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Abstract. We evaluated the effectiveness of carbaryl, bifenthrin, and permethrin in protecting Arizona cypress (*Cupressus arizonica*) and one seed juniper (*Juniperus monosperma*) from attack by two bark beetles (*Phloeosinus* spp.). Spray formulations of 2.0% carbaryl (Sevin SL), 0.03% and 0.06% bifenthrin (Onyx), and 0.19% permethrin (Permethrin Plus C) were assessed on bolts (sections of logs) of Arizona cypress for their effectiveness in preventing *Phloeosinus cristatus* attack and colonization. *P. cristatus* broods were produced in all of the Arizona cypress control bolts. Bifenthrin provided 80% and 70% protection by the 0.06% and 0.03% formulations, respectively, whereas 0.19% permethrin and 2.0% carbaryl treatments provided <70% protection. Insecticide sprays (1.0% carbaryl, 0.03% and 0.06% bifenthrin, and 0.19% permethrin) were tested for prevention of *P. scopulorum neomexicanus* attack and colonization on one-seed juniper bolts. Bark beetle galleries were present in 62.5% of the one-seed juniper control bolts. Data on the presence versus absence of *P. scopulorum neomexicanus* galleries indicated that the 0.03% and 0.06% bifenthrin and 0.19% permethrin treatments provided 90% protection and the 1.0% carbaryl spray was 80% effective at preventing colonization. The 0.06% bifenthrin formulation provided the best protection against both species of *Phloeosinus* beetles.

Key Words. Arizona Cypress; Bark Beetle; Bifenthrin; Carbaryl; Insecticides; One-Seed Juniper; *P. scopulorum neomexicanus*; Permethrin; *Phloeosinus cristatus*; Urban Forestry.

Paul D. Ries, A. Scott Reed, and Sarah J. Kresse
**The Impact of Statewide Urban Forestry Programs:
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Abstract. All 50 U.S. states have a state urban forestry program that provides assistance to cities. Statewide surveys of city urban forestry leaders are a common tool for assessing urban forestry needs and accomplishments. Oregon has conducted two such comprehensive surveys, in 1992 and 2004. The 2004 survey was designed to gain insight into the scope and extent of the urban forest resource in Oregon to measure local program accomplishment since 1992 and to measure the impact of a statewide urban forestry assistance program. The survey had a return rate of 51%, and the results show differences among small, medium, and large communities. Results show that Oregon cities have made significant gains in urban forest management over the last 12 years. The data reveal insights of local urban foresters relative to tree-related issues and outcomes of local efforts. This research illustrates the impact a state urban forestry assistance program can have on local program accomplishment. Oregon cities that have received state assistance are more likely to have urban forestry program components such as tree ordinances and inventories, are more likely to be Tree City USA communities, and are more likely to be investing in urban forestry activities.

Key Words. Performance Measurement; Program Assessment; Program Impact; Small Communities; Urban and Community Forestry; Urban Forestry Planning.

Henry D. Gerhold
Crabapple Cultivars Tested As Street Trees: Third Report 176

Abstract. Through the Municipal Tree Restoration Program, cooperators planted 22 crabapple (*Malus*) cultivars in 31 communities for evaluation as street trees, typically comparing two in each community. Standardized measurements in years 1, 2, 3, 6, 9, and 12 revealed differences in height, crown width, and foliage health. These are useful for selecting the most appropriate cultivars for various site conditions. Only the tallest cultivars, 'Spring Snow' and 'Red Barron', have reached an average height of 6.5 to 6.7 m (21.5 to 22 ft) in 12 years, which is still below most electric distribution lines. Yearly growth patterns varied somewhat among locations and cultivars. The rate of height growth of most cultivars has been declining during years 9 to 12, and in many cases appears to be leveling off at heights between 4 and 6 m (13.2 and 19.8 ft). Red Jewel®, Sugar Tyme®, and Centurion® have narrower crowns, whereas others are still enlarging. Foliage health remained good to excellent throughout the summer on all but seven of the cultivars, and even these retained more than half of their leaves in good condition.

Key Words. Crabapple Cultivars; *Malus*; Performance Testing; Street Tree Evaluation.

Henry D. Gerhold

Tree Lilac (*Syringa reticulata*) Cultivars Tested As Street Trees: Second Report..... 182

Abstract. Through the Municipal Tree Restoration Program, cooperators planted three tree lilac (*Syringa reticulata*) cultivars in 13 Pennsylvania and New York, U.S. communities for evaluation as street trees, comparing two in each community. Standardized measurements in years 1, 2, 3, 6, 9, and 12 revealed that 'Ivory Silk', 'Regent', and 'Summer Snow' grew well and remained healthy at all locations. Average heights of the cultivars in the 12th year ranged from 4.8 to 5.1 m (15.8 to 16.8 ft). Differences in average height and crown width were small. In one community, the tallest cultivar, 'Ivory Silk', attained an average height of 6.4 m (21.1 ft) in the 12th year. 'Summer Snow' grew more slowly in height initially, and 'Regent' had narrower crowns. Foliage health ratings were somewhat lower than those of other species in some years, probably reflecting earlier yellowing of leaves in the autumn. If the tree lilac cultivars continue to grow at the same rate, they would not grow into overhead utility wires until the 18th year or later.

Key Words. 'Ivory Silk'; Performance Testing; 'Regent'; Street Trees; 'Summer Snow'; *Syringa reticulata*; Tree Lilac.

Glynn C. Percival and Gillian A. Fraser

The Influence of Commercial Film-Forming Polymers on Reducing Salt Spray Injury in Evergreen Oak (*Quercus ilex* L.) and Laurel (*Prunus laurocerasus* L.)..... 185

Abstract. A field trial was undertaken to determine the influence of four commercially available film-forming polymers (Bond [alkyl phenyl hydroxyl polyoxyethylene], Newman Crop Spray 11E™ [paraffinic oil], Nu-Film P [poly-1-p menthene], and Spray Gard [di-1-p menthene]) on reducing salt spray injury on two woody species, evergreen oak (*Quercus ilex* L.) and laurel (*Prunus laurocerasus* L.). Irrespective of species, the film-forming polymers Nu-Film-P and Spay Gard did not provide any significant degree of protection against salt spray damage irrespective of concentration (1% or 2%) applied as measured by leaf chlorophyll concentrations, photosynthetic efficiency, visual leaf necrosis, foliar sodium and chloride content, and growth (height, leaf area). The film-forming polymer Newman Crop Spray 11E™ provided only 1-week protection against salt spray injury. The film-forming polymer Bond provided a significant ($P < 0.05$) degree of protection against salt spray injury 3 months after application as manifest by higher leaf chlorophyll content, photosynthetic efficiency, height and leaf area, and lower visual leaf necrosis and foliar Na and Cl content compared with nontreated controls. In conclusion, results indicate that application of a suitable film-forming polymer can provide a significant degree of protection of up to 3 months against salt spray injury in evergreen oak and laurel. Results also indicate that when applied at 1% or 2% solutions, no problems associated with phytotoxicity and rapid degradation on the leaf surface exist.

Key Words. Antitranspirants; Carotenoids; Chlorophyll Fluorescence; Chlorophylls; English Oak; Laurel; Leaf Necrosis; Photosystem II; Sodium Chloride; Urban Trees.

A.M. Shirazi and S.H. Vogel

Temperature Fluctuation in *Fraxinus pennsylvanica* var. *subintegerrima* and Its Surrounding Environment..... 193

Abstract. Temperature fluctuation (TF) in an 18-year-old *Fraxinus pennsylvanica* var. *subintegerrima* and its surrounding environment was monitored using HOBO Pro temperature sensors recording every 15 min from December 2001 to February 2003 at The Morton Arboretum, Lisle, Illinois, U.S. There were significant differences ($P < 0.05$) between TF in 2001, mild cold temperatures, and 2003, severe record-breaking cold temperatures. In mid-December 2001, TF range in soil 30 cm (12 in) was 4°C (39.2°F) to 4.5°C (40.1°F), sod was 3°C (37.4°F) to 4°C (39.2°F), and soil surface was 2°C (35.6°F) to 2.5°C (36.5°F), whereas canopy and mulch ranged from -1°C (30.2°F) to 10°C (50°F). The south side of the trunk had the highest fluctuation of 1°C (33.8°F) to 14°C (57.2°F) followed primarily by the west side with occasional peaks in the east. However, the west side had the highest temperature peak in mid-June. The temperature difference between south and north sides during mid-December were approximately 7°C (44.6°F). In April, the TF inside the trunk ranged from 2°C (35.6°F) to 5.5°C (41.9°F) compared with the canopy, which varied between -0.5°C (31.1°F) and 8°C (46.4°F). The west side was 2°C (35.6°F) to 3°C (37.4°F) higher in mid-July than the south, east, and north sides. On 15 February 2003, which was the coldest day recorded, the soil 30 cm (12 in) temperature (under the mulch) reached $\approx -1^\circ\text{C}$ ($\approx 30.2^\circ\text{F}$), whereas sod and soil surface were $\approx -2^\circ\text{C}$ ($\approx 28.4^\circ\text{F}$). Mulch and base temperature ranged from -1°C (30.2°F) to -5°C (23°F) and -2.5°C (27.5°F) to -7.5°C (18.5°F), respectively. Root core temperature was $\approx -1^\circ\text{C}$ ($\approx 30.2^\circ\text{F}$), the trunk temperature range was -2.5°C (27.5°F) to -3.5°C (25.7°F), whereas the canopy was -2.5°C (27.5°F) to -7.5°C (18.5°F). The south TF range was between -0.5°C (31.1°F) and -7.5°C (18.5°F) from midday to midnight. The TF difference between south and north sides was $\approx 2.5^\circ\text{C}$ ($\approx 36.5^\circ\text{F}$). This freeze and thaw of the south side during winter months has been attributed to sunscald in some trees. Based on temperature observations during the coldest and warmest week, a temperature fluctuation factor (TFF), a difference between weekly minimum and maximum temperature, was introduced. During the coldest week, the TFF for canopy to trunk was 2 \times , trunk to root or soil was 10 \times , and canopy to root or soil was 20 \times . During the warmest week, the TFF for canopy to trunk was 2 \times , trunk to root or soil was 7.5 \times , and canopy to root or soil was 15 \times . The stem water content was higher throughout the year; however, the bud water content was significantly higher when approaching budbreak in April to May. In a companion study, the effect of mulch depth on TF was reexamined showing that the temperature of mulch varies dependent on the time of year. In October, 15 cm (6 in) mulch was several degrees warmer than ground, 7.5 cm (3 in) mulch, and 30 cm (12 in) mulch ($P < 0.05$); however, in December and February, 30 cm (12 in) of mulch was significantly warmer ($P < 0.05$). There are many factors other than temperature that affect tree growth and development. The dynamics of TF give a greater understanding of the role temperature plays in tree physiology as well as improving horticultural and arboricultural understanding in urban environments, resulting in improved landscape management.

Key Words. Canopy; Cold Hardiness; HOBO Pro; Mulch; Root Zone; Sod; Temperature Sensor.

Thayne Montague, Cynthia McKenney, Michael Maurer, and Brian Winn

Influence of Irrigation Volume and Mulch on Establishment of Select Shrub Species 202

Abstract. In many climates, irrigating shrubs during establishment is critical for long-term growth and survival. However, little research has been conducted to investigate irrigation requirements of newly transplanted container-grown shrubs. During two growing seasons, we investigated gas exchange and growth of newly planted container-grown crapemyrtle (*Lagerstroemia indica* ‘Victor’), forsythia (*Forsythia* × *intermedia* ‘Ly wood’), Vanhoutte spirea (*Spiraea* × *vanhouttei*), and photinia (*Photinia* × *fraseri*) transplants placed into landscape beds with and without organic mulch. After transplanting, plants were irrigated twice each week at the following rates: 100%, 75%, and 50% of reference evapotranspiration (ETO). In general, each year, transplants with mulch and transplants receiving 100% or 75% ETO-based irrigation had greater stomatal conductance when compared with transplants without mulch and transplants receiving less irrigation. Growth of transplants followed similar trends. However, it is key to note all transplants survived and appeared healthy throughout the growing season. Even transplants receiving 50% ETO were aesthetically pleasing and had growth acceptable for landscape situations. These findings should be useful for landscape irrigation scheduling and for irrigation managers incorporating water conservation into their landscape maintenance programs.

Key Words. *Forsythia* × *intermedia*; *Lagerstroemia indica*; *Photinia* × *fraseri*; Reference Evapotranspiration; *Spiraea* × *vanhouttei*; Transplant.

M.T. Mmbaga and J.B. Oliver

Effect of Biopesticides on Foliar Diseases and Japanese Beetle (*Popillia japonica*) Adults in Roses (*Rosa* spp.), Oakleaf Hydrangea (*Hydrangea quercifolia*), and Crapemyrtle (*Lagerstroemia indica*) 210

Abstract. This study evaluated efficacy of biopesticides for reducing foliar diseases and feeding damage from Japanese beetle adults on hybrid T rose (*Rosa* spp.), oakleaf hydrangea (*Hydrangea quercifolia*), and crapemyrtle (*Lagerstroemia indica*). The materials tested included household soaps with Triclosan active ingredient (Equate® and Ajax), kaolin clay (Surround®), neem seed oil extract (Triact 70® and Neem Gold®), potassium salt of fatty acids (M-Pede®), horticultural oil (UltraFine® Sunspray oil), and bicarbonate salt (Armicarb®) applied to plants grown under greenhouse, shadehouse, and field conditions. Two fungicides, trifloxystrobin (Strobilurin) and triadimefon (Triazole), and the insecticide carbaryl were included for comparison. All materials tested were effective in controlling black spot (*Marssonina rosae*, anamorph *Diplocarpon rosae*) and powdery mildew (*Sphaerotheca pannosa*) of roses. Kaolin was effective in reducing disease severity of bacterial leaf spot (*Xanthomonas campestris*) on oakleaf hydrangea and powdery mildew of crapemyrtle. Based on data from repeated trials, the biopesticides were as effective as conventional fungicides in suppressing foliar diseases. Kaolin clay was as effective as carbaryl in controlling Japanese beetle adult feeding damage on oakleaf hydrangea, roses, and crapemyrtle, but other products were not effective. Results from this study indicate kaolin clay may be an alternative product to conventional pesticides in foliar diseases and insect pest management for roses, oakleaf hydrangea, and crapemyrtle.

Key Words. Black Spot; Fungicides; Insecticides; Japanese Beetle; Pest Management; Powdery Mildew; *Xanthomonas* Leaf Spot.

David J. Nowak, Robert Hoehn, and Daniel E. Crane

Oxygen Production by Urban Trees in the United States..... 220

Abstract. Urban forests in the coterminous United States are estimated to produce ≈61 million metric tons (67 million tons) of oxygen annually, enough oxygen to offset the annual oxygen consumption of approximately two-thirds of the U.S. population. Although oxygen production is often cited as a significant benefit of trees, this benefit is relatively insignificant and of negligible value as a result of the large oxygen content of the atmosphere. Other benefits of the urban forest are more critical to environmental quality and human health than oxygen production by urban trees.

Key Words. Air Quality; Environmental Quality; Tree Benefits; Urban Forests.
