

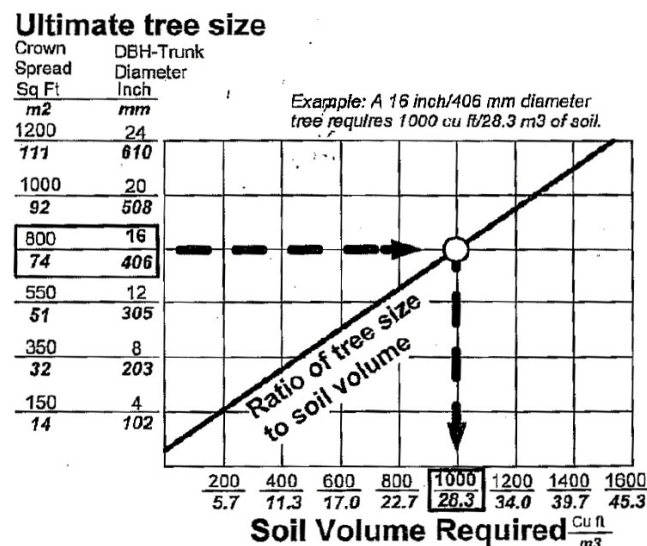
Soil for Urban Tree Planting

E. Thomas Smiley, Ph.D.

When installing trees in a city setting such as an urban plaza, downtown sidewalk, street median or other location where the native soil will not support plant growth, it is important to specify and install a soil that meets the specific cultural needs of the tree species. The following are guidelines for the development of a soil that will allow sustainable growth of most woody landscape plants. This soil is also suitable for the installation in new planting beds in suburban areas, but is not intended for roof top gardens.

Soil volume requirements. The amount of soil installed will in large part determine the maximum size that the tree will achieve during its usable life span. To determine soil volume required see the table below that was prepared by James Urban (*Up by Roots*, ISA Press, 2008). Only the upper three feet of soil should be used for calculations in this table. The example illustrated shows that to achieve a trunk diameter of 16 inches (40 cm), 1000 cubic feet (28 m³) of soil are needed.

Table 2.4.1. Tree size to soil volume relationships (Urban 1992).



Soil Depth. Tree soil should have a minimum depth of 3 feet (1 m). The soil can be composed of topsoil and subsoil layers. When installing the soil it should be installed in lifts or layers of ≤ 12 inches (30 cm). A subsoil mix should be installed first and this should be covered with a topsoil mix with a depth of at least 12 inches (30 cm). When installing lifts, the base soil surface should be tilled or scarified with the teeth of an excavator bucket initially and between each lift to break up any compaction that occurred.

Soil specification. The top soil and subsoil may be from either a naturally occurring soil or soil that has been mixed to achieve the requirements.

Texture. Both top and subsoil should be a sandy loam soil with 50-80% medium and coarse sand (<25 % fine sand), 5-20% clay, 5-35% silt.

Stones and rocks. No stones larger than 1 inch in the longest dimension are permitted. Stones ranging from 0.5 to 1 inch (1.25 to 2.5 cm) shall not exceed 5% of the soil volume, and gravel ¼ to ½ inches (0.6 to 1.25 cm) shall not exceed 5% of the soil volume.

Debris content. Particles greater than 1 inch in the longest dimension are not allowed. This includes fragments of brick, concrete, wood, glass, metal, stone and plastic. The total volume less than 1 inch long should not be more than 5% of the soil volume.

Contaminants. The soil should have no herbicides, heavy metals, biological toxins, or hydrocarbons that will impact plant growth or are at levels exceeding the EPA's standards for soil contaminants.

Clod size. Mixed soils often contain soil clods with a high clay content. While smaller soil peds are desirable from a soil drainage perspective, larger clods are not. Therefore, it is permissible to have unlimited amount of peds that are less than 1 inch long, but clods from 1-3 inches (2.5-7.5 cm) should make up less than 10% of the soil volume and clods 3-6 inch (7.5-15 cm) should be < 5%.

Organic matter content. Organic matter (OM) is important for retaining water, maintaining stable soil aggregates, promoting biological diversity and providing nutrients for tree growth. The top soil shall have 4-6% OM by weight. If additional organic matter is needed, compost can be added to the soil. A well composted yard waste or wood chips compost can be used, as long as there is 10% OM by volume in the compost. No soil mix should contain more than 15% compost by volume so as to avoid settling/subsidence problems. Subsoil should have between 1-3% OM, but higher levels are not detrimental.

Density Soil density needs to be high enough to avoid settling, yet low enough to allow root growth. Top soil should have a density of 1.0 to 1.4 g/cc and subsoil 1.2 to 1.5 g/cc. A vibrating plate compactor should be used between lifts to settle the soil. Number of passes required needs to be determined on site. A starting point is two passes of a 20 inch (55 cm) impact plate vibrating compactor on a moist (not wet) soil to achieve the desirable density.

Drainage. Water should readily drain from the soil. Percolation rates of 1-2 inches (2.5-5 cm) per hour are preferred, if irrigation will be installed. A drainage system should be installed if the native subsoil has a drainage rate less than 1 inch (2.5 cm) per hour. Corrugated, slotted pipe should be used for drainage. Slots must only be on the bottom half of the pipe. If pipe has slots on the top, plastic sheeting should be taped to the top to prevent soil contamination of the pipe. Drain pipe should be surrounded with coarse sand and should *not* be wrapped with filter fabric to avoid future clogging problems. The coarse sand trench should be at least 12 inches (30 cm) wide and 10 inches (25 cm) deep, with the pipe in the center. The pipe must go downhill to an appropriate drainage area.

Soil pH Soil pH determines the availability of nutrients in the soil. The exact pH range is dependent on the tree species to be planted. Generally, the most desirable pH range is 5.5-6.6 in humid regions (Eastern North American, western OR, WA and BC) and 6.0 to 7.4 in arid regions (TX, AZ, CA). Optimal pH is highly dependent on the tree species to be planted and should be tested and adjusted based on species prior to planting.

Nutrients. Plant available nutrients should be tested prior to soil installation. If they are found to be at levels that are listed as “medium” or less on the soil analysis report the soil should be amended with the appropriate fertilizers. If nitrogen is required, the nitrogen fertilizer shall contain at least 50% of the total N applied in a water insoluble (WIN) form.

Soluble salt content shall be less than 2 dS/m.

Water is an essential component of keeping new transplants alive and thriving. Soil moisture should be monitored regularly and irrigation applied when needed to assure adequate moisture. Excess irrigation can also harm plants so over irrigation should be avoided. Installation of soil moisture sensors at the time of soil installation is highly recommended.

With any new planting, the trees and soil moisture should be monitored regularly. Pest can do serious damage to new transplants and are most easily managed before populations build to damaging levels. An Integrated Pest Management (IPM) program is an effective means for protecting new transplants.