Urban trees enhance water infiltration

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Global land use patterns and increasing pressures on water resources demand creative urban stormwater management. Traditional stormwater management focuses on regulating the flow of runoff to waterways, but generally does little to restore the hydrologic cycle disrupted by extensive pavement and compacted urban soils with low permeability. The lack of infiltration opportunities affects groundwater recharge and has negative repercussions on water quality downstream. Researchers know that urban forests, like rural forest land, can play a pivotal role in stormwater mitigation, but developing approaches that exploit the ability of trees to handle stormwater is difficult in highly built city cores or in urban sprawl where asphalt can be the dominant cover feature.

A group of researchers from Virginia Tech, Cornell, and University of California at Davis have been investigating innovative ways to maximize the potential of trees to address stormwater in a series of studies supported by the U.S. Forest Service's Urban and Community Forestry Grants Program. The results of the studies were published in the November-December issue of the *Journal of Environmental Quality*.

Virginia Tech scientists used two container experiments to establish that urban tree roots have the potential to penetrate compacted subsoils and increase infiltration rates in reservoirs being used to store stormwater. In one study, roots of both black oak and red maple trees penetrated clay loam soil compacted to 1.6 g cm-3, increasing infiltration rates by an average of 153%.

In another experiment, researchers created a small-scale version of the stormwater best management practice (BMP) under study by the three universities. This BMP includes a below-pavement stormwater detention reservoir constructed of structural soil. Structural soils are engineered mixes designed to both support pavement loads and simultaneously provide rooting space for trees. In this study, green ash trees increased the average infiltration rate by 27 fold compared with unplanted controls. In the experiment, a structural soil reservoir (CUSoil, Amereq Corp., New York) was separated from compacted clay loam subsoil (1.6 g cm-3) by a woven geotextile in 102-liter containers. The roots of ash trees planted in the structural soil penetrated both the geotextile and the subsoil within two years.

"Although we observed many roots penetrating the geotextile, roots really proliferated where there was a slight tear in the fabric," said Susan Day, the project's lead investigator. "Manipulating root penetration through these separation geotextiles could potentially play a large role in bioretention system function and design, especially since the potentially saturated soils beneath detention reservoirs may have reduced soil strength, increasing opportunities for root growth by some species."

Structural soil reservoirs may thus provide new opportunities for meeting engineering, environmental, and greenspace management needs in urban areas. Further research is needed on the effects of tree roots and detention time on water quality in structural soils. Monitoring continues at four demonstration sites around the country and updated information is posted as it becomes available at www.cnr.vt.edu/urbanforestry/stormwater.

View the abstract at jeq.scijournals.org/cgi/content/abstract/37/6/2048 .

Source: American Society of Agronomy