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Landscape Below Ground V: Introduction to a Special Issue

By Jason W. Miesbauer

This special issue showcases research presented at the Landscape Below Ground V conference held in 2023 October at The Morton Arboretum in Lisle, Illinois, USA. The conference was hosted jointly by The Morton Arboretum and the International Society of Arboriculture (ISA). This is the fifth iteration of the conference, with previous Landscape Below Ground conferences occurring in 1993, 1998, 2008, and 2018. The Landscape Below Ground conference series is dedicated to highlighting research related to tree root growth and development in urban soils. The conference has a long history of bringing researchers and urban tree care practitioners and managers together in an environment that fosters the exchange of knowledge on the latest research and how that research is put into practice.

The conference consisted of 4 preconference workshops, 33 oral presentations, and 10 poster presentations. An incredible wealth of knowledge and experience was shared by an impressive slate of 39 presenters representing 9 countries. Notably, a number of the presenters were current or recent students who did a remarkable job representing the next generation of tree and soil scientists.

This introduction summarizes 8 research articles that comprise this special issue, representing 4 of the 6 conference session topics. A full conference proceedings document that includes all the conference presentations is forthcoming.

TREE ANCHORAGE AND STABILITY

Tree risk assessment is a growing area of focus in the tree care industry. Technological advances continue to help improve our ability to research tree stability and likelihood of failure. Miesbauer et al. investigated the effect of trench distance from the trunk on resistance to uprooting. They conducted static pull tests on *Acer rubrum* trees, dug trenches to sever the roots at either 1, 3, or 5 times the trunk diameter from the tree, and repeated the pull tests. They found the greatest loss in rooting strength occurred for the 2 closest trenching treatments. They further utilized photogrammetry software to create 3D models of the root systems from which they were able to measure root morphological characteristics. They found a positive correlation between percent root loss during trenching and reduction in rooting strength.

TREE ROOTS IN THE BUILT ENVIRONMENT

Urban environments often present unique and difficult challenges for tree root growth and development. Conflicts often arise where human activities encroach on the root zone, leading to substantial damage to tree roots. To better understand tree root regrowth following trenching, Koeser et al. trenched the root systems of *Quercus virginiana* trees at a distance of either 3, 6, or 12 times the trunk diameter. Five years after trenching, they measured the size of new roots that resulted from the trenching. They found greater root regrowth—relative to the original cut surface area—was positively correlated to the distance of the cut surface from the trunk.

ROOT TRAITS AND MORPHOLOGY

Although tree protection zones are sometimes put in place prior to construction activities, root damage during those activities is an all too common occurrence. When that damage does occur, it is difficult to

estimate the level to which the root system is damaged, in part because we don't have a good understanding of the total root area that trees possess. Grabosky et al. used a modified approach to the pipe model theory to investigate root cross-sectional area at distances of 1, 2, and 3 meters from the trunk on 3 tree species. They found a weak relationship between root cross-sectional area and distance from the trunk. In a second study using a code they developed to virtually dissect and measure root area of 29 digitized root systems, they found a high level of variability among the digital root systems.

Patrick et al. investigated the effects of waterlogging on tree physiological response and fine root mortality of 2 maple and 2 magnolia species. They found a high level of variation in fine root mortality and physiological response, with silver maple (*Acer saccharinum*) showing the greatest tolerance to waterlogging, and sugar maple (*Acer saccharum*) being the least tolerant.

TREE ROOT DEVELOPMENT AND MANAGEMENT

The concept and practice of induced resistance to tree pests and diseases is of keen interest to tree care managers. To better understand the efficacy of induced resistance elicitors, Harley et al. treated containerized white pine (*Pinus strobus*) trees with 4 elicitors to stimulate defensive enzymatic activity in the fine roots. They found evidence that some of the elicitors stimulated a biochemical response, with some variation among treatments.

There has been an unusually high rate of rapid decline and mortality of mature oak trees in Northeastern Illinois in recent years. To better understand this phenomenon, Watson and Adams initiated an investigation into site and soil characteristics and precipitation history across 18 sites experiencing rapid oak decline and mortality. The presence of *Phytophthora* spp. was detected in 87% of fine root samples that were analyzed. They also found that decline was much more prevalent on low lying sites that had moderately to poorly drained soils and where the spring water table was high, whereas trees located on slightly more elevated ground were comparatively healthy. The authors also noted the level of spring rains over the 3-year period of 2018–2020 was the highest over any 3-year period over the past 70 years. They concluded that the excessive spring rain and resulting high water table in low lying areas created conditions conducive for root disease to develop and cause the observed decline and mortality.

Rigsby et al. investigated the application of the plant growth regulator Paclobutrazol, which inhibits gibberellin biosynthesis, at different treatment levels on above- and belowground growth over a 14-month period. All treatment levels showed a similar reduction in root biomass and length, and no major trends in root:shoot ratio were observed.

Comin et al. tested the effects of amending planting substrate with *Ascophyllum nodosum* extract as a biostimulant at 4 different dosage levels. Plants treated at the highest dose showed an increase in dry mass and higher leaf greenness index after one year, which was attributed to an increase in nutrients.

LOOKING FORWARD

The 2023 Landscape Below Ground V Conference featured a wide range of topics on the research and management of urban tree root and soil management. Findings from research presented in this issue of *Arboriculture & Urban Forestry* will be a benefit to researchers to help inform and inspire future studies that address some of the knowledge gaps that pertain to urban tree roots and soils. Furthermore, new insights from research presented at this conference give tree care professionals more information they can use to help improve urban root and soil management.

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