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Edward F. Gilman

### **Anchorage Influence by Production Method and Root Pruning ..... 1**

**Abstract.** The objectives were to 1) compare the post-planting anchorage of container-grown and field-grown (balled-and-burlapped) live oaks (*Quercus virginiana* Mill.), and 2) evaluate the effects of root pruning and post-planting irrigation placement on anchorage and growth. At seven months after planting, field-grown trees were approximately 50% better secured to the soil than trees from containers. However, removing the peripheral 5 cm of the container root ball at planting improved anchorage of container-grown trees by approximately 13% without reducing diameter growth or causing visible symptoms. Irrigation placement (applied directly on the root ball or to a wider area) had no effect on anchorage and growth. There appeared to be no benefit to irrigating the soil around the root ball during tree establishment in the fine sand soils that receive 120 mm annual rainfall.

**Key Words.** Anchorage; Container-grown Nursery Trees; Field-grown Nursery Trees; Landscape Planting; Lateral Stability; Root Ball Shaving.

Richard W. Harper and Richard S. Cowles

### **Susceptibility of Chinese Hemlock (*Tsuga chinensis*) to Injury from Autumn Horticultural Oil Applications ..... 6**

**Abstract.** Chinese hemlock (*Tsuga chinensis*) has been suggested as a possible replacement in landscape plantings for eastern hemlocks (*T. canadensis*), which are being lost due to infestations of hemlock woolly adelgid (*Adelges tsugae*). Chinese hemlock is highly resistant to hemlock woolly adelgid, but is a host for elongate hemlock scale (*Fiorinia externa*). Horticultural oil is a popular insecticide commonly used by professionals to manage various insect and mite pests of hemlock in landscapes, including hemlock woolly adelgid, spruce spider mite, and armored scales. In tests, horticultural oil applied in two separate autumn sprays was not phytotoxic to Chinese hemlocks. Therefore, 1% or 2% horticultural oil may be used to maintain Chinese hemlocks in landscape plantings.

**Key Words.** Adelgid; Chinese Hemlock; *Fiorinia externa*; Horticultural Oil; *Tsuga chinensis*.

Anand B. Persad, John Siefer, Roy Montan, Scott Kirby, Oscar J. Rocha, Michael E. Redding, Christopher M. Ranger, and Andrew W. Jones

### **Effects of Emerald Ash Borer Infestation on the Structure and Material Properties of Ash Trees ..... 11**

**Abstract.** Emerald ash borer (EAB), an invasive insect borer on ash trees, currently occurs in the United States and Canada. In many regions, large populations of ash trees are affected with many trees exhibiting partial to full canopy dieback. Several cases exist in northwest Ohio, U.S., where EAB infested ash branches or stems fail prematurely during deadwood pruning or whole tree removal. This study was initiated to resolve the effects of EAB on the material properties of ash branches and stems. Visually non-infested ash trees and trees with recent and advanced EAB activity were examined. The data from static loading tests on primary branches indicate that maximum bending stress at failure was not significantly lower in EAB infested trees compared to non-infested trees. Examination of the fracture zone, however, revealed that wood moisture was significantly lower and more cracking was observed in wood sections of branches taken from EAB infested trees. During static loading, branch failure at the union occurred only in the EAB infested trees. In a wood resistance evaluation of infested and non-infested ash stems, significantly lower resistance was observed in advanced EAB infested ash stems when drilled at the base compared to drill sites 1 m above. This was not observed at similar drill site heights in the visually non-infested ash stems. These data may help identify risk elements associated with structural and material degradation of ash wood as early as one to two years after infestation by EAB.

**Key Words.** Anchor Points; Biomechanics; Branch Failure; Emerald Ash Borer; Resistance Drilling; Static Loading; Zone of Fracture.

C.M. Ryder and G.M. Moore

**The Arboricultural and Economic Benefits of Formative Pruning Street Trees ..... 17**

**Abstract.** Research was undertaken to determine the need for, and costs of, formative pruning recently planted street trees. Specimens of *Corymbia citriodora* (48), *Platanus × acerifolia* (104), *Pyrus calleryana* (79), *Quercus palustris* (65), and *Ulmus parvifolia* (52) were surveyed. Health was similar for all species, but form and structure varied. Data showed that codominant stems (68%) and included bark (40%) in the canopy or trunk were by far the most common structural defects.

Codominant stems were reported in 92% of all *Ulmus parvifolia*, 66% of *Quercus palustris*, 61% of *Pyrus calleryana*, 44% of *Platanus × acerifolia*, and 19% of *Corymbia citriodora*. The number of trees of a species that displayed no structural defects was 25% or less except for *Corymbia citriodora* with 60% showing no structural defects. The pruning required to rectify these structural defects was recorded and then multiplied by a time factor for pruning with secateurs (hand pruners), a handsaw, or a pole pruner. Total time was then converted to an economic cost using current labor market prices.

*Platanus × acerifolia* required the most work per tree with a final formative pruning cost of AUD \$4.13 followed by *Ulmus parvifolia* (\$3.25), *Pyrus calleryana* (\$2.76), *Quercus palustris* (\$1.62), and *Corymbia citriodora* (\$0.99). This compares with an average cost of \$44.59 per tree for structural pruning 20 year old trees. Formative pruning makes sound arboricultural and economic sense.

**Key Words.** Arboricultural Labor; Cost Benefit Analysis; Natural Target Pruning; Tree Management.

Craig A. Tinus and Michael LaMana

**Conversion Efficiency and Economics of Urban Wood Utilization ..... 25**

**Abstract.** Because of changes in land-use zoning, many standard forest management activities are no longer possible in urban and suburban woodland properties being developed. This trend has created an influx of wood fiber into municipal landfills at significant cost to both landowners and municipalities. An alternative to landfill or other off-site disposal was evaluated that returned wood products to the landowner in a fee-for-service business model. Additionally, the cost for removal was modeled in comparison to the potential value of the wood as lumber. In a case study, the overall average marginal difference to the landowner for material removal was a cost of USD \$35 from all job sites ( $n = 21$ ); which was essentially break-even. This approach was cost competitive with landfill disposal, and landowners were able to benefit from wood products derived from trees that were being removed because of site development. Additionally, these landowners were preferentially choosing a form of material recycling that likely reduced the load to municipal waste disposal sites, and as such was a benefit to the community.

**Key Words.** Avoided Disposal; Hedonic Valuation; Log; Lumber; Municipal; Recycling; Sawmill; Wood Waste.

Daniel C. Burcham, Eng-Choon Leong, Yok-King Fong, and Puay-Yok Tan

**Infrared Camera Measurements Reveal Diurnal Variation in the Effect of Mechanically Induced Internal Voids on Stem Temperatures of Small Trees Passively Heated by the Sun ..... 31**

**Abstract.** The relationship between stem temperature measured by an infrared (IR) camera and a tree's internal condition was proposed as a basis for diagnosing potentially hazardous defects in the landscape. Before practical application, this diagnostic technique needs clarification to guide expectations of its resolution and precision. In this study, cylindrical voids of varying size were created in 5 cm diameter stems of *Dracaena fragrans* and *Syzygium grande* by mechanically removing tissue from specimens in an outdoor nursery, and the surface temperature of these plants was measured twice daily at 0830h and 1830h using an IR camera. The collected IR images were analyzed using a concurrent mixed methods approach with qualitative image evaluation and quantitative temperature analysis where the temperature distributions of stems containing internal voids were compared to those without defects. For both species, there was no difference in stem temperatures, as observed in IR images, among any experimental plants at 0830h, but an anomalous temperature reduction was exclusively apparent at 1830h near the 3.8 cm void, occupying 76% stem cross-sectional area. There was also a larger decrease in the linear temperature trend ( $0.34^{\circ}\text{C}$ – $0.51^{\circ}\text{C}$ ) near this void margin compared with other treatments, although this was more pronounced in the monocot species than eudicot. The remaining treatments did not exhibit stem temperatures visibly different from the control. Under experimental conditions, the technique identified relatively large internal defects, but the reduced heat capacity of stems containing such defects is only apparent in the evening after being passively heated by the sun.

**Key Words.** Diagnostic Device; *Dracaena fragrans*; Infrared Camera; Internal Defect; Singapore; *Syzygium grande*; Temperature; Thermal.