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CONTENTS

Abstract. Urban trees are both an asset and a cost to municipalities. Past research has focused largely on the asset—quantifying and valuing the social, economic, and environmental benefits provided by trees in urban areas. Relatively fewer studies have focused on defining the appropriate level of tree care (costs or inputs) for efficiently maintaining tree health and structural integrity, and potential resulting liabilities. On 18–20 March 2015, the International Society of Arboriculture assembled a panel of research and industry experts for a research symposium and summit titled, The Costs of Not Maintaining Trees. In the weeks leading up to the summit, the Delphi technique was initiated to help build consensus on key research questions related to the economics of trees and their care. After three iterations of questions and discussion, the panel identified 14 research topics that were deemed "very important" or "important" by at least 12 of the 14 expert panelists (80% being a commonly used threshold for consensus). Results of this work are intended to help focus future research and funding efforts in arboriculture and urban forestry.

Key Words. Arboricultural Practices; Delphi Technique; Management Challenges; Net Benefits; Optimization; Research Summit; Stakeholder Engagement; Symposia, Urban Forest Management; Urban Tree Benefits.

Abstract. Emerald ash borer (EAB) (*Agrilus planipennis*), first identified near Detroit, Michigan, U.S., in 2002, has killed millions of ash trees (*Fraxinus* spp.) in 28 states and two Canadian provinces to date. Trunk injections of insecticide products containing emamectin benzoate (EB) (e.g., TREE-äge®) are often used to protect ash trees in landscapes from EAB, but wounds and potential injury resulting from injections are a concern. Researchers examined 507 injection sites on 61 trees and recorded evidence of secondary wounding (e.g., external bark cracks, internal xylem necrosis and pathogen infection). Researchers assessed 233 injection sites on 22 green ash and 24 white ash trees macro-injected with a low or a medium-high rate of EB in 2008 only, or in both 2008 and 2009. Only 12 of 233 injection sites (5%) were associated with external bark cracks and there was no evidence of pathogen infection. On 39 of the 46 trees (85%), new xylem was growing over injection sites. Researchers assessed 274 injection sites on 15 green ash trees injected annually with EB from 2008 to 2013 or injected in 2008 and again in 2011. Bark cracks were associated with four injection sites on three trees, but no evidence of injury was found on the other 12 trees. All 15 trees had new xylem laid over injection sites. Confocal laser scanning and polarizing digital microscopy were used to assess the integrity of discolored xylem tissue removed from the immediate area surrounding 140 injection sites on 61 trees. Researchers found no evidence of decay associated with discoloration.

Key Words. *Agrilus planipennis*; Bark Cracks; Emamectin Benzoate; *Fraxinus americana*; *Fraxinus pennsylvanica*; Green Ash; Insecticide; Macroinjection; Trunk Injection; White Ash.

Abstract. Urban forests are vital in urban areas because they clean the air, absorb water, and protect the environment from intense heat. Destruction of the urban forest by increased urbanization is a considerable threat to the ecosystem. Hence, urban planners must obtain and manage information about urban forests, but the complexity of urban areas has made these tasks difficult. With developments in remote-sensing technologies, the monitoring and detection of urban forests can be achieved without performing any field measurements. In this study, different remote-sensing imageries and various methods are evaluated to obtain urban forest information. This review demonstrates that very high resolution (VHR) satellite imagery, such as from WorldView-2, is the most efficient data that can be used to obtain urban forest information. The use of the combination of LiDAR data with VHR imagery increases the accuracy of information, particularly about tree crown delineation. Traditional pixel-based classification methods are not effectively applicable to obtain urban tree information because of significant spectral variability in urban areas. An object-based classification technique, which uses spatial, textural, and color information, can be a potential method to detect urban forest and tree species discrimination. The new VHR imaging method, which uses the object-based technique, is recommended to overcome limitations of collecting urban forest information.

Key Words. LiDAR; Object-Based Classification; Pixel-Based Classification; Satellite Imagery; Tree Crown Delineation; Tree Species Detection.

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Abstract. Degraded, highly compacted soils along roadsides present an inhospitable environment for trees and shrubs and lead to the failure of urban landscapes. Developing and testing practices to ameliorate urban soils, thereby improving plant growth and survival, is essential. This research compared the effects of waste-derived soil amendments on woody landscape plants and soil properties on a compacted highway roadside in Tacoma, Washington, U.S., and compared surface application versus incorporation of amendments. Treatments included yard debris compost (surface-applied and incorporated), biosolids blend (surface-applied and incorporated), and worm castings (surface-applied only), plus a control with no amendments. Amendments were applied 8 cm deep, and incorporated to a 10–15 cm depth on the tilled plots. An 8-cm layer of bark mulch was blown onto all plots, including the control. *Rhus aromatica*, *Symphoricarpos orbiculatus*, and *Mahonia aquifolium* were transplanted from 3.8 L containers in March 2007. One year later, soil under the mulch/amendments was analyzed for bulk density, total carbon, and nitrogen. Plant growth and survival was evaluated for three years. Incorporating soil amendments reduced bulk density by >50% and increased soil C and N tenfold in the incorporated zone. Soil properties within the surface and control treatments or within the incorporated treatments were not different. All amendments significantly improved plant growth in comparison to the bark mulch control, in the order worm castings ≥ biosolids blend ≥ yard debris compost. Neither plant growth nor plant survival was affected by surface application versus incorporation, and plant roots remained confined to the amended zone.

Key Words. Bark; Biomass; Biosolids; Compost; Coralberry; Fragrant Sumac; Highway; *Mahonia aquifolium*; Mulch; Oregon Grape; *Rhus aromatica*; Roadside; *Symphoricarpos orbiculatus*; Total Soil Carbon; Total Soil Nitrogen; Urban Soils; Vermicompost; Washington; Worm Castings; Yard Debris.

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