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Bryant C. Scharenbroch

### **A Meta-analysis of Studies Published in Arboriculture & Urban Forestry Relating to Organic Materials and Impacts on Soil, Tree, and Environmental Properties..... 221**

**Abstract.** Organic materials are commonly used in urban landscapes to improve soil quality and tree health. Literature reviews suggest that the effects of organic materials are beneficial, but these impacts have yet to be evaluated using meta-analytical approach. This work presents a literature summary of 176 articles published in *Arboriculture & Urban Forestry (AUF)* and evaluates 33 of these papers using a meta-analysis. Research relevant to this topic is not published solely in *AUF*, but the meta-analysis is limited to *AUF* in an attempt to specifically focus on the information provided to *AUF* readers. This meta-analysis provides evidence of the mostly positive impacts organic materials have on shoot growth, root growth, tree physiology, and soil physical properties. It also identifies specific gaps in *AUF* literature for the effects organic materials have on soil chemical, soil biological, and environmental (e.g., climate, competition) properties. Further, this meta-analysis suggests the type of organic material and the mode of application have differential effects on tree, soil, and environmental properties.

**Key Words.** Environment; Meta-Analysis; Organic Materials; Soil Organic Matter; Soil Biological Properties; Soil Chemical Properties; Soil Physical Properties; Tree Health.

Michael A. Arnold and Garry V. McDonald

### **Groundcovers, Organic and Inorganic Mulches, and Masonry Surfaces Differentially Affect Establishment and Root Zone Characteristics of Urban Trees ..... 232**

**Abstract.** Three experiments investigated the effects of various groundcovers on establishment of redbuds [*Cercis canadensis* L. var. *texensis* (S. Watson) M. Hopkins 'Alba'] and baldcypress [*Taxodium distichum* (L.) Rich.]. The first experiment involved eight surface treatments. Controls were bare soil. Remaining treatments were pine bark mulch; Asian jasmine [*Trachelospermum asiaticum* (Siebold & Zucc.) Nakai]; St. Augustinegrass [*Stenotaphrum secundatum* (Walt.) Kuntze]; decorative gravel; recycled paper mulch; decorative brick pavers; or seasonal rotations of herbaceous annuals. Other experiments compared brick-on-sand treatments ranging in color from light blonde to dark charcoal with bare soil on establishment of redbuds or baldcypress. Most organic and living soil surface covers were preferable to bare soils, however, some inorganic surface covers were detrimental to tree growth. Paving surfaces adversely affected survival, shoot or root growth, but differences were species dependent. Soil moisture, pH, and bulk density did not appear to be limiting under pavers, but substantial seasonal fluctuations in soil temperatures were observed. Light and medium bricks reflected more photosynthetically active radiation than dark bricks or bare soil. Atmospheric temperatures were greatest above dark and medium bricks. Root growth decreased as darkness of brick color increased. Redbud survival and growth were more adversely affected than with baldcypress.

**Key Words.** Baldcypress; Brick-on-Sand Paving; *Cercis canadensis* var. *texensis*; Groundcovers; Herbaceous Annuals; Inorganic Mulch; Organic Mulch; Plant Competition; Redbud; *Taxodium distichum*; Transplant Establishment; Tree Establishment.

Alessio Fini, Francesco Ferrini, Piero Frangi, Gabriele Amoroso, and Riccardo Piatti

### **Withholding Irrigation During the Establishment Phase Affected Growth and Physiology of Norway Maple (*Acer platanoides*) and Linden (*Tilia* spp.) ..... 241**

**Abstract.** The aim of this work was to investigate the drought tolerance of different *Tilia* species and of different cultivars of *Acer platanoides* grown during the establishment phase, and to evaluate irrigation effect on their growth and physiology. In winter 2004–2005, 168 trees [8–10 cm (3–4 in) circumference] of *Tilia platyphyllos*, *T. cordata*, *T. × europaea*, *T. tomentosa*, *Acer platanoides* 'Summershade', *A. platanoides* 'Deborah', and *A. platanoides* 'Emerald Queen' were planted in the field. Eighty-four plants were irrigated with a drip irrigation system (4 l/h) and eighty-four were not. Height, trunk diameter, and shoot elongation were measured at the end of the growing season in 2005, 2006, and 2007. Leaf gas exchange and chlorophyll fluorescence were measured monthly during the 2006 and 2007 growing seasons. Leaf greenness index content was measured in 2006 and 2007. Results indicate that *T. tomentosa* and *T. cordata* are more drought tolerant during establishment than *T. platyphyllos*, while *Acer platanoides* 'Summershade' is less drought tolerant during establishment than the cultivars 'Emerald Queen' and 'Deborah'.

**Key Words.** *Acer platanoides*; Chlorophyll Fluorescence; Drought Avoidance; Leaf Gas Exchange; *Tilia* spp.; Water Stress.

L.P. Werner and L.G. Jull

**Fertilizer Uptake, Partitioning, and Recovery in Container-Grown Common Hackberry (*Celtis occidentalis*) Trees ..... 252**

**Abstract.** Ammonium-nitrate ( $\text{NH}_4\text{NO}_3$ ) double enriched with the  $^{15}\text{N}$  isotope (1.5 atom %) was used to evaluate fertilizer N recovery, N partitioning, and aboveground N status in container-grown common hackberry (*Celtis occidentalis* L.) trees back-filled with native soil at Arlington, Wisconsin and Lisle, Illinois, U.S. Treatments consisted of 0, 1.42 g N tree<sup>-1</sup> (0.05 oz) and 4.27 g N tree<sup>-1</sup> (0.15 oz), the area equivalent of 0, 0.49, and 1.47 kg N 100 m<sup>-2</sup> (0, 1, and 3 lb N 1000 ft<sup>-2</sup>). Trees were harvested 14, 30, 60, and 90 days after fertilization. Fertilizer-induced changes in aboveground N status were significant only at the 4.27 g N tree<sup>-1</sup> (0.15 oz) treatment level. The amount of fertilizer N recovered in aboveground tissues increased with rate of application. Fertilizer N was preferentially partitioned to foliage and current season stem wood. The percentage of fertilizer recovered in aboveground tissues did not differ between the application rates, ranging from 15%–25% at Arlington, WI, and 5%–9% at Lisle, IL. Frost damage to the foliage at Lisle, IL may have resulted in location differences in aboveground biomass which affected fertilizer N uptake and recovery. These data suggest fertilizer N accumulated in nontarget sinks and/or were lost from the site of application at both rates of application.

**Key Words.** ANSI A-300; Fertilization; Landscape Trees;  $^{15}\text{N}$ .

Glynn C. Percival and Ian Haynes

**The Influence of Calcium Sprays to Reduce Fungicide Inputs Against Apple Scab [*Venturia inaequalis* (Cooke) G. Wint.] ..... 263**

**Abstract.** A goal of pathogen management in the arboriculture industry should be to eliminate or reduce the amount of active ingredients of synthetic fungicides used within a growing season. The aim of this research paper was to evaluate a nonfungicidal pathogen management system by investigating the hypothesis that replacing an apple scab fungicide spray program with calcium reduces fruit and leaf scab severity. In addition, a separate study investigated if a relationship existed between calcium concentrations within foliar tissue of resistant, intermediate, and sensitive apple species and varieties toward scab infection. A number of commercially available calcium products were applied to apple cv. Crown Gold trees at four distinct growth stages (bud break, 90% petal fall, early fruitlet, two weeks after early fruitlet). A comparative evaluation of the synthetic fungicide penconazole commercially used for scab control was also conducted. The experiment was performed in 2006 and repeated in 2007 at the University of Reading Experimental Field Site (UK). Application of calcium sprays significantly reduced the leaf and fruit scab severity of apple cv. Crown Gold however; in a separate study no relationship existed between foliar calcium content and susceptibility to apple scab attack between resistant, intermediate, and sensitive *Malus* species. Greatest protection in both field trials was provided by the synthetic fungicide penconazole. Within the calcium products evaluated, greatest protection in both field trials was provided by calcium chloride and calcium hydroxide. The integration of calcium foliar sprays into existing scab management practices offers a useful addition to reduce scab severity on ornamental apples that has applicability against other foliar diseases frequently encountered within urban landscapes.

**Key Words.** Fruit; Holistic Approach; Integrated Disease Management; Pathogen Control; Plant Health Care; Urban Landscapes.

Jason Grabosky, Edward Haffner, and Nina Bassuk

**Plant Available Moisture in Stone-soil Media for Use Under Pavement While Allowing Urban Tree Root Growth ..... 271**

**Abstract.** Three avenues of experimental observation detail aspects of plant available water holding capacity in compacted stone-soil media designed for urban tree establishment in paved situations. The various compacted media provided an estimated plant available moisture content of 7%–11% by volume, comparable to a loamy sand. Changes in aggregate and of soil influenced initial field capacity moisture content, but high matric potential moisture content was consistent, presumably as a reflection of the aggregate content of the designed system. A large portion of plant available moisture was weakly held in large voids, consistent with related infiltration and permeability data, and could be an influence in water storage and irrigation planning to use layers of designed soils in a layered pavement section for urban vegetation.

**Key Words.** Stalite; Structural Soil; Plant Available Moisture.