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Matt Follett, Charles A. Nock, Christian Buteau, and Christian Messier

**Testing a New Approach to Quantify Growth Responses to Pruning Among Three Temperate Tree Species ..... 133**

**Abstract.** In settled areas, electrical line safety is maintained by pruning encroaching trees. Identifying key predictors of branch elongation growth rate following pruning would assist in developing predictive models and optimizing pruning cycles. However, measuring branches in trees near electrical lines is complex and challenging. This paper describes an innovative approach using a handheld laser rangefinder to safely and accurately estimate growth from the ground. In-tree and ground-based laser measurements were highly correlated. This was followed by testing for correlations between branch growth response over a number of years after pruning and many biotic and abiotic factors for *Fraxinus pennsylvanica*, *Acer platanoides*, and *Acer saccharinum*, in the city of Montréal, Canada. In a sample of 59 trees, *A. saccharinum* had the greatest branch growth, followed by *F. pennsylvanica*, and finally *A. platanoides*. Branch growth increased following pruning and subsequently strongly declined, with *A. platanoides* declining the fastest. Branch inclination angle was positively correlated with growth rate for two species, but not for *A. saccharinum*. Among the types of pruning used, directional pruning techniques resulted in the least branch regrowth rate. Tree diameter was weakly related to branch growth rates. These results suggest that while growth conditions for street trees may be perceived as homogenous, there is substantial variation in branch growth response. This variation may be related to pruning history, or unmeasured abiotic or biotic variables. Estimating pruning cycle duration is a complex task and further work is needed to develop a predictive model for more accurate estimation of return times.

**Key Words.** *Acer platanoides*; *Acer saccharinum*; Branch Growth; Canada; *Fraxinus pennsylvanica*; Growth Modeling; Laser Rangefinder; Pruning; Québec; Urban Forestry; Utility Pruning; Vegetation Management.

Joseph B. Townsend, Thomas W. Ilvento, and Susan S. Barton

**Exploring the Relationship Between Trees and Human Stress in the Urban Environment ..... 146**

**Abstract.** The research literature describes a positive relationship between seeing plants and human well-being. More rapid recovery from surgery, reduced incidence of neighborhood crime, increased baby birth weight, and increased trust of neighborhood merchants are among the benefits attributed to exposure to trees and shrubs. This study attempted to find a common explanation for these outcomes. It examined the connection between urban trees and neighborhood stress. Each of the stated outcomes can be attributed, in part, to stress reduction. The literature indicated that stress reduction is one of the consequences of exposure to plants. Stress levels were measured at the block level in Wilmington, Delaware, U.S., by means of a survey mailed to 2,704 residents. Physical conditions were catalogued using an on-site inventory. The survey and inventory demonstrated that the total number of trees on a block has a strong negative relationship with neighborhood stress and a positive relationship with self-reported health. The results suggest that moderation of stress is one of the factors that underlies the beneficial consequences of exposure to green vegetation on inner-city blocks. This research should prove useful to city planners and urban residents alike.

**Key Words.** Cross-reference Directory; Delaware; Hassles and Uplifts Scale; Human Stress; Perceived Stress Scale; Street Trees; Survey; Tree Canopy; Tailored Design Method; Tree Inventory; Wilmington.

Edward F. Gilman, Maria Paz, and Chris Harchick

**Impact of Nursery Root Pruning and Tree Orientation at Planting on Growth and Anchorage ..... 160**

**Abstract.** Root pruning by shaving 12 L container root balls when shifting to 51 L containers did not impact *Acer rubrum* L. or *Quercus virginiana* Mill. root architecture within the top 12 cm of planted 51 L root balls five years later, despite marked differences at planting, and had no impact on tree height or trunk diameter increase. Root pruning in the nursery did not affect bending stress required to tilt *Acer* trunks up to five degrees (anchorage) either one, two, or three years after landscape planting. In contrast, anchorage was greater the second year after planting *Quercus* that were root pruned. Rotating trees 180 degrees at planting from their orientation in the nursery had no impact on *Acer* or *Quercus* anchorage, tree height, or trunk diameter. Rotating oak (not maple) trees 180 degrees at planting increased root cross-sectional area growing from the hot (south) side of the root ball when trees were rotated at planting.

**Key Words.** *Acer rubrum*; Anchorage; Bending Stress; Maple; Oak; *Quercus virginiana*; Root Ball Shaving; Root Morphology; Root Pruning; Winching.

Lauren M. Garcia, Michael A. Arnold, Geoffrey C. Denny, Sean T. Carver, and Andrew R. King  
**Differential Environments Influence Initial Transplant Establishment Among Tree Species  
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**Abstract.** Effects of two post-transplant environments were tested on trees grown in five nursery container sizes to determine differences in initial post-transplant growth. *Vitex agnus-castus* L., *Acer rubrum* L. var. *drummondii* (Hook. & Arn. ex Nutt.) Sarg., and *Taxodium distichum* (L.) Rich. grown in 3.5 L (#1), 11.7 L (#3), 23.3 L (#7), 97.8 L (#25), and 175.0 L (#45) containers were transplanted in early summer into field plots in College Station, Texas, and Starkville, Mississippi, U.S. Height, trunk diameter, and canopy width measurements were recorded after nursery production and the end of the first growing season to determine initial growth during landscape establishment. Growth of *A. rubrum* and *T. distichum* were significantly ( $P \leq 0.05$ ) affected by interactions among container sizes and environments, while *V. agnus-castus* did not demonstrate a difference between environments but were affected by container sizes. Across all species and locations, trees transplanted from smaller container sizes exhibited a greater percent change in growth than the larger container-size trees. Greater percent change in growth measures in the smaller container-size trees during the first growing season may indicate a more rapid establishment time compared to trees from larger containers. Where differential responses to environments occurred, predominantly the beneficial effects of smaller container sizes on post-transplant establishment were accentuated with more stressful establishment conditions.

**Key Words.** *Acer rubrum*; Bald Cypress; Chaste Tree; College Station; Mississippi; Red Maple; Starkville; *Taxodium distichum*; Texas; *Vitex agnus-castus*.

Adam G. Dale, Elsa Youngsteadt, and Steven D. Frank  
**Forecasting the Effects of Heat and Pests on Urban Trees: Impervious Surface Thresholds  
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**Abstract.** Trees provide ecosystem services that benefit humans and the environment. Unfortunately, urban trees often do not provide maximum services due to abiotic stress and arthropod herbivores and borers. These problems often originate from trees being planted in unsuitable conditions. Cities are warmer than natural areas because impervious surfaces absorb and reradiate heat. Higher temperatures can increase pest insect abundance and water stress, and reduce street tree condition relative to natural forests. For example, the gloomy scale insect [*Melanaspis tenebricosa* Comstock (Hemiptera: Diaspididae)], a pest of red maple (*Acer rubrum*) street trees, is more abundant in warmer than cooler urban sites. *Acer rubrum*, at warmer urban sites with more *M. tenebricosa*, are typically in poor condition. Here, researchers demonstrate these relationships and illustrate how impervious surface cover can be used to predict the condition of *A. rubrum* street trees. Impervious surface thresholds were then developed to define suitable planting sites that can be used by individuals with access to GIS software. Researchers present the pace-to-plant technique, which can be used by landscape professionals to quickly estimate impervious surface cover around a planting site. These thresholds predict future tree condition based on planting site impervious surface cover. The hope is that more informed planting will minimize pest infestations and maximize the future vigor and performance of street trees.

**Key Words.** *Acer rubrum*; Gloomy Scale; Impervious Surface; Integrated Pest Management; *Melanaspis tenebricosa*; Red Maple; Street Tree; Urban Forestry.

Alessio Fini, Ciro Degl'Innocenti, and Francesco Ferrini  
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**Abstract.** The effects of mixed compost as mulching material on growth and physiology of newly planted elm trees were evaluated over a three-year period after planting in an urban park. Trees mulched with compost generally had greater height (+10% and +19% for 5 cm layer and 10 cm layer treatments, respectively, if compared to control), trunk diameter (+13% and +29%) and current-year shoot growth (+46% and +56%). Limited effects were found with regard to carbon assimilation when considered on a per unit-leaf-area basis (-0.1% and +0.3%), but whole tree carbon assimilation increased in mulched trees (+7% and +59% for 5 cm and 10 cm treatments, respectively, if compared to control) because of the larger total tree leaf area of mulched plants. Mulching also increased chlorophyll content (+4% and +7% for 5 cm and 10 cm treatments, respectively). The results obtained in this study show how mulching with compost increased growth, carbon storage, and improved water use efficiency of trees planted in an urban environment characterized by hot dry summers.

**Key Words.** Carbon Assimilation; Chlorophyll; Elm; Florence; Italy; Mediterranean Climate; Mulch; Photosynthesis; *Ulmus*; Water Use Efficiency.

Cheng-Jung Lin, Chia-Ju Lee, and Ming-Jer Tsai

**Inspection and Evaluation of Decay Damage in Japanese Cedar Trees Through  
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**Abstract.** The purpose of this study was to investigate the standard values of living, undamaged Japanese cedar (*Cryptomeria japonica*) trees through different nondestructive techniques. This study also detects the stress wave velocity (V) and tomogram (VT), and resolves corresponding V maps of Japanese cedar trees with and without decay damage for tree risk assessment. A visual tree inspection form, with seven categories of tree damage, is proposed for tree hazard assessment. Different nondestructive evaluation parameters can serve as an index for diagnosing standard values (with or without decay). The VT and corresponding stress wave velocity maps of decay-damaged and damaged Japanese cedar trees can detect the general location and area of wood deterioration. The transversal acoustic velocity values increased with increasing diameter in undamaged trees, and the difference between the maximum and minimum V value of the trunks in undamaged trees fell within a range of constants. The proposed approach can be combined with other non-destructive techniques to better examine and confirm the situation of trees.

**Key Words.** *Cryptomeria japonica*; Japanese Cedar; Nantou; Nondestructive Technique; Stress Wave; Taiwan; Tomography; Tree Hazard Assessment; Visual Tree Inspection.

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