Innovative Production Strategies to Enhance Urban Tree Recovery and Resilience to Climate Change

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Résumé

Urban trees are essential for mitigating the effects of climate change in cities, hosting biodiversity and improving human health and well-being. However, the expected services from the tree are not necessarily realised as their planting is often marked by weak recovery, followed by dieback and death. The growing conditions in urban environments seem partly responsible for these failures, but the effect of nursery tree production practices also warrants examination: They promote vigorous growth of the tree's aerial system during production while the root system is drastically reduced during uprooting. When planted in the city, the aerial system is oversized compared to the severely mutilated root system.
Our research aims to 1) identify observable morphological indicators on the aerial system to assess the recovery and health status of the underground system after planting, 2) assess the impact of pruning, root/shoot balance, and environmental factors on recovery, and 3) assess the effect of production methods on tree recovery, and develop methods to prepare the tree for urban conditions and climate change.

750 young Mediterranean hackberry trees (*Celtis australis* L.) planted in a nursery were subjected either to alternative production methods (no aerial pruning, various types of root pruning, restrictive soils, different irrigation regimes), or to conventional methods (staking, aerial pruning, quality soil, irrigation, and fertilisation). The growth of the aerial systems was monitored, and 125 targeted excavations allowed for the study of the link between stem growth dynamics and root recovery performance. Different pruning protocols before planting allowed us to obtain different root/shoot ratio categories and to study their impact on recovery quality.

After two growing seasons, we observe a strong effect of production methods on the development and shape of the trees. Alternative methods promote trunk thickness growth, developing a squat shape (low H/D), while conventional methods favour height growth, developing a slender shape (high H/D) at the expense of the trunk's mechanical stability. We demonstrate a relationship between the expression of aerial growth (characterised by the number of annual elongation cycles, length of elongation units, leaf area, type of buds mobilised) and the performance of the regeneration of amputated roots and their health status. Trees that were pruned beforehand, displaying a higher root/shoot ratio at planting, showed better recovery, underscoring the importance of this balance for post-planting survival.
Our findings offer innovative prospects for adjusting nursery production practices, assessing the initial quality of plant supply, and optimising the resilience of urban trees to climatic disturbances.

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Mots-Clés: urban tree, production systems, nursery, shoot, root relationships, climate change, tree growth