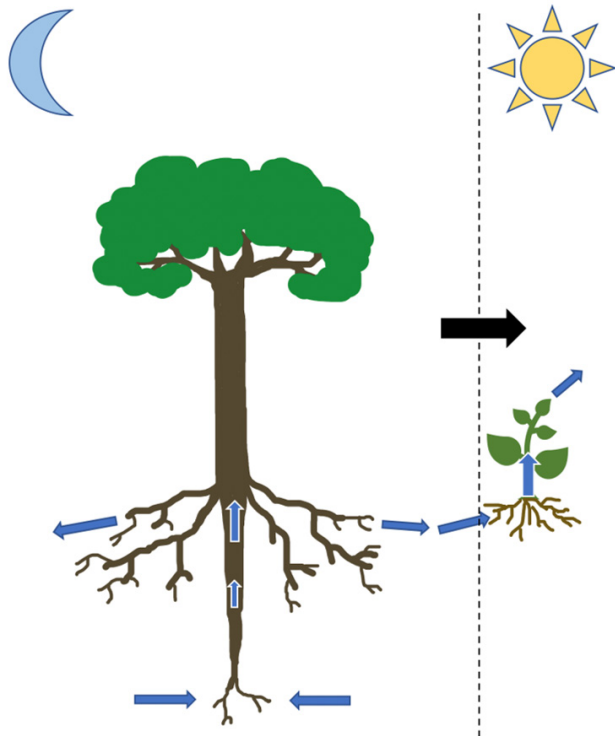


Rainfall from below: how tree roots recirculate deep soil water

Rainfall that percolates into shallow soils supplies most water used by plants in southeastern US ecosystems. However, other water sources may provide an important hedge against drought stress. Some tree species, such as longleaf pine, can grow deep taproots that reach several meters into the soil, giving them access to wetter soil layers, or even groundwater. At night, these trees also move deeper water up within their roots through a passive process called hydraulic redistribution (HR). Roots release excess water from HR—i.e. water the tree doesn't need and cannot store—into shallow soils. This process may supply an important water subsidy for understory plants during drought, but little is known about the quantity, timing, or environmental drivers of HR.



Hydraulic lift is the nighttime movement of deep soil water through tree roots into shallow soils where it can be taken up by other plants the next day. Graphic by Phoebe Judge.

We compared HR among common tree species found in longleaf pine ecosystems. Working with collaborators from the Savannah River Ecology Lab, we measured sap-flux in lateral roots of longleaf pine, turkey oak, and sand post oak. We also used water chemical signatures in the form of hydrogen and oxygen stable isotopes to find the source of water.

We found that all three species had access to groundwater. Trees used shallow soil water when it was available but shifted to deeper soil water when necessary. Longleaf pine used more water than either oak species, but also redistributed much more water through its roots as HR. Longleaf and sand post oak HR was ~50% of total water uptake, compared to 20% for turkey oak. Most HR happened late in the growing season and was related to cooling nighttime temperatures. These results help illustrate the importance of HR in moving deeper water into shallow soils.

MORE INFORMATION

Belovitch MW, ST Brantley, and DP Aubrey. 2022. Interspecific variation in the timing and magnitude of hydraulic redistribution in a forest with distinct water sources. *Plant and Soil* 472: 451-464. <https://doi.org/10.1007/s11104-021-05253-9>

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KEY POINTS

Trees move water within their rooting system through a passive, nighttime process called hydraulic redistribution (HR) and release much of this water into shallow soils.

Gradients in water content between shallow and deeper soils or groundwater, and how well plants can access deep water with their roots affects the quantity of water moved.

Longleaf pine moved more water than co-occurring oak species, likely because longleaf have deep taproots that give them better access to wetter soils and groundwater.

Ongoing research is focused on understanding the importance of HR water released into shallow soils.