



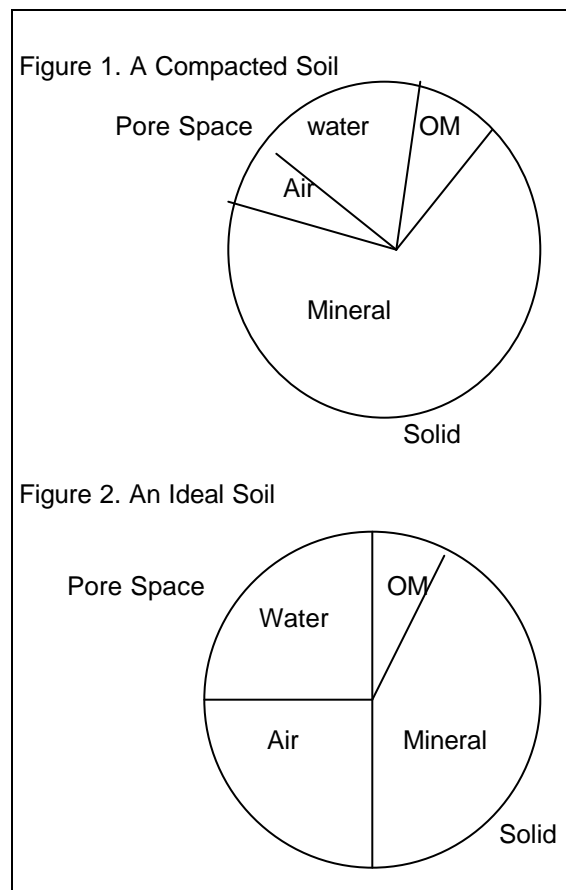
Soil Density Analysis

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Natural soils are a complex network of different sized particles and aggregations of particles called peds. Organic matter formed of dead roots, decomposed leaves and branches is the main “cement” that holds the peds together. The spaces between particles and peds allow for the movement of air and water, and the growth of roots. An ideal soil is composed of ½ pore space and ½ solid (Figure 2). Large pores drain quickly after rain or irrigation so they are usually filled with air. Smaller pores hold water more tightly, so unless there is severe drought, they hold water. Roots grow easily in the pore space, sending root hairs or mycorrhizal strands into the small pores to absorb water and nutrients.

In urban areas, there are many forces acting on the soil that compact the soil. These forces include foot or vehicle traffic, construction equipment and vibration from nearby traffic. Compaction affects the pore component of the soil. This creates an environment far less favorable for root growth. Compacted soils do not readily absorb water or allow for water drainage. There is less air to provide oxygen to the roots and carry carbon dioxide away, and there are fewer spaces for roots to grow.

It is best to address compaction problems prior to planting. At that point, tilling the soil can significantly reduce the compaction. This may be done with an excavator, plow, or backhoe on large sites or with a rototiller on smaller sites.



For established landscapes the problem is more difficult. Before prescribing a treatment it is best to accurately diagnose the problem. This is done by determining the bulk density of the soil. If the density of the soil is above the threshold value, a drastic treatment is needed. For recently transplanted trees with little root growth into the surrounding soil,

this should consist of rototilling around the root ball. Roots on average grow 18" (45 cm) per year. So by tilling a 36" radius around the tree, two years of good growing conditions can be provided.

For established trees, treatments that avoid significant root damage are employed. There are four basic treatments that can be applied to aid in the reduction of compaction: surface mulching, fertilizing, vertical mulching, and trenching. If the soil is only slightly compacted the combination of surface mulching and fertilizing is often sufficient. For more compacted soils, the combination of mulching, fertilization and vertical mulching is recommended.

In the most severe cases, radial trenching in the primary rooting zone provides continuous pathways for roots to grow. Trenches are dug from slightly beyond the drip line toward the trunk until significant roots (>1/2" diameter) are encountered. Trenches are filled with a blend of equal amounts of soil and organic matter such as wood chips or composted yard waste. In addition to the soil mix, this is an ideal time to add fertilizer and mycorrhizae. Apply surface mulch after the trenches are filled.

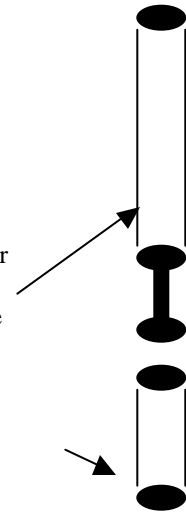
In summary, soil compaction can be severely limiting problem for trees and shrubs in the landscape. It is best to treat this problem prior to planting. However, for established landscapes with compaction problems, there are several remedial actions that can be taken. The first step is to determine the degree of compaction. Then a combination of surface mulching, fertilizing, vertical mulching and / or trenching can be used to provide soil in which roots can more easily grow. Typically with compaction, years of treatments may be required, and if the tree received too much damage during the compaction process, it may not be possible to save it.

Testing Bulk Density

Equipment needed:

Bulk Density Sampler
Split Sampling Tube
Core Measuring Gauge
Knife, Bottle Brush,
Soil Bags, Marking Pen

Bulk Density Sampler
Slide Hammer Handle
Sampler Head with
Split Sampling Tube inside



Procedure:

Clean the inside of the bulk density sampler head and the outside of the split sampling tube sampler with a bottlebrush. Insert the tube into the sampler and attach to slide hammer handle. Drive the head into soil to a depth of 4 to 5 inches (10-14 cm). Rock the handle to break the bottom of the soil core and lift or drive the sampler out of the soil. Carefully unscrew the sampler and remove the sample tube and soil core. Remove half of the split tube to expose the soil core. Place the core-measuring gauge on the soil core and cut the core cleanly at either end to the exact length of the gauge. Remove all non-core soil from the tube. Slide the 3" (7.5 cm) core into a soil sample bag and send to the Bartlett Tree Research Lab for drying and weighing.

What is Bulk Density?

Bulk density is a measure of the dry weight of certain volume of soil. It is the standard number used by soil scientist to quantify the degree of compaction in the soil. Solid rock has a density of 2.6 g/cc and water has a density of 1 g/cc. Some non-compacted forest topsoil actually has a density less than one, so it would float on water if it were sealed against leakage.

The threshold line for bulk density that separates compacted from non-compacted soil is often not a distinct line. It is dependent on soil texture and the plant that is growing there. The Bartlett Tree Lab does have a chart of commonly accepted values.