Impacts of water restriction on the development of urban trees and their associated climate services

Dorine Canonne, Sabine Demotes-Mainard, Lydie Ledroit, Marc Saudreau, Julien Thierry, Bénédicte Dubuc, Denis Cesbron, Camille Lebras, Lydia Brialix, Dominique Lemesle, et al.

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Abstract submitted:

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Authors: D. Canonne[1], S. Demotes-Mainard[2], M. Saudreau[3], J. Thierry[1], B. Dubuc[2], L. Ledroit[2], D. Cesbron[2], C. Lebras[2], L. Brialix[1], D. Lemesle[1], S. Herpin[1], P.E. Bournet[1]

[1]Institut Agro, EPHOR, 49000 Angers, France
[2]Institut Agro, Univ Angers, INRAE, IRHS, SFR QUASAV, F-49000 Angers, France
[3]INRAE, Université Clermont Auvergne, UMR 547 PIAF, F-63178 Aubière, France

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Street trees can improve thermal comfort of city dwellers through the cast shadow and the transpiration they provide. These two mechanisms are linked to the crown light interception capacity which depends on tree architecture and leaf traits. These two characteristics can be themselves impacted by water availability. Yet, little is known on urban tree functioning regarding climate services they render in the context of global change and enhanced water scarcity.

The aim of this work is to study the effects of contrasted water supplies on tree development and associated climate services. In this prospect, a 1/5th scale outdoor canyon street, North-South oriented, with two central tree alignments consisting each in five ornamental apple trees, was used in Angers, France. Each alignment was equipped with meteorological and soil sensors with continuous data acquisition from May 2022 to September 2022, and architectural and foliar measurements were carried out on four specific sub-periods. Before July 2022, all trees of both alignments were well-watered. Then, from the beginning of July 2022 and for noticeably two months, a moderate water restriction was applied to one of the tree alignments, while the other was kept well-watered. In the water-restricted alignment, irrigation was adjusted according to the analysis of daily micrometric variations of the trunk diameter and soil water content data. The target was to ensure that soil moisture remained above the wilting point, but in the non-readily available water content so that water remained difficult to extract by the roots.

Both tree transpiration and architecture differences between the two treatments were observed and highlight the impact of the water deficit on tree functioning in an urban environment. For instance, at the end of August 2022, the leaf surface area of the well-watered trees was on average almost twice as high as that of the water-restricted trees. The tree leaf surface area was deeply analyzed in order to appreciate architectural traits as a whole. It was also discussed in regard of the tree climatic contribution, characterized by the reduction of the air temperature and Universal Thermal Comfort Index (UTCI). For the purpose of guiding the choice of tree species to improve human thermal comfort, these results support the need to consider tree architectural and hydric functional traits.