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DROUGHT STRESS AND XYLEM EMBOLISM: VALIDATING HYDRAULIC TECHNIQUES BY DIRECT OBSERVATIONS OF THE FUNCTIONAL STATUS OF XYLEM CONDUITS

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Long distance water transport in plants through the xylem relies on negative pressure generated by leaf-level transpiration. Water in the xylem conduits is therefore in a metastable status and is prone to embolism formation by air-seeding via pit membranes facing adjacent air-filled compartments. The resistance to embolism formation varies widely across species and cultivars, with xylem pressure thresholds for air entry between -0.4 and -10 MPa. Hence, measuring the amount of embolism as a function of xylem pressure (vulnerability curve) allows precise quantification of species' resistance to drought stress, eventually providing a very sound basis for breeding and selecting crop varieties with improved resistance to water stress.

Current techniques for embolism detection are indirect and based on hydraulic methods, which have been recently suggested to introduce significant bias in the estimates of plants' vulnerability to embolism formation. Hence, validation of these techniques is necessary, and direct visualization of the xylem conduits' status (water-filled vs air-filled) at different xylem pressure offers the only opportunity in this direction. We performed direct monitoring of xylem conduits' functional status via Synchrotron based X-ray micro-tomography (micro-CT) at Elettra-Sincrotrone Trieste (www.elettra.trieste.it). More than 20 Laurel (*Laurus nobilis* L.) stems dehydrated to xylem pressure values ranging from 0 to -3.3 MPa were scanned, and we compared visual data and theoretical hydraulic conductance data with values of percentage loss of hydraulic conductivity obtained with hydraulic techniques. Preliminary elaboration of images suggests that hydraulic techniques can provide accurate estimates of the amount of embolism in this species, and also offer new insights into the patterns of embolism formation and spread in the xylem.