Rehabilitating Damaged Urban Soils to Optimize Tree Establishment and Growth & Improve Soil Function

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Trees have been recognized as important tools for improving the urban environment. Unfortunately, urban land development is accompanied by activities that damage soil structure, remove organic matter, and subsequently reduce tree survival, establishment, growth rates and canopy coverage. Soil rehabilitation protocols are needed to implement effective soil improvement that promote root development and canopy growth for urban trees.

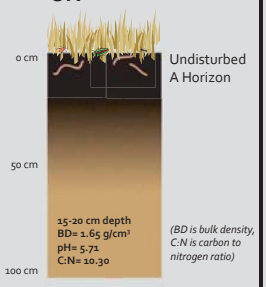
This study evaluates three soil rehabilitation protocols to determine their effects on soil physical properties, tree establishment, root development, and other growth parameters for five tree species on a graded and compacted site.

The site was constructed in 2007 and measurements include tree height, trunk diameter, canopy, soil bulk density, pH, and carbon to nitrogen ratio.

The research site before (top) and after (bottom) soil treatments were installed and trees were planted. Each plot is 4.6 by 18.3 m.

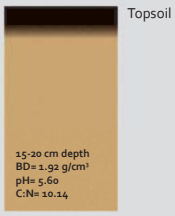
Treatment profiles

Before treatments were applied to ME, ET and PR, the plots were pretreated to match standard urban post-construction soil conditions: topsoil was removed and subsoil was compacted to 2 g/cm³ bulk density.



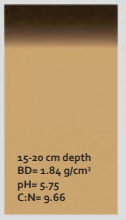
UN

The Undisturbed (UN) treatment was not graded or compacted. Existing vegetation was sprayed with herbicide.



ME

The Minimum Effort (ME) treatment represents a low effort level of rehabilitation of compacted and low organic soils. It is a common practice among many contractors and landscapers.



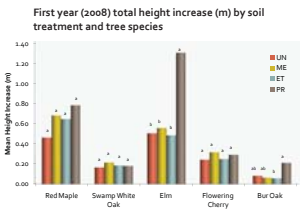
ET

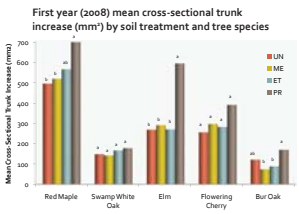
Enhanced Topsoil (ET) treatment represents a moderate level of soil rehabilitation. Topsoil is rototilled to scarify the interface between the topsoil and existing compacted soil.

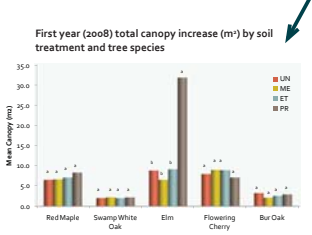
PR

Profile Rebuilding (PR) treatment involves the highest degree of rehabilitation and is intended to both address the low organic matter of the compacted soil as well as the high bulk density.

Based on Rolf, K. 1994. A review of preventative and loosening measures to alleviate soil compaction in tree planting areas. Arboric. J. 18: 431-448.







Letters specify differences among treatments within a species. Matching letters are not significantly different at the α= 0.05 level (comparisonwise), using a comparison by LSD. n=6

An elm tree growing at the research site.

The PR soil treatment had the greatest effect on elm trees in total height, cross-sectional trunk increase and total canopy. Results for other tree species were not as drastic, especially for tree canopy increase. A second year of growth and physiological data is planned for 2009 and is expected to represent more completely the effects of the treatments on tree growth as the roots penetrate the soil beyond the planting holes into the rehabilitation treatment soil.

Other measurements not included on this poster include physiological measurements such as photosynthesis, chlorophyll fluorescence, leaf water potential, and root measurements such as depth and length.

At a glance

Soil rehabilitation methods are needed to improve urban soil conditions and promote tree canopy growth.

Objectives

- **Can we restore valuable soil functions to damaged urban soils?**
- **How will each soil treatment influence tree growth?**

Randomized Experimental Design

4 soil treatments
Minimum Effort (ME)
Enhanced Topsoil (ET)
Profile Rebuilding (PR)
Undisturbed (UN)

5 species
Accolade Elm (*Ulmus* 'Accolade')
Red Maple (*Acer rubrum*)
Swamp White Oak (*Quercus bicolor*)
First Lady Cherry (*Prunus* 'First Lady')
Bur Oak (*Quercus macrocarpa*)

6 replicates

Tree species were selected for different tolerances (drought, drainage, compaction, etc.) and growth rates.

Results

Soil rehabilitation is capable of improving soil physical properties and tree growth short-term

- **The most intensive rehabilitation protocol (PR) decreased bulk density in the subsoil.**
- **Increased tree growth was measured in PR soil treatments.**

Future

The trees will continue to be monitored for long term growth and canopy spread. The site will also be used to determine the effects of the soil treatments on the soils' ability to provide ecosystem services such as carbon sequestration, rainfall interception, and groundwater recharge.

To learn more about soil rehabilitation, visit www.cnr.vt.edu/urbanforestry/SRES

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