Does soil sealing affect health of urban trees? An eight-year research

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An experiment started in 2011 to evaluate the effects of impermeable, permeable, and porous pavements on growth and health of two urban tree species with different rooting characteristics, namely *Fraxinus ornus* (Manna ash) and *Celtis australis (European hackberry)*. 48 plants of the two species were planted in a 1 m^2 planting pit surrounded by 50 m^2 (538 sft) of: 1- impermeable pavement (asphalt on concrete sub-base); 2- permeable pavement (pavers on a crushed rock sub-base); 3- porous pavement (monolithic porous pavement on a crushed rock sub-base); 4- no pavement (bare soil kept free of weeds by herbicides). Since 2012, several biometric (e.g. shoot growth, dripline area, dbh) and physiological (e.g. leaf gas exchange, water relations, chlorophyll fluorescence, VOC emission) were measured. Soil parameters, such as soil moisture, soil temperature, and gas exchange between the soil and atmosphere were also monitored. In December 2019-March 2020, the effects of pavements on root distribution will be assessed using non-invasive methods (e.g. georadar, tomography).

Results displayed that, during tree establishment, permeable and porous pavements can increase soil water availability and improve tree health, compared to control. Young trees growing near asphalt, instead, could not benefit from higher moisture, probably because root activity was hindered by higher CO2 accumulation in the soil. After tree establishment, transpiration progressively increased overall water consumption from the soil, reducing the relative importance of evaporation in soil water balance. Soil moisture was progressively depleted, particularly under impermeable pavements. In all treatments, however, soil moisture always remained above wilting point.

Health of established trees was slightly affected by pavements, despite large effects on soil parameters were observed. *Celtis* outcompeted *Fraxinus* in the capacity of establish and quickly develop large leaf areas. These characteristics, couple with a high CO_2 assimilation rate per unit leaf area, render *Celtis* a very plastic species, capable to adapt to all kind of pavements and to provide large benefits when grown as a street tree.

Root growth as affected by soil cover type and species will be revealed, as well as the frequency of conflicts between roots and pavements.

Results of this experiment may be crucial for sustainable cities because they may provide rationale for enhancing the use of pervious pavements to improve element cycling and promote tree health at urban sites.