CUTT

The Roots of Success

Questions Answered by Urban Horticulture Institute Director, Professor Nina Bassuk

Program Spotlight

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Why is an adequate soil volume important for tree growth?

The soil provides many resources for the tree, primary among them being water, oxygen, nutrients, and a medium for root growth. When soil volume is limited, tree growth suffers because so much of the top growth of the tree is dependent on what the roots can deliver and that in turn depends on how large a resource pool there is. It is possible to grow trees in quite small containers as long as water, nutrients and oxygen are supplemented—something not easily done in urban areas.

However, we are beginning to learn that roots not only are the conduits of resources to the tops of the trees, they also produce growth factors that are necessary for growth as well. Roots need to grow in order to produce these growth factors. Therefore, if root growth is restricted, top growth will also be restricted even if water and nutrients are plentiful.

How much soil volume does a tree need?

Several researchers have looked at this question. Although variables such as size of the tree canopy, site conditions and tree species will have an enormous effect on determining an adequate soil volume, a few generalities can be drawn. We found that for much of the United States, a soil volume of two cubic feet for every square foot of canopy crown projection is a good place to start. This work applies to mesophytic, deciduous trees, not trees specially adapted to arid or swampy areas or evergreens.

Most of the climatic conditions in the United States would be satisfied by this relationship except for the desert southwest where there is an extremely high atmospheric demand for water and very little replenishing precipitation.

When we reinterpret other researcher's soil volume calculations, a similar relationship of between one and three cubic feet of soil volume per square foot of crown projection can be generated. It is easy to calculate the crown projection of an existing or envisioned tree by calculating the area under the drip line of the tree which is the same as crown projection. By using the formula for area of a circle (Pi r squared), the crown projection may be calculated. By doubling that figure and calling it cubic feet, we can come to a reasonable starting place to discuss adequate soil volumes for most urban trees.

How can this information be used to reduce tree/sidewalk conflicts?

One might reasonable assume that soil under pavements may be accessed by tree roots in their search for water, nutrients and oxygen. However, the need to compact soils under pavements to give them strength and prevent pavement subsidence often makes soil impenetrable to tree roots. This purposeful compaction can severely limit the potential rooting space for a tree surrounded by pavement.

Because soils under pavements are compacted, roots are generally relegated to growing upwards towards the surface of the soil where there is an interface between pavement and base course that allow for root growth exploitation. This sets them up for direct impact on pavements as the roots expand and grow radially. In a forest situation, large buttressing tree roots normally taper down as these roots grow away from the tree, in the first 6 feet or so. It is these large roots, near the base of the tree, that cause the most damage to pavements.

One suggestion for reducing this problem would be to leave a larger cutout section of pavement so as not to interfere with these largest of tree roots. Another suggestion would be to use a structural soil that could be compacted to meet engineers' specifications while still allowing tree roots to grow deeper.

Structural soils could be used to channel roots safely under pavement into an open grass area adjacent to the pavement or to be the sole rooting area. Either way, structural soils should be at least 24" deep and preferably 36" deep and extend for a large area at least equal to what the soil volume calculations predict.