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Tree Roots—Where Are They?

The plant root system may be described as unseen and unappreciated. It is extremely difficult to study an entire root system, particularly in the case of trees. Heavy, woody roots, at diameters up to 12 inches, may be revealed by washing away the soil. However, trees also produce a multitude of hair-like, non-woody roots (about 0.008 inches in diameter).

When a tree seed germinates, the first (primary) root grows down in the soil in response to gravity. Secondary roots then branch off horizontally, with subsequent branching into tertiary roots, etc. Absorption of water and mineral nutrients is the function of the very fine, non-woody roots (the feeder roots). With continued growth, each root will lose its ability for absorption. These larger woody roots then function as the transport system for water and nutrients from the new feeder roots to the stem. They are also the tree's system of anchorage and a food storage area. The resulting system thus consists of several main transport roots that extend radially and horizontally from the tree base and divide into ever-smaller roots, each ending in a dense mass of fine feeder roots.

Because of the horizontal growth pattern of the tree root system, nearly 99 percent of all the tree's root mass is usually located in the top three feet of soil. The roots can also extend far beyond the tree's "drip line," typically radiating out from the trunk a distance of 0.5 to 1.5 times the tree's height. Imagine tree roots branching in a round pie plate of one-yard depth and a width 2 to 3 times the tree's height.

This growth pattern is a direct result of the root biology. When the soft feeder roots become woody, or if they are lost to insect feeding or other physical damage, the absorption capacity is lost, and new feeder roots must be produced. This means that absorption is dependent on continued growth of new roots. Roots only grow where the physical and chemical environment is correct – temperature, moisture, aeration, pH, nutrient supply, soil structure. Roots do not seek water; they grow where moisture is available. Roots also need oxygen, and growth is restricted where oxygen is limited. Unless the tree is particularly adapted to growing in wet, swampy soils, the maximum rooting depth possible is just above the water table. In most soils, a satisfactory growing environment exists only within the top few feet. In fact, the greatest proliferation of tree roots will be found in the transition zone at the soil surface – under the leaf litter in a forest or thoroughly intermingled with grass roots in a lawn.

The landscaping implications from this pattern are significant. In the case of tree fertilization, one researcher has stated, "Any tree growing in a well-fertilized lawn is well fertilized." Because the tree's feeder roots are in the same soil volume as the grass roots, both have access to all the applied fertilizer. There is no advantage to punching holes in the ground for deep application of general fertilizers, including phosphorus. We do need to be aware that the tree and turf are competing for those nutrients. Poorer growth of both may indicate that a higher application rate is needed, although remember that water may actually be the limiting factor. Other lawn treatments can pose a threat to the trees. Some good turf herbicides are very damaging to trees and shrubs when absorbed by the roots. The herbicide does not have to move down in the soil to the tree roots; these roots are with the grass and weed roots. Restricting herbicide application to the lawn outside the tree canopy may not be sufficient, as we do not know how far the roots extend. Other care is needed when the soil is disturbed. Construction or landscaping activities that cut roots of mature trees will often lead to death of part or all of the tree top, commonly two years or more after the injury was done and forgotten. Keep in mind that tree roots do not respect property lines. The effects of these activities in your yard may be in your neighbor's trees, and vice versa.

By far, the most common and serious root injuries we inflict on mature trees are from changing the soil's aeration. Adding soil, even as little as a few inches, over the existing surface places the major root mass that much deeper. With less oxygen the roots may die quickly, and unless new roots can be rapidly produced in the surface soil, the tree will die. Soil compaction has the same effect, reducing the soil's air supply plus creating a physical barrier to new root growth. Recreation or other areas that receive regular foot or vehicle traffic are prone to this problem.

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