

## ARBORICULTURAL ABSTRACTS

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### ELEVATED CO<sub>2</sub> AND TREE ROOT GROWTH: CONTRASTING RESPONSES IN FRAXINUS EXCELSIOR, QUERCUS PETRAEA, AND PINUS SYLVESTRIS

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Root growth and respiration in elevated CO<sub>2</sub> (700  $\mu\text{mol mol}^{-1}$ ) was studied in 3 tree species, *Fraxinus excelsior* L., *Quercus petraea* L., and *Pinus sylvestris* L. grown in open-top chambers (OTCs) during a long-term exposure (20 months), during which root systems were allowed to develop without restriction imposed by pots. Root growth, measured as root length using root in-growth bags, was increased significantly in trees exposed to elevated CO<sub>2</sub>, although the magnitude of the response differed considerably between species and with time of sampling, the greatest effect observed after 6 months in ash (ratio of elevated:ambient, e:a; 3.40) and the smallest effect observed in oak (e:a; 1.95). This was accompanied by changes in specific root length, with a significant decrease in all species after 6 months, suggesting that root diameter or root density was increased in elevated CO<sub>2</sub>. Increases in root length might have resulted from an acceleration in root cell expansion, since epidermal cell size was significantly increased in the zone of elongation in ash root tips ( $P < 0.05$ ).

Contrasting effects of elevated CO<sub>2</sub> were observed for root carbohydrates, with significant increases in soluble sugars for all species ( $P < 0.05$ ), but both increases and decreases in starch content were observed, depending on species, and producing a significant interaction between species and CO<sub>2</sub> ( $P < 0.001$ ). Exposure to elevated CO<sub>2</sub> increased the total root dry weight for whole trees of all 3 species after 8 months of exposure, although the magnitude of this effect, in contrast to the root in-growth study, was greatest in Scots pine and smallest in ash. No significant effect of elevated CO<sub>2</sub> was observed on the root:shoot ratio. Further detailed analysis of whole root systems after 20 months confirmed that species differences in root responses to elevated CO<sub>2</sub>

were apparent, with increased coarse and fine root production in elevated CO<sub>2</sub> for Scots pine and ash, respectively. Lateral root number was increased in elevated CO<sub>2</sub> for all species, as was mean root diameter. Root respiration rates were significantly reduced in elevated CO<sub>2</sub> for all 3 species. These results provide firm evidence that exposure of trees to future CO<sub>2</sub> concentrations will have large effects on root system development, growth, carbohydrate status, and respiration. The magnitude and direction of such effects will differ, depending on species. The consequences of such responses for the 3 species are discussed. (New Phytology. 1998. 138:241–250)

### RELATIVE SUSCEPTIBILITY OF CULTIVARS OF FLOWERING CRABAPPLES, LINDENS, AND ROSES TO DEFOLIATION BY JAPANESE BEETLES

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Relative resistance to defoliation by Japanese beetles (*Popillia japonica* Newman) was compared among 28 cultivars of flowering crabapples (*Malus* spp.), 8 species and cultivars of lindens (*Tilia* spp.), and 53 cultivars of hybrid tea, floribunda, and grandiflora roses (*Rosa* spp.) in multi-year field evaluations in central Kentucky. Defoliation of crabapples ranged from > 95% to < 10% among cultivars at the same site, with cultivars 'Jewelberry', 'Louisa', *Malus baccata* 'Jackii', and 'Harvest Gold' having greatest resistance. All lindens were severely damaged in years with heavy beetle flight, but *Tilia americana* 'Legend' and *T. tomentosa* 'Sterling' were less damaged than the others in years with moderate beetle pressure. When beetles were abundant, all rose cultivars were severely defoliated regardless of bloom color. Under more moderate beetle pressure, however, 'Milestone', 'Dynasty', and 'Headliner' hybrid tea roses sustained less damage than others. Damage among individual plants within cultivars often varied widely on a given date, reflecting the beetles' tendency to aggregate on foliage with prior feeding damage. (Journal of Environmental Horticulture. June 1998. 16(2):105–110)

FERTILIZER RATE AND POT-IN-POT  
PRODUCTION INCREASE GROWTH OF  
HERITAGE RIVER BIRCH

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A study was conducted to compare the effects of 3 fertilizer rates (High N Southern Formula, 23N-1.7P-6.6K [23-4-8] at 1.3, 1.7, and 2.0 kg N/m<sup>3</sup> [2.2, 2.8, and 3.4 lb N/yd<sup>3</sup>]) and 2 production systems (pot-in-pot [PIP] or conventional above-ground [CAG]) on the growth of Heritage river birch (*Betula nigra* L. 'Cully') in 26-L (#7) containers. Plants grown PIP had greater shoot dry weight (20%), root dry weight (31%), total biomass (27%), and root:shoot ratios (12%). Increasing fertilizer rates increased shoot dry weights but decreased root:shoot ratios. Rate of fertilizer application influenced foliar Mg, Zn, and Fe, while production system had no effect. The foliar P:Zn ratio increased linearly as rate of fertilizer increased. Soluble salts and NO<sub>3</sub>-N in the leachate increased linearly as rate of fertilizer increased at 15 and 60 days after application (DAA), whereas the response was curvilinear at 120 DAA. When different, nutrient concentrations in the leachate were greater for plants grown CAG. Fertilizer longevity based on prill analysis was greater when the PIP system was used, presumably due to lower substrate temperatures during the experimental period. (Journal of Environmental Horticulture. September 1998. 16(3):135-138)

ASSOCIATION OF THE PITCH CANKER  
FUNGUS, *FUSARIUM SUBGLUTINANS*  
*F.SP. PINI*, WITH MONTEREY PINE SEEDS  
AND SEEDLINGS IN CALIFORNIA

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The causal agent of pitch canker disease of pines, *Fusarium subglutinans* f.sp. *pini*, is a recent introduction to California. The work presented here demonstrates that this pathogen is seed-borne in Monterey pine (*Pinus radiata*). The pathogen was isolated from up to 83% of seeds collected from cones on recently infected branches. Seedling emergence from infested Monterey pine seeds was 9%, compared with 67% for uninfested seeds. The fungus was isolated more frequently from seedlings originating from diseased

branches than from symptomless branches. However, more than 50% of seeds from symptomless Monterey pine branches produced symptomless seedlings from which the pathogen was isolated. It is hypothesized that *F. s. pini* is carried within the seeds, where it may remain dormant until germination. The implications of these findings for the regeneration of native and landscape-planted Monterey pines, and for the transport of this non-native pathogen in pine seeds and seedlings to previously uninfested areas are discussed. (Plant Pathology. 1998. 47:649-656)

OPTIMIZING THE USE OF BARRIER ZONES  
TO SLOW THE SPREAD OF GYPSY MOTH  
(LEPIDOPTERA: LYMANTRIIDAE) IN  
NORTH AMERICA

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Slowing the expansion of the range of the gypsy moth, *Lymantria dispar* (L.), in North America will reduce the area affected by gypsy moth populations in the future and hence may be economically justified. The rate of range expansion can be reduced by eradication of isolated gypsy moth infestations in a barrier zone that is located just beyond the expanding population front and is slowly shifted in the direction of population spread. We developed a model to optimize the allocation of resources for monitoring and treatment of isolated colonies in a barrier zone. Model parameters were estimated using data collected in the central Appalachian Mountains. The model predicted that the cost of slowing population spread is minimized when the density of pheromone traps and eradication activity within the barrier zone decrease with increasing distance from the population front. Sensitivity analysis indicated that the output was most sensitive to the change of the maximum distance from the population front at which colonies can become established. The present value of predicted costs of all monitoring and treatment in the barrier zone were < 1/4 the present value of expected benefits from slowing the spread of the gypsy moth over 25 years. (Journal of Economic Entomology. 1998. 91(1):165-174)