Cooperative Extension Service
College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Soil and Crop Management
Jan. 2005
SCM-11

Use of Soil Amendments in Landscape Plantings

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Decisions to use soil amendments should be based on information about the soil. Amendments should be considered in relation to soil pH, available nutrient levels, and drainage. The first two factors can be determined by a standard soil analysis, which can be done by the CTAHR Agricultural Diagnostic Service Center, via Cooperative Extension Service offices, or by a commercial laboratory (for more information, see CTAHR's *Testing your soil: why and how to take a soil-test sample*). Drainage can be assessed by observation.

Soil pH and available nutrients

The generalized ideal soil pH range for many ornamental plants is 6.0–6.8, which is mildly acidic. For most soils of Hawaii, pH in the range 5.8–6.2 is adequate and does not require modification for good growth of most plants. If a soil analysis indicates that the pH is excessively acidic, the soil should be amended to raise the pH. Calcium carbonate (ground limestone or coral), dolomite, and calcium hydroxide (hydrated lime) are commonly used to raise the pH of acidic soils.

When a lot of organic matter is present, as in soils that have been heavily amended with compost, or in artificial potting media containing peat moss, the low pH can be amended to the vicinity of 5.5.

If the soil pH is above 7.0 (neutral), it is alkaline. Sulfur or iron sulfate can be used to lower the pH of alkaline soils.

Recommendations for modification of soil pH are designed to enhance the availability of essential plant nutrient elements and decrease the presence of toxic elements.

Strongly acidic soils can result in excessive availability of iron, manganese, and aluminum at levels that are toxic to plants. In Hawaii, manganese toxicity is much more common than aluminum or iron toxicity. These soils also generally have lower amounts of essential nutrients such as calcium, magnesium, and potassium, and phosphorus may be restricted in its availability to plants.

Strongly acidic soils are generally found in upland areas such as Mililani and Waikele on Oahu. These soils often are reddish, have a high clay content, and have traditionally been planted to pineapple and sugarcane. Long-term use of ammonium fertilizers on those crops further lowered the pH of the already acidic soils. Amending these soils with lime to raise the pH is necessary for good growth of most plants.

Alkaline soils with pH of 7.4 or more can induce deficiencies of minor elements, such as iron and zinc, in plants vulnerable to such deficiencies, such as hibiscus, ixora, macadamia, psittacorum heliconia, bauhinia, pikake, and gardenia. The application of excessive amounts of phosphate in "maintenance" fertilizer programs can also induce minor element deficiency in the plants just mentioned, as well as in allamanda, citrus, and honeysuckle.

Alkaline soils are found close to beaches and are derived from coral reefs; on Oahu such soils are found, for example, in coastal areas of Kailua, Hawaii Kai, and parts of Ewa. It is generally not reasonable to try to lower the pH of calcareous soils. Additions of compost and use of acidulating fertilizers such as ammonium sulfate can make these soils somewhat better for plants that otherwise would not grow well in them. However, choosing plants that are naturally adapted to these soils is a better option.

Spraying water-soluble minor element fertilizers on the foliage will help provide these nutrients to plants. However, in the case of phosphorus-induced minor element deficiency, spraying soluble minor element fertilizers on the foliage will be of limited use, because the

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high levels of phosphorus in the plant, which inactivate whatever minor elements might be in the plant, must be lowered first. Therefore, curtail the use of phosphorus fertilizers until the chlorotic symptoms on the new foliage disappear.

Drainage

Oxygen is required for the active uptake of water and plant nutrients by roots. Adequate soil drainage is important so soil aeration is not limited for long by waterlogging (the condition where the soil is saturated or nearly saturated with water). Some soils have naturally good structure and adequate aeration—they absorb water quickly and drain readily—while others lack good structure or swell upon wetting and tend to puddle quickly and remain wet for a long time. For example, most upland soils in Hawaii have good drainage, while lowland soils in dry climates, such as Ewa and Hawaii Kai on Oahu, often have poor drainage.

Human activity often impairs natural soil drainage. Construction activity including cutting, filling, and use of heavy equipment can result in compacted soils, particularly in new subdivisions or resorts. No easy solutions to poor soil drainage are available.

The most effective way to address soil compaction and drainage problems is to apply compost to the soil. Compost is plant material decomposed to the point that the source material cannot be recognized. Compost mixed into the soil improves the drainage of clay soils, but large amounts may be needed, and compost eventually breaks down.

Replenishing compost in the soil in landscapes is difficult to accomplish without damaging roots. However, incorporating compost before planting is perhaps the best and least expensive of the options for improving drainage in most soils. Tilling at least a 4-inch layer of compost into the surface 6–8 inches of soil is recommended for improving the structure of that soil layer, although if drainage is impaired at deeper soil levels, growth of landscape plants will still be less than optimum.

Livestock manure has been traditionally used to improve soil structure, but some manures are high in salts and possibly heavy metals, and care must therefore be exercised in using them to improve soil drainage.

Additions of volcanic cinders and crushed coral or sand (calcium carbonate) in an attempt to improve drainage of heavy clay soil can lead to compacted soil when vertical pressure, such as foot or vehicle traffic, is applied. Additions of silica sand and crushed basaltic rock (bluestone or man-sand) will not disintegrate and compact the soil, but the amounts of these amendments necessary to improve drainage may be prohibitively expensive in field situations.

Gypsum (calcium sulfate) can be used when poor drainage is due to a high level of exchangeable sodium (saline-sodic soil). This problem is rare in Hawaii. It can occur when the soil is irrigated with brackish water or wastewater from livestock operations, or where there is a high water table in coastal areas. A high sodium level causes dispersion of clay particles, which is deleterious to soil structure, reducing soil porosity and limiting drainage. The calcium in gypsum replaces sodium in the soil, allowing the sodium to be leached away. The use of gypsum as a soil amendment is relatively common in parts of the world where saline-sodic soils occur, but it is seldom necessary in Hawaii.

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