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Breakdown of water transport and resilient xylem structure in vascular plants JEONGEUN RYU, Department of Mechanical Engineering, POSTECH, WONJUNG KIM, Department of Mechanical Engineering, Sogang University, SANG JOON LEE, Department of Mechanical Engineering, POSTECH — Plants can transport sap water without using a mechanical pump by exploiting a metastable state of water. However, sap water in a metastable state is vulnerable to cavitation and embolism, disrupting water transport in xylem vessels. We note that under this paradox, plants have been evolved to have resilient xylem network against breakdown of water transport as a survival strategy. In this study, we directly observe the onset of embolism and its spreading dynamics in live plants to establish a synthetic tree model. We also rationalize our experimental findings with a model describing embolism propagation under a metastable state of water and an interconnected xylem network structure which can minimize damages from cavitation and embolism. This study would shed light on the design of complex networks with resilience for effective transport as well as the physical understanding on the transport of metastable water.

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