

Is Root Pressure a Driving Force for the Rise of Sap in the Xylem?

Root pressures have been observed in many plants. If a stem is cut from a grapevine, for example, and a tube with mercury is attached, water is sometimes forced upwards from the roots under considerable pressure (see Figure). Root pressures form when water is readily available and transpiration is very slow or absent, as it is at night, because ions are still actively transported into the xylem, and water follows by osmosis, creating a positive pressure that forces water and dissolved ions up the xylem.

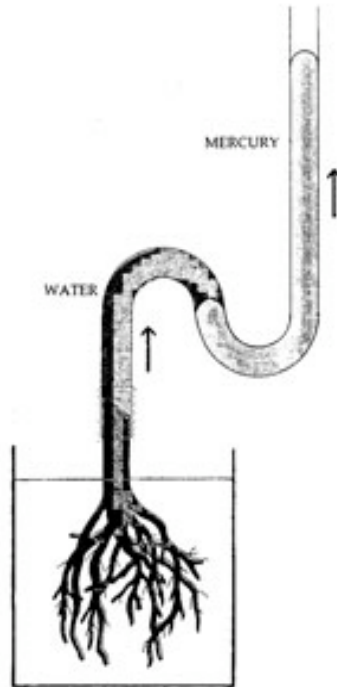
Evidence for root pressure

- Root pressure is seen in many species
- Pressures as high as 1 - 3 atmospheres may develop
- Guttation in certain plants: droplets of water are forced out special openings at the tips of grass leaves by root pressure
- Pressures may be sufficient to force water to the tops of many herbaceous plants

Evidence against root pressure

- Does not occur when plants are exposed to dry air, low soil moisture, or both
- Pressure is never high enough to force water to the tops of tall trees
- Root pressure is least effective during the day when the movement of water through the plant is fastest
- Movement by root pressure is too slow to account for total water movement
- Root pressure is never found in certain plants (e.g. the conifers: pines, firs, and sequoias)

Conclusion: Root pressure may be important in some species under certain conditions at certain times of the year. It may be regarded as a by-product of the mechanism of pumping ions into the xylem and a subsidiary means of moving water into the shoot under special conditions.



Demonstration of root pressure in the cut stump of a plant. Uptake of water by the plant roots causes the mercury to rise in the column. Pressures of 3 to 5 bars have been demonstrated by this method.