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Susan D. Day, P. Eric Wiseman, Sarah B. Dickinson, and J. Roger Harris
Contemporary Concepts of Root System Architecture of Urban Trees 149

Abstract. Knowledge of the extent and distribution of tree root systems is essential for managing trees in the built environment. Despite recent advances in root detection tools, published research on tree root architecture in urban settings has been limited and only partially synthesized. Root growth patterns of urban trees may differ considerably from similar species in forested or agricultural environments. This paper reviews literature documenting tree root growth in urban settings as well as literature addressing root architecture in nonurban settings that may contribute to present understanding of tree roots in built environments. Although tree species may have the genetic potential for generating deep root systems (>2 m), rooting depth in urban situations is frequently restricted by impenetrable or inhospitable soil layers or by underground infrastructure. Lateral root extent is likewise subject to restriction by dense soils under hardscape or by absence of irrigation in dry areas. By combining results of numerous studies, the authors of this paper estimated the radius of an unrestricted root system initially increases at a rate of approximately 38 to 1, compared to trunk diameter; however, this ratio likely considerably declines as trees mature. Roots are often irregularly distributed around the tree and may be influenced by cardinal direction, terrain, tree lean, or obstacles in the built environment. Buttress roots, tap roots, and other root types are also discussed.

Key Words. Root Depth; Root Extent; Root Restriction; Urban Forestry; Woody Plants.

Chris Sargent, Michael Raupp, Dick Bean, and Alan J. Sawyer
Dispersal of Emerald Ash Borer within an Intensively Managed Quarantine Zone 160

Abstract. Emerald ash borer (EAB) (*Agrilus planipennis*) is one of the most destructive insect pests of urban trees in the United States. The objective of the current study was to determine the rate of spread of EAB in a quarantine zone where aggressive intervention tactics such as tree destruction occurred. Historical records were examined from the Maryland Department of Agriculture for the years 2003, 2006, 2007, and 2008, to determine the rate of spread of EAB in Maryland, U.S., within the quarantine zone. Despite attempts at eradication and public education, EAB persisted, and the leading edge of beetles moved away from the central infestation point at an average annual rate of 1 km per year and a maximum annual rate of 1.37 km per year between 2003 and 2008. This paper discusses the relative merits and limitations of this quarantine and eradication program and makes suggestions for future management of EAB.

Key Words. *Agrilus planipennis*; dispersal; emerald ash borer; eradication; quarantine; rate of spread.

Rebecca Tirado-Corbalá and Brian K. Slater
Soil Compaction Effects on the Establishment of Three Tropical Tree Species 164

Abstract. Tree seedlings planted in containers along sidewalks in urban environments show restricted growth and development over time. This is the result of limited soil volume and soil compaction that hampers nutrient availability and water movement. Using tree species commonly used in urban forestry in Puerto Rico, this study was conducted to determine their growth response when planted in compacted soils. Seedlings of three ornamental tropical tree species, trumpet bush [*Tecoma stans* (L.) Juss. ex Kunth], bottle brush [*Callistemon citrinus* (Curtis) Skeels], and pink trumpet (*Tabebuia rosea* dc.) were transplanted into pots of sandy clay loam or clay soils at three levels of compaction: control (no compaction), 1.2 g/cm³ and 1.4 g/cm³ bulk density, respectively. Plant height, shoot diameter, leaf number and color, foliar area, and root, shoot, and leaf dry weights were measured on two plants every two months for six months. All species exhibited better growth in sandy clay loam at 1.2 g/cm³; after six months, all species showed a reduced root-shoot ratio. When planted in clay at 1.4 g/cm³, all trumpet bush seedlings died within two months. No leaf color differences were observed between species at different compaction levels. Bottle brush showed less growth suppression by increasing compaction level in both soils.

Key Words. *Callistemon citrinus*; Root Growth; Root-Shoot Ratio; *Tabebuia rosea*; *Tecoma stans*; Tree Establishment; Urban Forestry; Urban Soils.

Jennifer Juzwik, Joseph O'Brien, Charles Evenson, Paul Castillo, and Graham Mahal

Controlling Spread of the Oak Wilt Pathogen (*Ceratocystis fagacearum*) in a Minnesota Urban Forest Park Reserve 171

Abstract. Effectiveness of oak wilt control actions taken between 1997 and 1999 were evaluated for an urban forest park reserve in Minnesota, U.S. A high level of success (84% of evaluated disease centers) was achieved in controlling belowground spread of the vascular pathogen for four to six years by mechanically disrupting inter-tree root connections with the blade of a cable plow (vibratory plow, VP). Placements of the outermost (i.e., primary) VP treatment lines were based on a modified, rule-of-thumb model. Plausible scenarios based on two protocols for preventing pathogen spore production, and thus aboveground insect-mediated spread, were explored in conjunction with alternative, root treatment models using a geographical information system. For the 95% confidence level of a statistical model, the numbers of red oaks inside primary lines were 2.5 times greater than those inside the primary, installed lines and represents the difference in tree losses if all red oaks were removed to the primary lines [i.e., a “cut-to-the-line” (CTL) protocol]. Alternatively, a “monitor and remove” (MR) option (i.e., annual removal of wilting red oaks), would have resulted in 64% fewer removals than CTL. The park’s forestry division subsequently added the MR protocol to its oak wilt control program.

Key Words: Cultural Control; Insect Vector Spread; Integrated Pest Management; Plant Health Care.

Gary Watson

The Effect of Broadcast Nitrogen Fertilization Rates and Placement on the Growth of Green Ash Trees 179

Abstract. Tree responses to slow-release nitrogen fertilization treatments were limited, but application of fertilizer to the inner half of the root zone improved caliper growth and relative chlorophyll content. Concentrating nitrogen fertilizer applications closer to the base of the tree may be able to take advantage of naturally higher root density, in addition to any further root stimulation resulting from the applied fertilizer treatment. The study site was moderately fertile, as are many urban landscapes where lawn and planting beds surrounding trees are fertilized. The pre-existing level of fertility may have contributed to the limited growth response to the nitrogen applications.

Key Words. *Fraxinus pennsylvanica*; Growth Response; Nitrogen; Tree Fertilization; Tree Health.

Edward F. Gilman, Chris Harchick, and Maria Paz

Effect of Tree Size, Root Pruning, and Production Method on Establishment of *Quercus virginiana* 183

Abstract. Significant differences may exist in establishment rate between trees planted from containers and those from field nursery. Container-grown plants have root balls with deflected roots which could impact establishment. Slicing root balls at planting could improve post-planting performance of container-grown trees. Sixty live oak 170 L containers were planted into landscape field soil. Root balls from 30 of these containers were sliced prior to planting. Thirty field-grown trees of slightly larger size, and 30 smaller trees from 57 L containers, were also planted. During dry periods in the first 432 days after planting (DAP), 57 L container trees had the least negative xylem potential. Field-grown trees had the most negative xylem potential when irrigation was withheld 12 DAP. Slicing root balls had little impact on xylem water potential in drought. Defoliation was greater for 170 L container trees than for 57 L containers. Trunk diameter increase of 57 L containers and field-grown trees was greater than for 170 L containers. Field-grown trees grew less in height. Root system radius was similar for 170 L containers and field-grown trees, and greater than 57 L containers. Small trees appear to establish quicker than larger trees.

Key Words: B&B; Containers; Drought; Field-Grown; Irrigation; Planting; Root Ball; root:shoot Ratio; Transplanting; Tree Survival; Xylem Water Potential.