

Soil Compaction – The Silent Plant Killer

John Eisenhower

It doesn't fly, chew, creep or crawl. It isn't a pesky pathogen. It has no dramatic signs and symptoms. But this often neglected cause of plant death is killing trees and shrubs all across Arizona. What is it? This silent killer is Soil Compaction.

What is Soil Compaction?

"Soil compaction is the compression of soil that breaks down soil aggregates and reduces soil volume and total pore space, especially macropore space." (*Up by Roots*, James Urban)

Loss of pore space between soil particles limits oxygen diffusion into the soil. And because oxygen is a key component of cell metabolism in root tissue, without it, roots can't thrive and perform their important functions of absorption, conduction, and anchorage. When oxygen levels drop, roots suffer. And when roots don't function, the entire plant is affected.

When soil is compacted, the pathways for oxygen to reach the surface of roots are lost. The networks of pore spaces collapse. This condition results in poor root function or even root death. And root death causes less absorption and conduction of water and nutrients to the leaves for photosynthesis.



A compromised root system also leads to other problems such as a water deficit. The depleted energy reserves result in higher susceptibility to environmental stresses. Foliage thins out and branch tips die back. Disease and insects problems often exploit the tree's weakened condition.

Causes of Soil Compaction

There are several causes of soil compaction. A major contributing factor in Arizona is our heavy clay soil texture. Soil texture is the relative fineness of a soil due to the proportion of the three different particles of sand, silt, and clay. Of the three types of soil particles, clay particles are the smallest. Their flat shape and small size contribute to clay's high risk of compaction. They compress easily, especially when wet.

Clay has great water holding capacity which is a big plus for desert plants. But that capacity can become a liability if not understood and managed well. When soil pores are constantly filled with water, oxygen is unavailable to roots. An oxygen deficit can result if soils remain wet for extended periods of time.

Other common causes of soil compaction are vehicular and pedestrian traffic. Construction projects are notorious for compacting soil around trees. Workers park vehicles under trees or store building supplies, sand or pallets beneath their canopies. Unfortunately, the compaction damage can be permanent. Even after the vehicles or materials are removed, the soil compaction remains. And though the full extent of the health impacts may not be seen for years, the tree decline is often traced to soil compaction.



Mitigating Soil Compaction

Remedial measures to reverse or combat the effects of compaction include surface or subsurface applications of various organic materials including peat moss. These materials can hold the soil open and provide additional pathways for oxygen to reach the roots. Vertical mulching using a drill and auger or hydro-mulching using high pressure water can also be used to open holes in the soil which are then backfilled with gravel, sand, soil amendments, and fertilizer. Radial trenching is another option used to successfully combat soil compaction. This technique creates trenches within the root zone, then replaces deficient soil with better quality soil in the trenches.

To prevent compaction, avoid pedestrian and vehicular traffic following irrigation of clay soils.

Compaction due to compressing wet clay soils can cause irreparable damage to the soil and tree roots that grow in them. The best way to prevent soil compaction is to stay off wet or moist clay soils. If activity is unavoidable, designate specific, limited ingress and egress routes to minimize compacted areas. A municipal park manager told me their policy is to wait at least 5 days after a flood irrigation cycle to conduct any business in and around the park trees. This is a great policy to prevent damage to the roots that rely on adequate soil oxygen to remain functional and healthy.

A word about overwatering: Remember that it is easy to overcompensate for our hot temperatures by setting timers to run too long or too frequently. Even when the ground looks dry, clay particles may be holding water just inches below the soil surface. Using a soil probe or tensiometer may help measure soil moisture content before resuming traffic over previously wet clay soils. During the monsoon cycle, consider turning off your irrigation timer to avoid waterlogged soil conditions.



The saying, “As go the roots, so go the shoots,” reminds us that root health usually predicts shoot health. Unfortunately, this connection can be missed when diagnosing biotic and abiotic tree problems. Because the trunk, branches, leaves as well as several disease and insect problems are so easily seen, we often begin and end our problem diagnosis focusing only on these things. But next time, consider the possibility that the quiet culprit of soil compaction may be at work.