Root hydraulic conductance linked to trees' post-transplant recovery

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Survival of field-grown trees grown for transplanting into landscapes depends on many factors, such as transplant timing and tree size. Species-specific characteristics also contribute to trees' ability to withstand and survive environmental stresses. In a newly published study researchers report on the relationship between tree roots' hydraulic conductance—the roots' ability to take up water from a growing medium and transport the water to other parts of a tree—and post-transplant recovery. The study was also designed to determine whether size and transplant timing affects trees' transplant recovery.

Taryn Bauerle from the Department of Horticulture at Cornell University, corresponding author of the study in the *Journal of the American Society for Horticultural Science*, explained. "During bare-root tree transplanting, a major part of the root system is severed, the tree is held in storage, and then replanted into a new location. Not surprisingly, the loss of a large proportion of biomass usually results in major physiological changes within the tree until an adequate root system is rebuilt." Bauerle added that poor root-soil contact resulting from the loss of a majority of fine roots often creates water stress in newly transplanted trees. This large loss of plant biomass coupled with exposure to dry conditions is referred to as "transplant shock". Plants in transplant shock have less shoot growth, smaller "scorched" new leaves, and a general lack of vigor.

Bauerle and Cornell scientists Jingjing Yin, Nina Bassuk, and Madeline Olbergom noted that other factors can affect trees' survival rates.

"Transplant timing is important in post-transplant recovery. Tree species vary in their survival rates as a function of transplant seasons," the authors said. Tree size may also affect the plants ability to recover from transplanting. "Although large-caliper trees are often more desired to produce an immediately mature landscape, it has been found that large caliper trees have a slower growth rate than small-caliper trees."

"The fine root traits of trees largely determine maximum potential growth rate of seedlings," Bauerle explained. "By understanding the physiological basis of root behavior during fall or spring transplanting, better decisions regarding transplant timing can be made." Roots' capacity to conduct water from a growing medium and then move the water to other parts of the tree is a critical contributor to trees' vitality. "Water stress during transplant shock greatly disrupts normal water transport capacity of a tree," the authors said.

The scientists chose two *Quercus* species known to have different transplant traits: *Quercus bicolor* and *Quercus macrocarpa*. "Although these species are closely related, *Quercus bicolor* easily survives transplanting, whereas *Quecus macrocarpa* often does not," noted Bauerle. The research team transplanted both small- and large-caliper trees of both species and examined hydraulic conductance before and after transplanting in fine roots, coarse roots, and the entire root system of the trees. The study also involved assessments of how transplant timing affects post-transplant recovery in large-caliper trees.

Analyses showed hydraulic conductance in fine roots to be related to transplant recovery of the two species after transplanting. "Six months after transplanting, although none of the small-caliper trees suffered from visible signs of transplant shock, fine root hydraulic conductance in root-pruned *Quercus bicolor* was much higher than that in root-pruned *Quercus macrocarpa*, resulting in larger stem growth in Quercus bicolor," the authors said. For large-caliper trees, all *Quecus macrocarpa* trees

were found to show symptoms of transplant shock regardless of transplant timing, which the scientists attributed to the species' higher vulnerability to mild water stress, resulting in a significant reduction in fine root hydraulic conductance.

The authors added that fine root hydraulic conductance in spring-transplanted *Quercus bicolor* trees was much higher than that in fall-transplanted trees, a finding they say implies that spring transplanting is optimal for *Quercus bicolor*.

More information: The complete study and abstract are available on the ASHS *J. Amer. Soc. Hort. Sci.* electronic journal web site: journal.ashspublications.org/c … t/139/6/649.abstract

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