HAWAII COOPERATIVE EXTENSION SERVICE
College of Tropical Agriculture and Human Resources
University of Hawaii
GENERAL HOME GARDEN SERIES No. 3

SOILS FOR THE HOME GARDEN

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The basic resource for a successful home garden is the soil, which provides support, nutrients, air, and water for plant growth. If the soil is managed properly, high yields of high-quality vegetables can be expected.

What is Soil?

Soil is a mixture of mineral and organic constituents that are the result of climate and vegetation acting upon parent material over a period of time. Soil is approximately one-half solid material (the mineral and organic matter) and one-half open (pore) space where the air and water are found. The amount of pore space depends upon the texture and structure (arrangement) of the soil particles. If the pore space is too small, water and air move very slowly, resulting in water-logged soils, poor aeration, and poor plant growth. If the pore space is too large, water and air move through the soil very rapidly, resulting in the leaching of soluble plant nutrients and soils that dry out too quickly.

Mineral Matter

Soil is composed of many different minerals of different sizes, and the terms "sand," "silt," and "clay" are a means of classifying soil by the size of mineral particles. *Clay*, less than 0.002 mm (1/64,000 inch) in diameter, yields a large amount of surface area and increases the water-holding capacity of the soil. Each clay particle has an electrical charge that can adsorb ions from the fertilizer materials; the electrical charge varies from positive to negative, depending upon the minerals present, pH, humus content, and climate. Most clay minerals are negatively charged and will adsorb the cations—the positively charged ions. Since many of our plant nutrients are cations, the ability of the soil to adsorb and release (exchange) these cations is important also. Clay, then, is the most important mineral constituent of the soil and will increase soil productivity if properly managed.

Sand

Sand is the largest mineral particle in the soil and generally has little effect upon the exchange capacity. Due to their size, sand particles increase drainage and aeration, reduce the water-holding capacity, and increase the leaching of plant nutrients. The white sands of Hawaii are coral, or calcium carbonate, and they increase soil pH and thus create problems with the micronutrients that are necessary for good plant nutrition. *Silt*, a mineral size between sand and clay, has little influence upon soil properties.

Organic Matter

The addition of organic material to the soil, such as compost, manure, and so forth, results in the formation of humus. Humus is small-sized like clay, has a large surface area and a high exchange capacity (mostly cation but also anion), and will combine with clay to develop a desirable soil structure. It will also improve the water-holding and exchange capacities of sandy soils, as well as the tilth or manageability of any soil.

The major advantage of adding organic matter is the effect upon the physical properties of the soil. It will also supply some nitrogen. Due to the great fluctuation in nitrogen supply under conditions in Hawaii, however, this small amount of nitrogen is seldom considered when recommending fertilizer for the home garden. Too much organic matter should be avoided because it will accumulate and cause excessive aeration, nitrogen deficiency, and other problems.

Soil Reaction or pH

The acidity or alkalinity of the soil has an important effect upon the availability of nutrients to the plant. If soils are too acid—for example the soil from Haiku—phosphorus, calcium, magnesium, potassium, and molybdenum are likely to be

Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Noel P. Kefford, Director of the Institute and Dean of the College, Cooperative Extension Service, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, Honolulu, HI 96822. An Equal Opportunity Employer providing programs and services to the citizens of Hawaii without regard to race, color, national origin, or sex.

deficient. If soils are too alkaline—for example the white sands of Hawaii—phosphorus, iron, zinc, copper, manganese, and boron are likely to be deficient. Each plant has specific pH ranges; turnips, for instance, grow best when the pH is between 5.5 and 6.8. For the majority of garden plants, pH 5.5 to 6.5 is the optimum range. If the pH is higher than this, those elements deficient in the alkaline range will probably be needed in the fertilizer. The pH may be reduced by adding sulfur or other acid-forming materials. If the pH is too low, it may be increased by adding ground coral, hydrated lime, or a similar alkaline material.

Soil Salinity

Many soils have high levels of soluble salts (salinity) in them. Proper drainage is necessary to correct this problem. Materals, such as calcium sulfate, may be added, but , if proper drainage is not available, the salinity will increase because the calcium will release additional sodium from the soil. Replacing the soil may work unless the salts are coming from irrigation water, movement of salts by capillarity from a high water table, or salty subsoil layers. Vegetables vary in their tolerance to salts; those that are resistent to salts can be grown where salinity is a problem.

Physical Improvement

The properties of soil may be improved by mixing clay and organic matter with sandy soils or by mixing sand and organic matter with clay soils. It is important that the clay added is not of the expanding type because it causes poor soil physical conditions. These materials must be uniformly mixed to the depth that plant roots will extend, generally 6 to 8 inches deep, to permit uniform moisture, aeration, and other environmental conditions for root growth and development. An excellent garden soil may be produced by composting the soil with manures and organic residues. This is especially effective for small gardens, for use in containers, or for use in beds. Plant nutrients may be added during the composting process.

The soil should be maintained in good physical condition at all times. Cultivate, as necessary, to loosen the soil, control weeds, and improve soil conditions. If the soil is in good tilth, if organic matter is added, if mulches are used on the surface, if moisture supply is adequate, and if adequate plant nutrients are properly applied, little cultivation will be needed.

Pest and Disease Treatment

Some soils are infested with nematodes, weeds, or other pests. Treat the soil by heating with steam or dry heat or with general-purpose chemicals, such as methyl bromide, nematicides, or herbicides. Heating the soil to 180 F for 30 minutes will kill all diseases, insects, and weed seeds. Using general-purpose chemicals will serve the same purpose. Nematicides will kill nematodes only. Herbicides will kill only weeds. State law requires an applicator to have a permit to apply dangerous chemicals, such as methyl bromide. Many commercial applicators can apply chemicals for home garden use.

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Reprinted June, 1980—2M