soil in fall has several advantages over the traditional spring plowing. It allows for earlier spring planting, since the basic soil preparation is already done when spring arrives. Turning under large amounts of organic matter in the fall is likely to result in better decomposition 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 roughly plowed 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 into the soil and influence spring plant growth.

Fall plowing alone is not recommended for hillside or steep garden plots, since soil is left exposed all winter and is 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 plowing is better for sandy soils and those where shallow tilling is practiced. Generally, most gardens must be disked or rototilled in the spring to smooth the soil for planting.

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Soil Amendments to Change pH and Nutrient Levels

Lime, sulfur, and gypsum are common amendments used to change the soil pH level. 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 your 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. Ashes should not come into contact with germinating seedlings or plant roots as they may cause root burn. Spread in a thin layer over the winter, and incorporate into the soil; check the pH level yearly if you use wood ashes. Never use coal ashes or large amounts of wood ashes (no more than 20 lbs. per 1000 square feet), as toxicity problems may occur.

Other amendments are added specifically to improve soil nutrient levels. Greensand and granite meal are sources of potassium. Granite meal is finely ground granite rock which releases its potassium slowly. Greensand is relatively low in potassium which is readily dissolved. Neither should be considered a sole nutrient source. Both materials may be hard to find in some areas. Other nutritional amendments that can be purchased for garden use include cottonseed meal, kelp meal, leather meal, and worm castings, as well as an array of synthetic fertilizers. The organic amendments are particularly useful where a trace element deficiency exists, while synthetic fertilizers are generally more available, less expensive, and have quicker results.

Soil Amendments to Improve Soil Qualities

In special cases, coarse sand, vermiculite, and perlite are sometimes added to heavy clays to help improve the soil texture (the ratio of sand, silt, and clay) or structure. However, these inert materials can be expensive, and large quantities are needed to do any good. Composts, manures, and other amendments usually serve the purpose just as well and more economically.

Organic matter is a great soil improver for clay and sandy soils. Good sources of organic matter include manure, leaf mold, sawdust, straw, and others. 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 these 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 decomposing organisms. Adding nitrogen may be necessary if large amounts of undecomposed leaves, straw, sawdust, or other high-carbon substances are used. Nitrogen is used by the decayers to make proteins for their own bodies, and if it is not present in sufficient amounts, the microbes have no

qualms about stealing the plants' share. Generally, fresh green wastes, such as grass clippings, are higher in nitrogen than dry matter.

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. Correct composting is an art which results in a valuable nutrient and humus source for any garden. The basis of the process is the microbial decomposition of mixed, raw organic materials to a dark, fluffy product resembling rich soil, which is then spread and incorporated into the garden soils.

Animal manures are commonly used directly as a garden soil amendment. The value of manure in terms of the nutrients it contains varies. Fresh horse, sheep, rabbit, and poultry manures are quite high in nitrogen and may even "burn" plants if applied directly to a growing garden. They are best applied in the fall and tilled under. Manure usually has fewer total nutrients than synthetic fertilizers in terms of nitrogen, phosphorus, and potassium, but it 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 may be hard to obtain, but country dwellers usually find it plentiful.

Another source of inexpensive soil improvement that should not be underestimated is the cover crop. Green manures, or cover crops, such as annual rye, ryegrass, and oats, are planted in the garden in the fall for incorporation in the spring. For best results, seed should be sown a month before the first killing 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 have been lost over the winter, and reduces erosion and loss of topsoil. 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 a problem soil can help break up a hardpan and greatly improve tilth. Incorporate green manures at least two weeks before planting vegetables; they should not be allowed to go to seed.

The *regular* addition of manures, composts, cover crops, and organic materials can raise the soil's nutrient and physical level to a point at which the addition of synthetic fertilizers is no longer needed, or at least greatly reduced. This comes about not only through the intrinsic fertilizing value of the amendment, but also through the increased action of micro-organisms on soil and humus particles; humic acid (and other acids) helps to release previously "locked-up" nutrients naturally 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 addition(s) of organic material, but rather requires a serious soil-building program. Information is widely available in books and magazine articles on this subject.

Remember, your soil is alive and constantly changing. By keeping it fertile and rich, many of your gardening problems will be diminished. Soil is the base for plant growth, and much attention should be paid to getting and keeping it in the best condition.