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Adrianna Szczepaniec and Michael J. Raupp

Effects of Imidacloprid on Spider Mite (Acari: Tetranychidae) Abundance and Associated Injury to Boxwood (*Buxus* spp.) 37

Abstract. Boxwoods are one of the most widely used woody shrubs in managed landscapes, but they suffer frequent attack by the boxwood leafminer (*Monarthropalpus flavus*). The neonicotinoid insecticide imidacloprid is highly efficacious in reducing the abundance of *M. flavus* when applied as a foliar spray or a soil drench. Recent reports of elevated populations of spider mites following applications of imidacloprid to other species of woody plants prompted an investigation to determine the effects of imidacloprid on abundance of a specialist spider mite, *Eurytetranychus buxi*, and the resultant damage it causes. Boxwoods treated with imidacloprid housed significantly more *E. buxi* and sustained more discoloration than untreated boxwoods. Moreover, there was a direct relationship between the abundance of *E. buxi* and the amount of associated injury. Arborists and landscape managers should be aware of the potential for elevated abundance of spider mites on boxwoods and greater levels of discoloration following applications of imidacloprid.

Key Words. *Buxus* spp.; *Eurytetranychus buxi*; Imidacloprid; Injury; *Monarthropalpus flavus*; Secondary Pest Outbreak.

Joseph J. Docola, William Hascher, John Joseph Aiken, and Peter M. Wild

Treatment Strategies Using Imidacloprid in Hemlock Woolly Adelgid (*Adelges tsugae* Annand) Infested Eastern Hemlock (*Tsuga canadensis* Carrière) Trees 41

Abstract. Due to the widespread establishment of hemlock woolly adelgid (*Adelges tsugae* Annand) (HWA) across the range of eastern hemlock (*Tsuga canadensis* Carrière), woodland trees may be infested for many years before treatment is made. Symptoms of prolonged infestation include extensive dieback and thinned canopies. Imidacloprid, a systemic neonicotinoid insecticide, is a useful and effective tool to manage HWA. In this study, mature, large diameter trees in poor condition were treated with imidacloprid. Trees were treated once by trunk and/or soil injection in Asheville, North Carolina, U.S. Following application, changes in tree growth, HWA density and imidacloprid residues were measured for three years. Trees treated with imidacloprid recovered, whereas the untreated trees continued to struggle. Trees injected with imidacloprid accumulated compound in the canopy, facilitating refoliation and the imidacloprid persisted for three years. This extended activity of trunk-injected imidacloprid was attributed in part to slow upward movement through the restrictive tracheid vascular system and to perennial needle retention. The imidacloprid soil injection was slower to act systemically, but has potential for longer-term activity. Researchers suggest the combination of tree and soil injection for immediate and long-term (4+ years) activity as an effective and economic strategy to protect high-value trees.

Key Words. Eastern Hemlock; Hemlock Woolly Adelgid; Imidacloprid, Soil Injection; Tree Injection.

Evan M. Keto, Melissa R. McHale, George R. Hess, Bronson P. Bullock, and Gary B. Blank

Design Choices and Urban Forest Characteristics in Raleigh, North Carolina, U.S. Parking Lots 50

Abstract. Trees provide important environmental, economic, and social benefits that can help to offset the negative effects of parking lots. Many cities recognize that adding space for trees in parking lots is beneficial and have created regulations that dictate minimum requirements for tree planting. However, it is not clear if tree plantings in parking lots achieve the urban tree canopy goals initially imagined by these communities. The study authors sampled parking lot trees in Raleigh, North Carolina, U.S., to determine how species composition and urban forest structure vary with respect to parking lot size, shape, and design. Using a two-stage cluster sampling scheme, Raleigh's parking lots were found to contain 44,000 ± 24,000 trees (95% confidence interval). No differences in tree composition were explained by the size or shape of the parking lots. Planting spaces within the parking lot that were preserved during construction were found to have more trees, canopy, and basal area per hectare than designed planting spaces in which the number, spacing, and species of trees were prescribed. Among designed planting spaces, large, linear rows had greater canopy and basal area per tree but fewer trees per hectare than smaller, circular islands. These results suggest that decisions made during the design process may have lasting effects on the structure and function of this portion of the urban forest.

Key Words. Automobile; Car Park; Environmental Impacts; Parking Lot Design; Transportation; Tree Planting; Tree Preservation; Urban Forest Structure.

Nicholas A. Martin, Arthur H. Chappelka, Edward F. Loewenstein, Gary J. Keever, and Greg Somers
**Predictive Open-grown Crown Width Equations for Three Oak Species Planted
in a Southern Urban Locale 58**

Abstract. Models that predict ecosystem services in urban areas are useful tools to urban forest managers. Predictive open-grown crown width equations were developed for three oak species common in urban forests in the southern United States. Tree crown form is an important component of these equations; however, there are few predictive equations available for urban, open-grown trees. The species used were *Quercus lyrata* Walt. (overcup oak), *Quercus nuttallii* Palmer (Nuttall oak), and *Quercus phellos* L. (willow oak). The study authors believe that these are the first predictive open-grown crown width equations developed for these species in the southern U.S. Diameter at breast height (DBH) (independent variable), DBH² (independent variable), and average crown width (dependent variable) data were used to create the predictive crown width equations and yielded R² values of 0.96, 0.94, and 0.91 for overcup, Nuttall, and willow oaks, respectively. These equations can aid urban landscape and utility planners by providing a means to predict crown dimensions at varying trunk diameters. Field time could also be minimized by reducing the need to measure crown width and with time, these equations could be used to validate species specific equations (e.g., leaf biomass) for these and other southern urban-planted tree species.

Key Words. Dimensional Relationships; Open-Grown Crown Width Equations; Predictive Crown Width Equations; *Quercus lyrata*; *Quercus nuttallii*; *Quercus phellos*; Urban Trees.

Barbara A. Fair, James D. Metzger, and James Vent
**Response of Eight Maple Cultivars (*Acer* spp.) to Soil Compaction and Effects of Two Rates
of Pre-plant Nitrogen on Tree Establishment and Aboveground Growth 64**

Abstract. This study assessed soil compaction effects on aboveground growth of maple cultivars, and compared two nitrogen rates applied pre-planting for their influence on establishment and growth of trees planted into compacted soils. Eight commonly used maple cultivars of *Acer rubrum* and *Acer × freemanii* were evaluated. During container production, plants received either 25 or 100 mg·L⁻¹ nitrogen through fertigation twice per day. Trees were planted into non-compacted field plots with a mean bulk density of 1.40 g·cm⁻³, or into compacted plots with a mean bulk density of 1.60 g·cm⁻³. In 2002, researchers randomly selected half of the compacted plots and applied an additional soil treatment. At the completion of this treatment, mean bulk density was 1.55 g·cm⁻³. Trees growing in higher density soils had significantly smaller aboveground biomass measures ($P < 0.05$), than those growing in non-compacted plots. There was a significant difference between cultivars ($P < 0.0001$); for example, ‘Celzam’ and ‘Fairview Flame’ had greater aboveground biomass values than other cultivars when grown in compacted soils, but compaction still affected growth. The 100 mg·L⁻¹ nitrogen rate increased leaf dry weight and area, but did not impact height and caliper growth or stem dry weight.

Key Words. *Acer × freemanii*; *Acer rubrum*; Compaction; Freeman Maple; Nitrogen Rates; Red Maple; Tree Establishment.
