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MicroCT provides novel insights into plant form and function

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MicroCT has tremendous potential to provide novel insights into plant form and function My research uses this and other, novel, non-invasive optical techniques to view the process of leaf and stem xylem embolism formation within intact plants to resolve long-standing questions in plant physiology. Here, I will highlight two recent experiments performed at the Australian Synchrotron in Melbourne Australia and the Lawrence Berkeley Laborartory in Berkeley, California in the USA. We used multiple visual techniques, including X-ray micro- computed tomography and the optical vulnerability method, to investigate the spread of embolism within intact stems, leaves and roots of Solanum lycopersicum (common tomato) and North American oak species. We found that roots, stems and leaves of tomato plants all exhibited similar vulnerability to embolism, suggesting that embolism rapidly propagates among tissues. Although we found scarce evidence for differentiation of xylem vulnerability among tissues at the scale of the whole plant, within a leaf the midrib embolized at higher water potentials than lower order veins. In oaks, air-entry water potential varied 2-fold in leaves, ranging from -1.7 ± 0.25 MPa to -3.74 ± 0.23 MPa, and 4-fold in stems, ranging from -1.17 ± 0.04 MPa to -4.91 ± 0.3 MPa. Embolism occurred earlier in leaves than in stems in only one out of eight sample species, and plants always lost turgor before experiencing stem embolism. Our results show that herbaceous species (tomato) and long-vesseled oak species are more resistant to embolism than previously thought and support the hypothesis that avoiding stem embolism is a critical component of drought tolerance in plants.

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