Soil Rehabilitation Experiment Site (SRES) at Kentland Farm, Virginia Tech

Center for Sustainable Urban Landscapes

VirginiaTech
Invent the Future

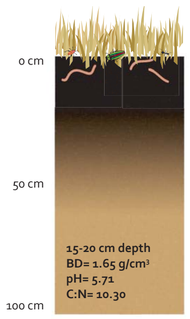
This research site has been developed to study the effects of different soil improvement practices on damaged soils. Soils can be damaged by development activities such as grading and heavy equipment use. Once soils are damaged, they cannot support healthy tree growth or provide other essential ecosystem services such as storing carbon.

Two graduate student research projects are currently in progress at this site. Rachel Layman is evaluating the three soil treatments to determine their effects on soil physical properties and tree establishment of five species of trees. Yujuan Chen working to determine the soil treatments' effects on soil carbon storage, soil structure, hydrologic properties and health.

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.

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

Why Trees?

Trees have been recognized as important tools for improving the urban environment and because of this, many cities have established tree canopy goals. Unfortunately, most urban soils are so damaged that trees struggle to grow and have shorter life spans. This research aims to determine the most effective and practical soil treatment for optimal tree growth.

Key Soil Concepts

Planting trees at the research site.

Bulk Density- the density of a soil measured by dividing the dry weight of a soil to its volume.

Carbon Storage- the removal and storage of carbon from the atmosphere in carbon sinks (such as soils, forests, and oceans) through physical and biological processes, such as photosynthesis.

Compaction- the increase in soil bulk density caused by foot or motor traffic and/or heavy machinery.

Ecosystem Services- valuable functions that ecosystems provide free of charge to human societies.

Grading- a common land development practice to level the soil elevation and usually involves removing topsoil.

Organic Matter- consists of materials that were once living that are in the process of decomposition.

Soil Rehabilitation- practices to improve soil for plant growth or other ecosystem services.

Topsoil- the top layer of the soil, usually dark colored and rich in organic matter (A horizon).

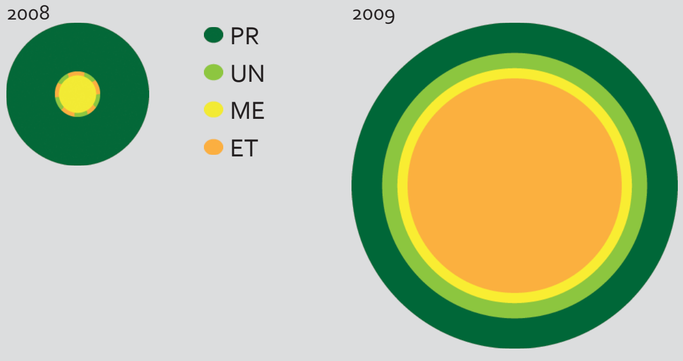
Results

For the Accolade elm trees, the PR treatment (the most intensive soil rehabilitation treatment) had the highest significant increase in height, trunk diameter and mean canopy area for both 2008 and 2009 measurements.

An Accolade elm tree growing at the research site.

These effects were not as strong in other tree species tested, except in the case of trunk diameter. In addition to the Accolade elm, red maple, First Lady cherry, and bur oak all showed a significantly larger trunk diameter increases in PR treatments compared to other soil treatments.

Tree canopy comparison with Accolade elm trees for each soil treatment.



At a glance

After land development and building construction, many new trees struggle and die, others grow slowly and never attain their full potential. 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 soil properties, tree growth and carbon storage?**

Randomized Experimental Design (6 replicates)

4 soil treatments

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

Research site in October 2007 after soil treatments and trees were installed.

5 species

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

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

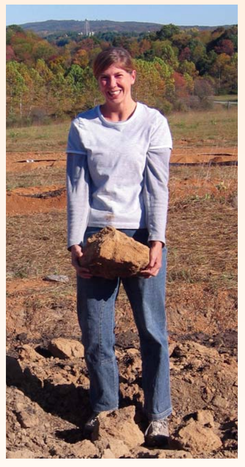
Results

Soil rehabilitation is capable of improving soil physical properties and tree growth.

- **The most intensive rehabilitation protocol (PR) decreased bulk density in the subsoil.**
- **Increased tree growth (tree height, canopy and trunk diameter) was observed for PR soil treatments, especially with Accolade elm trees.**
- **Early results indicate that the PR treatment is accelerating the process of soil structure formation and long-term carbon storage.**

Future

Tree growth and soil properties will continue to be monitored to determine the long-term effects of each soil treatment. Soil carbon storage results are expected during the Fall 2010 semester.



Project Participants

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

The Center for Sustainable Urban Landscapes (CSUL) is a cooperative research effort affiliated with the Department of Horticulture and the Department of Forest Resources and Environmental Conservation at Virginia Tech in Blacksburg, VA.

For information on other CSUL projects, contact Susan Day, sdd@vt.edu

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Poster designed by Sarah B. Gugercin