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Landscape Below Ground IV: Introduction to a Special Issue

By Gary Watson

Abstract. This special issue is dedicated to research presented at the 2018 Landscape Below Ground IV conference. We describe highlights from the ten original research articles included in this issue. With these articles, we aim to support the advancement of tree care practices and inform managers and policymakers to choose, site, plant, and care for healthier, longer-lived trees by focusing on their critical and vulnerable root systems and the soil that surrounds them.

Keywords. Anchorage; Infrastructure; Root Development; Site Design; Stability; Tree Planting and Establishment.

This special issue is dedicated to research presented at the Landscape Below Ground IV conference held in October 2018 in Lisle, Illinois. That event was presented jointly by The Morton Arboretum and the International Society of Arboriculture (ISA). Previous Landscape Below Ground conferences were held in 1993, 1998, and 2008.

Over the last 25 years, the Landscape Below Ground has become a premier outlet for the dissemination of research that supports tree care practices, and the impact has been significant. For example, today, structural soils are commonly used to support both stable pavements and healthy tree roots, but they were a new innovation when presented at the first Landscape Below Ground conference.

Landscape Below Ground IV featured an impressive international group of 49 presenters from nine countries, conducting and applying the latest research on urban roots and soils. This information will help practitioners, managers, and policymakers choose, site, plant, and care for healthier, longer-lived trees by focusing on their critical and vulnerable root systems and the soil that surrounds them.

Below we summarize the ten articles featured in this special issue, representing five of the six topics included in the Landscape Below Ground IV conference program and proceedings. The full proceedings documenting the remaining presentations will be published by ISA so that this wealth of information is captured and readily available to researchers and practitioners alike.

Root Development and Management

Root growth of trees is affected by the soil environment, which can be much more challenging in urban areas than in natural sites. Abiotic factors, including soil penetration resistance, temperature, aeration, moisture, and chemistry interact with biotic factors, such as mycorrhizal fungi, to affect root growth.

Moore et al. investigated the ability of tree species to cope with compacted soils. The results suggest that careful species selection and soil amelioration for species prone to the effects of compaction would facilitate street tree establishment.

The root growth of six species of trees grown in loam and loam-over-compacted-clay soil profiles was assessed (Hewitt et al.). Fine root density of all species decreased with depth except American elm (*Ulmus americana*). Root growth was reduced more by high soil moisture and reduced aeration than soil texture and compaction.

Anchorage and Stability

Interest in the biomechanics of tree stability and resulting risk assessment has grown considerably. Static and dynamic assessment techniques and tools continue to improve. Mechanisms of stability and failure are now becoming better understood.

Johnson et al. assessed the intensity and degree of damage inflicted on urban trees by wind loading events. Both long-term, opportunistic gathering of wind loading events and accompanying damage to trees, and a case study of one storm in one city on one day revealed critical preexisting conditions that leave trees vulnerable to whole tree losses.

The consequences of deep planting on tree stability of green ash (*Fraxinus pennsylvanica* 'Patmore') trees were

investigated using static pull tests and photogrammetry-derived computer models (Miesbauer et el.). Roots at multiple depths in a 90° wedge on the side opposite of the pull direction were the most significant factor affecting tree stability.

Detter et al. explored if, and to what extent, trees can regain anchoring strength after their root systems have been overloaded. London plane trees were subjected to destructive winching tests until primary anchorage failure occurred. Retesting these trees over time revealed that partially uprooted trees may reestablish stability, but some will not and can fail.

Silver maple (*Acer saccharinum*) and red maple (*Acer rubrum*) roots from interior and edge positions of a plantation were examined to observe cross-section radial growth patterning in response to wind (Grabosky). The loss of observed upward radial growth bias very closely coincided with the ending of the zone of rapid taper. Observations suggested a morphological response to wind exposure.

Planting Site Design

Urban landscapes frequently require trees to be planted in confined spaces. Work aimed at improving the quality of those spaces continues. Structural soils and suspended pavement systems are designed to support pavement while providing for root growth; these systems continue to evolve.

Root densities of Accolade™ elms planted in CU-Structural Soil©, overlaid with porous or nonporous asphalt over a twelve-year period, were measured with Ground Penetrating Radar (Bassuk et al.). Root development was better under the porous asphalt. Shoot growth was reduced sooner in trees that grew under the nonporous asphalt.

Smiley et al. directly compared supported pavement and structural growing media systems in two studies. Trees growing in the supported pavement treatments with low-density soil media resulted in significantly greater tree growth and a healthier appearance.

Tree Roots and the Built Environment

Urban sites and tree roots are often in conflict. Activity around trees can damage trees if it encroaches too far into the root zone. Trees can damage infrastructure by heaving pavements, contributing to foundations subsiding, and invading pipes.

Moore et al. investigated root penetration into PVC pipes in two experiments. Properly installed pipes were impenetrable, but the width and number of openings in a pipe influenced the capacity for penetration. Species had different capacities for penetrating pipes, and appropriate species selection could reduce incidences of pipe damage.

Tree Production, Planting, and Establishment

Container systems remain a mainstay of the nursery industry, though natural, lateral root spread is very limited, and root defects are common. New bare root systems are being used to increase fine root density and improve planting success throughout the season.

The Missouri Gravel Bed system (MGB) has been used to enhance fine root growth of bare root stock prior to planting. Fite et al. compared gravel beds with mulch beds and showed very few differences, suggesting that the less expensive, more readily available substrate of wood chip mulch should be considered in these aboveground growing systems.

Managing Urban Soils

Urban soils may be the least studied and understood of all soils. Compaction and lack of structure and organic matter are common problems. Though not represented in this special issue, the proceedings will include information on compost and biochar amendments to improve the soil, rebuilding the soil profile, and understanding how natural soils provide a root environment that is closer to nature where the trees evolved.

Looking Forward

The 2018 Landscape Below Ground IV conference punctuated 25 years of tree root and soil management research. The articles included in this special issue contribute to the growing body of knowledge on these topics and will undoubtedly be an important resource for practitioners, managers, and policymakers involved in tree care in cities. Despite considerable advances, the field of study has many knowledge gaps. Future research can build upon the last quarter century of research by addressing these and other gaps.

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