

Nature based solutions to mitigate soil sealing in urban areas: Results from a 6-year study comparing permeable, porous, and impermeable pavements

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Abstract

A long-term research was started in 2011 to evaluate the effects on four different pavement systems on two woody species and on soil physical traits. 48 plants of *Celtis australis* and *Fraxinus ornus* were planted in a 1 m² planting pit surrounded by 50 m² 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). Effects of the different pavements on growth and physiology of establishing trees have been described in a previous work. Trees have now fully established, showing most of their roots outside the planting pit, right under the pavements. The presentation will describe the results of the long-term measurements of tree growth (shoot and diameter growth, canopy size), phenology (leaf shedding, dormancy outbreak), and physiology (leaf gas exchange, water relations), which have been carried out on regular basis on 6 replicate trees per treatment. Effects observed on trees have been related to changes induced by pavements on soil characteristics (e.g. oxygen, CO₂, water availability). Also, interestingly, the effect of pavements on the emission of volatile organic compounds (VOCs) by tree species has been investigated.

Results have shown that soil physical traits have been largely affected by impermeable pavements, with a significant reduction of evaporation of water from soil resulting in the onset of a subterranean urban heat island. On the contrary, porous pavements were extremely effective in maintaining soil temperature similar to that of unpaved soil. Furthermore, under impermeable pavements CO₂ accumulates, with negative effects on root activity, but porous pavements can largely mitigate this CO₂ enrichment. Indeed, the effects of the different on growth and physiology of ash and hackberry will be discussed in detail in the presentation.