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Anna Levinsson

**Post-transplant Shoot Growth of Trees From Five Different Production Methods is Affected by Site and Species ..... 201**

**Abstract.** After transplanting, many trees enter a period of reduced growth that may limit their environmental and aesthetic benefits for several years. A number of nursery production methods have been developed in attempt to reduce root disturbance, which is often associated with the reduced growth. The main objective of this study was to investigate how five nursery production methods affect root systems and post-transplant shoot growth. Other objectives were the study of the effect of root structure (i.e., fibrous verses coarse) on trees' response to different production methods and the effect of the conditions at the transplanting site. Sweet cherry (*Prunus avium* L.) and red oak (*Quercus rubra* L.) with a stem circumference of 16–18 cm were produced as bare-rooted-, balled-and-burlapped-, root-pruned-, air-potted-, or fabric-container-grown trees, transplanted at two sites and studied for five seasons. Visual analysis showed that the production methods had clear effect on the root balls at transplanting. However, the differences were not clearly related to shoot growth. All transplanted red oaks, regardless of production method, showed significantly reduced shoot growth compared to pre-transplant growth. Balled and burlapped, root-pruned, and fabric-container-grown sweet cherry trees exhibited restored pre-transplant shoot growth three years after transplanting at the more favorable site. The results suggest that the fibrous-rooted sweet cherry was more responsive to production methods designed to reduce transplanting stress than the coarse-rooted red oak, and that site affected the time required for normal shoot growth to be regained. The results do not indicate that different sites require differently produced trees.

**Key Words.** Nursery Production; *Prunus avium*; *Quercus rubra*; Red Oak; Root Growth; Root Structure; Shoot Growth; Sweden; Sweet Cherry; Transplanting Stress; Urban Trees.

Nematollah Etemadi, Rezvan Mohammadi Nezhad, Najmeh Zamani, and Mohammad Mahdi Majidi

**Effect of Transplanting Date and Harvest Method on Growth and Survival of Three Urban Tree Species in an Arid Climate ..... 211**

**Abstract.** The major challenges for transplanting trees in arid regions compared to temperate regions are higher mortality and slower rate of establishment. As such, date and method of transplanting can potentially improve survival and establishment as well as subsequent landscape performance of transplanted trees in arid climate. In the present study, three urban species commonly used in the Isfahan, Iran, landscape including eldarica pine (*Pinus eldarica* Medw.), white mulberry (*Morus alba* L.), and smoothleaf elm (*Ulmus carpiniifolia* Gled.), were transplanted from January to June 2010, when mean air temperature was less than 10°C (early winter), between 10°C and 20°C (early spring), or more than 20°C (late spring). Half of the trees were bare root (BR) and half balled and burlapped (B&B). White mulberry and smoothleaf elm trees transplanted early in winter had the highest survival percentage over two years. The best survival for eldarica pine was observed in early spring transplanted trees. For all species, survival rate and trunk diameter increase of B&B trees were significantly greater than BR trees during the first year. Also, the first year's shoot growth and shoot number of pine trees, and dieback on elm trees, were significantly affected by transplanting method. During the second year, tree growth and survival for all species were similar for B&B and BR trees. Annual shoot growth of eldarica pine and smoothleaf elm trees, but not white mulberry, equaled to non-transplanted trees by the end of third year after transplanting, suggesting a species-specific response for post-transplant establishment in arid climate.

**Key Words.** Arid Climate; Balled and Burlapped; Bare Root; Cultural Practices; Eldarica Pine; Iran; Isfahan; *Morus alba*; *Pinus eldarica*; Relative Growth Rate; Shoot Growth; Smoothleaf Elm; *Ulmus carpiniifolia*; White Mulberry.

Hanns Christof Spatz and Jochen Pfisterer

**Mechanical Properties of Green Wood and Their Relevance for Tree Risk Assessment..... 218**

**Abstract.** In a biological context, the mechanical properties as elasticity and strength of green wood, particularly as measured in the axial direction, influence the stability of trees against static loads (e.g., snow, ice, rain) and dynamic loads (i.e., wind). Extensive collections of data on mechanical properties are listed in three different catalogs edited in Canada, Great Britain, and the United States. A statistical analysis shows that the density of the wood is a major predictor for the mechanical properties as measured in axial direction. In this respect, conifers from temperate zones and deciduous trees both from temperate and tropical zones do not differ significantly from each other. A common, nearly linear relation between the modulus of elasticity and the density at 50% moisture content is found. Relationships between strengths in bending, compression, and shear and green wood density have ordinary least squares scaling exponents around 1.2, but can almost equally well be approximated by linear functions of wood density. Therefore, if the density of stem wood of a given tree is known from direct measurement and differs from the tabulated value, the values tabulated for mechanical properties can be corrected for by a simple rule of proportion.

Pulling tests as tools for tree control are discussed with emphasis on how the method is based on the knowledge of the mechanical properties of green wood, and how wood density is measured.

**Key Words.** Conifers; Deciduous trees; Elasticity; Green wood; Pulling Tests; Strength; Wood density.

Munna Singh, Aradhna Kumari, and Krishan Kumar Verma

**Physiological, Growth, and Biomass Attributes in *Populus deltoides* L. (clones G-48 and Kranti) Influenced by Water Stress ..... 226**

**Abstract.** Six-week-old uniform cottonwood seedlings (clones G-48 and Kranti) were raised from stem cuttings and subjected under two different water regimes (full and half field capacity) up to 60 days under open field conditions. The higher and lower regulations of physiological responses were triggered in case these seedlings irrigated up to their full and half-field capacities. The enhanced *A* value was observed from 13–19 and 12–14  $\mu\text{mol m}^{-2}\text{s}^{-1}$  in clones G-48 and Kranti after subjecting them under irrigation to the level of full field capacity. The withdrawal of irrigation to the level of half field capacity could reduce these values ( $\leq 50\%$ ), significantly. The decreased  $\text{CO}_2$  assimilation during drought stress was found to be correlated with decline in transpiration, largely regulated by stomatal dynamics to restrict  $\text{CO}_2$  diffusion, which also impaired carboxylation. Upon experiencing drought, the progressive loss in maximum quantum yield of photosystem II photochemistry (*Fv/Fm*) and  $\text{CO}_2$  assimilation was found to be correlated with the loss in transpiration in both these clones. Consequently, the study reveals that irrigation to the level of half field capacity for a period of 60 days impaired agronomic traits viz., plant height, number of leaves, leaf area expansion, specific leaf area, relative water content, biomass, and harvest index, significantly. It also concludes susceptibility of clones G-48 and Kranti toward drought in relation to plant performance (i.e.,  $\text{CO}_2$  assimilation, *Fv/Fm*, and biomass yield).

**Key Words.** Biomass; Cottonwood; Drought; *Fv/Fm*; Photosynthesis; *Populus deltoides* L.; Transpiration.

Adrianna Szczepaniec, Brian B. Raupp, and Michael J. Raupp

**Effects of Dinotefuran and Imidacloprid on Target and Non-target Arthropods on American Elm ..... 231**

**Abstract.** Neonicotinoid insecticides are a relatively new class of compounds with excellent efficacy against a broad assemblage of key insect pests of woody plants. Unfortunately, the use of one neonicotinoid, imidacloprid, has been linked to secondary outbreaks of several species of spider mites on different trees and shrubs. Dinotefuran is another neonicotinoid insecticide now widely used by arborists to manage insects, including egregious borers like emerald ash borer. Researchers tested a hypothesis that applications of dinotefuran to American elms (*Ulmus americana*) elevated populations of a spider mite, *Tetranychus schoenei*, and rust mites in the family Diptilomiopidae, and found no indication that dinotefuran elevated densities of either mite. Applications of imidacloprid elevated densities of *T. schoenei*, but not Diptilomiopidae. Both neonicotinoids were highly efficacious in reducing abundances of European elm scale, *Eriococcus spuria*, and elm cockscomb gall aphid, *Colopha ulmicola*.

**Key Words.** Cockscomb Gall Aphid; *Colopha ulmicola*; Diptilomiopidae; Dinotefuran; *Eriococcus spuria*; European Elm Scale; Imidacloprid; Rust Mites; Secondary Pest Outbreak; Spider Mites; *Tetranychus schoenei*; *Ulmus americana*.

Daniel A. Potter and Carl T. Redmond

**Relative Resistance or Susceptibility of Landscape-suitable Elms (*Ulmus* spp.)  
to Multiple Insect Pests.....**

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**Abstract.** The National Elm Trial is a cooperative project to assess landscape suitability of Dutch elm disease-resistant elms (*Ulmus* spp.) in various regions of the United States. Researchers evaluated 20 cultivars of American, Asian, and hybrid elms for relative resistance or susceptibility to multiple insect pests in central Kentucky over seven years. Ratings for Japanese beetle, European elm flea weevil (EEFW), and several other pests were previously published. This paper reports data for seven additional pests, including honeydew-excreting scale insects (*Parthenolecanium corni*, *Eriococcus spuria*, and *Pulvinaria innumerabilis*), leaf-distorting woolly elm and woolly apple aphids (*Eriosoma* spp.), elm cockscomb gall aphid (*Colopha ulmicola*), and an invasive weevil (*Oedophrys hilleri*) not previously known to damage elms. Rankings for all 12 of the monitored pests are summarized. Most *U. americana* cultivars were relatively susceptible to the scale insects and likewise, *Eriosoma* spp. and *C. ulmicola* only infested the American elms. *O. hilleri* is a new state record for Kentucky. Its adults, active in mid- to late summer, chewed notches in edges of leaves. Cultivars of the Asian species *U. parvifolia* and *U. propinqua*, including ‘Athena Classic Lacebark’, ‘Everclear Lacebark’, ‘Emer II Allee’, and ‘Emerald Sunshine’ were top-rated for insect resistance. They were nearly pest-free except for foliar damage by EEFW, to which nearly all elms were susceptible. Insect resistance should be considered when re-introducing elms to urban landscapes. The data may help city foresters, landscapers, and others re-introducing elms to urban landscapes to select relatively pest-free cultivars requiring minimal inputs for insect control.

**Key Words.** Cockscomb gall Aphid; Dutch Elm Disease; *Eriococcus spuria*; *Eriosoma* spp.; European Elm Flea Weevil; National Elm Trial; *Oedophrys hilleri*; *Parthenolecanium corni*; *Ulmus* spp.

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