ARBORICULTURAL ABSTRACTS

INFLUENCE OF SOIL STRENGTH ON ROOT GROWTH: EXPERIMENTS AND ANALYSIS USING A CRITICAL-STATE MODEL

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Roots grow thicker in compacted soil, even though it requires greater force for a large object to penetrate soil than it does for a small one. We examined the advantage of thickening in terms of the stresses around a root penetrating with constant shape, rather than the stresses around an expanding cylinder or sphere as has been studied previously. We combined experiments and simulations of the stresses around roots growing in compacted soils. We measured the diameter of pea roots growing in sandy loam and clay loam at four different densities, and the critical-state properties of the soils. At a penetration resistance of about 1 MPa, the diameter of the roots in the sandy loam was about 40% greater than that at 0.7 MPa, and at 2 MPa it was about 60% greater. In the clay loam, there was less thickening—about 10% greater at 1 MPa and about 20% greater at 1.5 MPa. The maximum axial stresses were predicted using a critical state finite-element model to be at the very tip of the root cap. When there was friction between the roots and the soil, shear stresses were predicted with smaller values at the tip than just behind the tip. When the interface between the soil and the root was assumed to be frictionless, there were by definition no shear stresses. In the frictionless case, the advantage of root thickening on relieving peak stress at the root top was diminished. The axial and shear stresses were predicted to be smaller in the clay loam than in the sandy loam and may explain why the roots did not thicken in this soil although its resistance to penetration was similar. Our results suggest that the local values of axial and shear stresses experienced by the root near its tip may be as important in constraining root growth as the total penetration resistance. (Eur. J. Soil Sci. 2002. 53:119–128)

MODELING SEASONALITY OF GYPSY MOTH, *LYMANTRIA DISPAR* (LEPIDOPTERA: LYMANTRIIDAE) TO EVALUATE PROBABILITY OF ITS PERSISTENCE IN NOVEL ENVIRONMENTS

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The predictions of three published models of temperature-dependent egg hatch of the European strain of the gypsy moth, *Lymantria dispar* L., were compared with observed hatch rates of caged egg masses in Victoria, British Columbia, Canada. Two of the three models gave a good fit to observations. Both of these models considered explicitly the period between oviposition in the summer of one year and hatch of neonates the following spring. When combined with models for temperature-dependent development of larvae and pupae, and adult longevity, the seasonal life history of an entire generation of gypsy moth could be simulated. These composite models predict the seasonal occurrence of all life stages of the insect. The simulated flight period of adult male gypsy moth on Vancouver Island in 1998 compared favorably with observed captures in pheromone traps. A series of gypsy moth generations was simulated using daily temperature inputs reconstructed from climatic normals (period 1961–1990) at various locations on the south coast and southern interior of British Columbia where gypsy moth has been frequently introduced but is not established. These simulations provided estimates of the probability of a persistent population resulting from a predicted stable seasonality of the gypsy moth. The highest probabilities of persistence were in coastal areas along the Strait of Georgia between Vancouver Island and the continental mainland and in southern interior valleys below approximately 500 m elevation (above sea level). Outside these regions, normal climatic profiles resulted in an unstable seasonality for gypsy moth with increasingly late oviposition dates, and subsequent problems in synchronizing initiation and completion of winter diapause with appropriate ambient conditions. The phenology models discussed here can be and were used as decision-support tools either to improve the efficiency of pest management operations (sampling, pesticide applications) or to make better decisions concerning the need for eradication of the gypsy moth in novel environments. (Can. Entomol. 2002. 134:805–824)

HYDRAULIC AND TRANSPORT PROPERTIES OF THE PLANT-SOIL SYSTEM ESTIMATED BY INVERSE MODELING

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Modeling soil water flow and solute transport under field conditions requires the knowledge of many parameters that are difficult to determine directly. Values determined on small, isolated samples in the laboratory are often not representative of field situations. We investigated the applicability of inverse modeling to a soil-plant system in lysimeter experiments. We also tested whether parameters obtained from one experiment could be applied to another with the same soil. In a lysimeter planted with young trees, we first did a multistep drainage experiment and then a long-term bromide tracer experiment with atmospheric boundary conditions at the soil surface. To estimate the unsaturated

hydraulic properties, we linked the inverse program SUFI (Sequential Uncertainty Fitting) to the flow and transport model HYDRUS5. A comparison of several scenarios showed that the resulting values of parameters depended strongly on the data used for calibration and the formulation of the objective function. The results suggested that inverse modeling could be used to identify important processes. Inversely obtained parameters gave better predictions for a second experiment when more variables were considered in the objective function and when the range of hydraulic conditions was wider. Furthermore, with retention curves directly fitted to measured water retention data we achieved acceptable results. Despite some limitations, the inverse approach was found to be a sound and useful procedure for estimating parameters of a complex system involving water uptake by roots, solute transport and unsaturated flow. (Eur. J. Soil Sci. 2003. 54:127–138)

POTENTIAL BEETLE VECTORS OF *SIROCOCCUS CLAVIGIGNENTI-JUGLANDACEARUM* ON BUTTERNUT

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To identify potential beetle (Coleoptera) vectors of the butternut canker fungus *(Sirococcus clavigignenti-juglandacearum),* beetles were collected from butternut *(Juglans cinerea)* trees and freshly cut logs and branches in Vermont from 1997 through 1999. At least 17 species of beetles representing eight families were found to carry conidia of the pathogen. Species most commonly collected and most frequently carrying the fungus were *Acoptus suturalis* (Curculionidae), *Astylopsis macula* (Cerambycidae), *Eubulus parochus* (Curculionidae), and *Hyperplatrys maculata* (Cerambycidae). In 1999, 64%, 74%, 37%, and 52% of these species, respectively, were carrying conidia. These beetles were often collected from dead butternut stems and branches upon which the fungus was fruiting and were less frequently found in crowns of living butternut trees. The butternut curculio *(Conotrachelus juglandis)* (Curculionidae) was found creating feeding and oviposition wounds on new shoots in crowns of butternut trees. Six to eleven percent of curculios collected carried the fungus. Species of Nitidulidae were observed crawling on logs or burrowing into cankers and curculio wounds. Six to seven percent of the nitidulids, *Cryptarcha ampla* and *Glischrochilus sanguinolentus,* carried conidia in 1999, and 31% of *G. vittatus* carried the fungus in 1998. Additional study is necessary to learn how consistently any of these beetles move from diseased to healthy tissue of butternut and vector conidia of *S. clavigignenti-juglandacearum.* (Plant Dis. 2002. May:521–531)

ECOLOGICAL AND AESTHETIC VALUES IN URBAN FOREST MANAGEMENT

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In the planning processes of urban forests, there are frequent conflicting opinions about the extent to which forests should be managed. On the one hand, management is needed to deal with the intensive use of forests, as well as unfavorable growing conditions, security factors, and aesthetic variables. On the other hand, there is an increasing demand for unmanaged areas, which is based primarily on ecological arguments. This paper presents research that was conducted in connection with the participatory planning process of Helsinki city forests. The main aim of this research was to study whether aesthetic and ecological values can be combined in the management of urban forests. Furthermore, the stability of forest landscape preferences during the participatory planning process was studied, along with the representativeness of planning groups compared to larger user groups. The data were collected in planning group meetings and public hearings in Helsinki during 1998–2000. Respondents evaluated a set of photographs designed to cover the main conflict situations in urban forest management: thinnings, understory management, the leaving of dead snags, and decaying ground-wood. These results show that the majority of residents in Helsinki prefer managed forests. The preferences are, however, closely connected to the background characteristics of respondents. Younger residents with a higher education and active urban forest users prefer more ecologically oriented management when compared to older residents with less education, or less active users. The individuals had a rather clear and relatively stable opinion of what constitutes suitable management in urban forests, but the views differed considerably as a whole. This means that a participatory planning process will typically lead to some type of compromise. Moreover, the planning groups in Helsinki reflected the opinions of the larger user groups rather well. This indicates that the currently used participatory planning approach sufficiently integrates public values into its planning process. (Urban For. Urban Green. 2003. 1:135–149)

TREE ESTABLISHMENT PRACTICE IN TOWNS AND CITIES—RESULTS FROM A EUROPEAN SURVEY

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A working group within the European Union funded COST Action E12, "Urban Forests and Trees," carried out a survey between 1999 and 2001 to study current tree establishment practice in European towns and cities. An extensive questionnaire requesting information on the urban area, selection of tree species, establishment and aftercare practices, and the main damaging factors was sent to tree professionals in urban areas in each of 17 countries. Indicators such as the relationship between the urban population and the number of street trees were used to compare urban areas. While most central European cities have a ratio of 50 to 80 street trees per 1,000 inhabitants, the tree density was as low as 20 street trees per 1,000 inhabitants for Nice. Often only a few species are planted, and this may give cause for concern since species diversity is considered an important factor in increasing the resilience of the urban tree population to abiotic and biotic stresses. The planting of larger street trees of 20 to 30 cm circumference, usually with hessian-wrapped root balls, is becoming increasingly common practice. However, some countries report the use of mostly bare-rooted stock of much smaller trees (less than 12 cm circumference). Establishment costs for street trees range from less than 200 to over 1,500 each. Poor site conditions and impacts such as utility trenching are considered to be major restrictions to healthy tree life. Vandalism affects up to 30% of newly planted street trees in some towns and cities. Overall, the survey reveals large differences in tree establishment and management practices among European cities. There is a need to provide urban tree managers with guidance on good practice for tree selection and establishment based on empirical information. The survey was a first step toward collecting the necessary urban forest information from across Europe. (Urban For. Urban Green. 2002. 1:83–96)