Healthy Soils: The Key to Healthy Trees in Our Communities

by William M. Fountain

Trees may be of the natural forest, but for the majority of the world's population the closest trees are part of the urban forest. Species found in our cities and towns are also found in natural forests and woodlands but in drastically different environments and often on distant continents. The differences in the environments between natural areas and the communities where we live present a series of interrelated problems. When compared with urban trees, Kentucky's woodlands have a more moderate climate, less intense sunlight and drastically different soils. The properties of the soil environment are usually dissimilar to woodlands and, as a result, present the greatest challenges to sustainable, healthy urban trees.

Urban soils are so radically different from undisturbed soils that the major thing they have in common is what we call them -- soil. Urban trees provide us with benefits that make our communities livable, yet we relegate them to an existence confined by human needs and habits. Limited soil volume along with changes in soil chemistry and physical characteristics limit the ultimate size and life span of our urban trees, also limiting their effectiveness in making our homes, be they hamlets or mega cities, the best possible places to live and raise our families.

Changes in Soil Volume

The volume of soil available for tree roots to explore in search of water and mineral elements has a significant impact on the ultimate size and longevity of the tree. The question of "How much soils is necessary for a tree?" can only be answered when we first answer the question, "How big do you want the tree to get?" and "How long do you want it to live?"

The rule of thumb is that a minimum of three cubic feet of soil is required for each square foot of crown projection (number of square feet of canopy in silhouette). This minimum amount of soil will require regular irrigation and fertilization. Less soil than the minimum requirement will not allow the roots to physically anchor the top during windstorms. Limited amounts of soil will not provide a sufficiently large reservoir for the water and mineral element.

Native, undisturbed soils are characteristically expansive, allowing multiple trees to root into the same common area. Because urban real estate is expensive, designers try to maximize every square inch for development. One way they do this is by spacing trees far apart in small tree pits. The result is solitary trees where each is exposed to lower humidity, more wind and more intense sunlight than masses

Photo courtesy: William M. Fountain

of trees in woodlands. To add insult to injury, the soil urban trees are forced to grow in is nothing like that in woodlands. The volume of the soil is important, but the quality is even more so.

Soil Structure

Soil is ALIVE!--at least soils suitable for growing large, healthy trees must be alive. Microorganisms, insects and other invertebrates are responsible for developing soil structure. Structure is how something is put together. We recognize good quality soil as naturally granular or crumbly. The structure of many urban soils has been altered by equipment scraping and compaction to the point where it more closely resembles pudding when wet and concrete when dry. Roots have to push through this substance in order to grow and develop. Roots travel through the path of least resistance. In native, undisturbed soils, this path is through small cracks that open and close with changes in moisture. Roots also follow old worm holes and insect burrows and even grow through the same paths where roots of now dead plants once grew. All of these cracks and crevices are lost when soil is pounded by foot traffic and equipment.

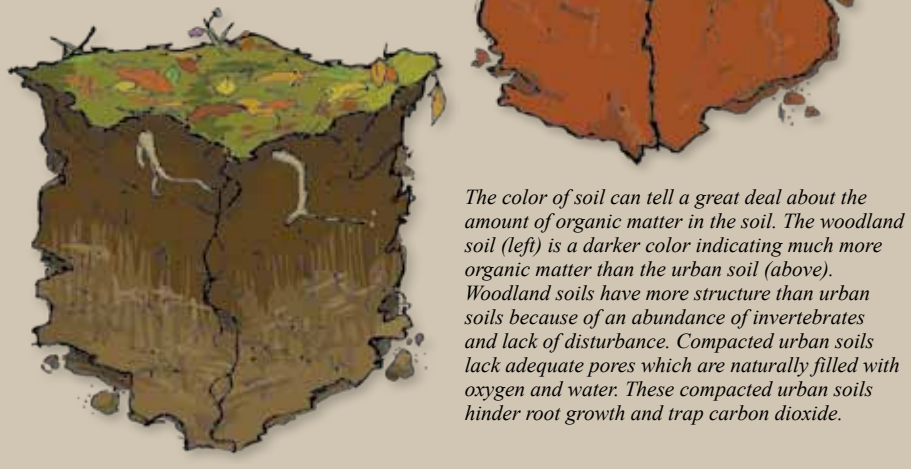
Urban trees are often severely restricted because of soil limitations.

Photo courtesy: Bill Fountain

Compacted urban soils can have a weight–to-volume ratio, called bulk density, that is higher than concrete. Not only is it difficult for roots to physically push through these hard, compacted soils, it may be impossible for them to function like normal roots. Compacted soils lack the pores that would naturally be filled with water and oxygen. In order to grow and absorb water and mineral elements from the soil, roots must have an abundance of oxygen in the soil. Compacted soils trap carbon dioxide and lack sufficient oxygen. Roots that cannot physically grow through the soil and absorb water and mineral elements are not able to provide the structural support for the tree or supply water and mineral elements for growth. These physical characteristics of urban soils make them distinctly different from native, undisturbed soils.

Chemistry

Along with the physical alterations in urban soils, chemical characteristics also change. Woody plants require 19 essential elements to survive. Most Kentucky soils have an abundance of these elements, and many are among the most fertile in the world; however, when soils become too acidic or too alkaline these elements can be changed to chemical forms that are impossible for the plant to absorb, or elements may become so readily available that they are toxic to the tree. The result is stunting of the roots and shoots and yellow foliage that cannot photosynthesize and carry out the other processes necessary for growing, flowering and maturing fruit. Weakened plants are less efficient at being able to fend off disease and insect pests.



The color of soil can tell a great deal about the amount of organic matter in the soil. The woodland soil (left) is a darker color indicating much more organic matter than the urban soil (above). Woodland soils have more structure than urban soils because of an abundance of invertebrates and lack of disturbance. Compacted urban soils lack adequate pores which are naturally filled with oxygen and water. These compacted urban soils hinder root growth and trap carbon dioxide.

Alkaline soils are more common in our urban areas than soils that are too acidic. Two elements, calcium and sodium, result in soils becoming too alkaline. The most common source of sodium is deicing salt (sodium chloride) used in winter to keep streets and sidewalks safe and passable. After streets are salted, snow melts and vehicular traffic quickly returns to normal speeds. High speeds result in splashing and minute droplets of salty water traveling long distances. The remaining salty slush is either splashed or plowed onto median strips. Tree islands in parking lots and along streets make a convenient place to pile snow and ice out of the way of cars and pedestrians. As the snow melts the sodium is absorbed onto clay particles, making them alkaline, sometimes reaching a pH of 8.0 or 9.0.

Calcium is the other chemical responsible for making our urban soils too alkaline. Most of the excess calcium comes from the lime in concrete and mortar from construction. Soils become contaminated with excess calcium as lime leaches out of mortar joints on new masonry construction or washes out of the delivery chutes of concrete trucks.

Once damaged, soils in the urban environment that were once fertile and productive cannot be easily re-

stored to their original state. Remediation is both more expensive and time consuming than protecting the soil from compaction and contamination. Where contaminated soils are too alkaline we must select species that are tolerant of a high pH and accept greater maintenance expenses and shorter life spans. Quality trees in urban areas don't cost money; they yield economic benefits. Healthy trees in the urban environment make our cities livable but they must be designed for and protected. Inserting trees into a previously treeless urban area requires knowledge of the cultural requirements of potential species and selection of only those which are tolerant of an altered environment. The right tree must be installed in the right place. Equally important to designing the urban environment is providing protection from urban pressures by using best management practices that will ensure that trees will not just remain technically alive but will grow and thrive, yielding all of the intended environmental and aesthetic benefits.

Photos courtesy: Bill Fountain

It is well documented that trees greatly enhance the urban environment making it much more livable. Unfortunately, urban trees are often given too little space to grow and subjected to harsh environments that drastically reduce their ultimate size and life spans. Trees that are given adequate room to grow and are provided some basic protections, can provide many benefits to our towns and cities for many years.

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