# Disentangling drought-responsive traits with focus on Arabidopsis

Thonglim, A.

# REFERENCES

**Adams HD, Luce CH, Breshears DD, Allen CD, Weiler M, Hale VC, Smith AMS, Huxman TE**. 2012. Ecohydrological consequences of drought- and infestation- triggered tree die-off: insights and hypotheses. Ecohydrology **5**, 145–159.

**Adams HD, Zeppel MJB, Anderegg WRL, *et al.*** 2017. A multi-species synthesis of physiological mechanisms in drought-induced tree mortality. Nature Ecology & Evolution **1**, 1285–1291.

**Agnolucci P, De Lipsis V**. 2020. Long-run trend in agricultural yield and climatic factors in Europe. Climatic Change **159**, 385–405.

**Agusti J, Herold S, Schwarz M, *et al.*** 2011. Strigolactone signaling is required for auxin-dependent stimulation of secondary growth in plants. Proceedings of the National Academy of Sciences **108**, 20242–20247.

**Ahmad HB, Lens F, Capdeville G, Burlett R, Lamarque LJ, Delzon S**. 2018. Intraspecific variation in embolism resistance and stem anatomy across four sunflower (*Helianthus annuus* L.) accessions. Physiologia Plantarum **163**, 59–72.

**Ahmad F, Singh A, Kamal A**. 2020. Osmoprotective role of sugar in mitigating abiotic stress in plants. In: Roychoudhury A, Tripathi DK, eds. Protective Chemical Agents in the Amelioration of Plant Abiotic Stress. Wiley, 53–70.

**Ainsworth EA, Rogers A**. 2007. The response of photosynthesis and stomatal conductance to rising [$CO_2$]: mechanisms and environmental interactions: Photosynthesis and stomatal conductance responses to rising [$CO_2$]. Plant, Cell & Environment **30**, 258–270.

**Al Abdallat AM, Ayad JY, Abu Elenein JM, Al Ajlouni Z, Harwood WA**. 2014. Overexpression of the transcription factor HvSNAC1 improves drought tolerance in barley (*Hordeum vulgare* L.). Molecular Breeding **33**, 401–414.

**Alder NN, Pockman WT, Sperry JS, Nuismer S**. 1997. Use of centrifugal force in the study of xylem cavitation. Journal of Experimental Botany **48**, 665–674.

**Allen CD, Breshears DD, McDowell NG**. 2015. On underestimation of global vulnerability to tree mortality and forest die-off from hotter drought in the Anthropocene. Ecosphere **6**, art129.

**Allen CD, Macalady AK, Chenchouni H, *et al.*** 2009. A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests. Forest Ecology and Management **259**, 660–684.

**Alshareef NO, Wang JY, Ali S, Al-Babili S, Tester M, Schmöckel SM**. 2019. Overexpression of the NAC transcription factor JUNGBRUNNEN1 (JUB1) increases salinity tolerance in tomato. Plant Physiology and Biochemistry **140**, 113–121.

**Altamura MM, Possenti M, Matteucci A, Baima S, Ruberti I, Morelli G**. 2001. Development of the vascular system in the inflorescence stem of *Arabidopsis*. New Phytologist **151**, 381–389.

**Alves ES, Angyalossy-Alfonso V**. 2000. Ecological trend in wood anatomy of some Brazilian species. 1. growth rings and vessels. IAWA Journal **21**, 3–30.

**Anderegg WRL, Hicke JA, Fisher RA, *et al.*** 2015. Tree mortality from drought, insects, and their interactions in a changing climate. New Phytologist **208**, 674–683.

**Anderegg WRL, Kane JM, Anderegg LDL**. 2013. Consequences of widespread tree mortality triggered by drought and temperature stress. Nature Climate Change **3**, 30–36.

**Anderegg WRL, Klein T, Bartlett M, Sack L, Pellegrini AFA, Choat B, Jansen S**. 2016. Meta-analysis reveals that hydraulic traits explain cross-species patterns of drought-induced tree mortality across the globe. Proceedings of the National Academy of Sciences **113**, 5024–5029.

**Aoki S, Toh S, Nakamichi N, Hayashi Y, Wang Y, Suzuki T, Tsuji H, Kinoshita T**. 2019. Regulation of stomatal opening and histone

modification by photoperiod in Arabidopsis thaliana. Scientific Reports **9**, 10054.

**Asseng S, Ewert F, Martre P, *et al.*** 2015. Rising temperatures reduce global wheat production. Nature Climate Change **5**, 143–147.

**Assmann SM, Wang X-Q**. 2001. From milliseconds to millions of years: guard cells and environmental responses. Current Opinion in Plant Biology **4**, 421–428.

**Augspurger CK, Kelly CK**. 1984. Pathogen mortality of tropical tree seedlings: experimental studies of the effects of dispersal distance, seedling density, and light conditions. Oecologia **61**, 211–217.

**Awad H, Herbette S, Brunel N, Tixier A, Pilate G, Cochard H, Badel E**. 2012. No trade-off between hydraulic and mechanical properties in several transgenic poplars modified for lignins metabolism. Environmental and Experimental Botany **77**, 185–195.

**Baas P**. 1976. Some functional and adaptive aspects of vessel member morphology. Leiden Botanical Series **3**, 157–181.

**Baas P, Ewers FW, Davis SD, Wheeler EA**. 2004. Evolution of xylem physiology. The Evolution of Plant Physiology. Elsevier, 273–295.

**Baas P, Werker E, Fahn A**. 1983. Some ecological trends in vessel characters. IAWA Journal **4**, 141–159.

**Bac-Molenaar JA, Granier C, Keurentjes JJB, Vreugdenhil D**. 2016. Genome-wide association mapping of time-dependent growth responses to moderate drought stress in *Arabidopsis*. Plant, Cell & Environment **39**, 88–102.

**Bai H, Qian X, Fan J, Qian Y, Duo Y, Liu Y, Wang X**. 2020. Computing pore size distribution in non-woven fibrous filter media. Fibers and Polymers **21**, 196–203.

**Barbosa EGG, Leite JP, Marin SRR, *et al.*** 2013. Overexpression of the ABA-dependent AREB1 transcription factor from *Arabidopsis thaliana* improves

soybean tolerance to water deficit. Plant Molecular Biology Reporter **31**, 719–730.

**Barcelo AR**. 1997. Lignification in Plant Cell Walls. International Review of Cytology. Elsevier, 87–132.

**Barros J, Serk H, Granlund I, Pesquet E**. 2015. The cell biology of lignification in higher plants. Annals of Botany **115**, 1053–1074.

**Bartlett MK, Klein T, Jansen S, Choat B, Sack L**. 2016. The correlations and sequence of plant stomatal, hydraulic, and wilting responses to drought. Proceedings of the National Academy of Sciences **113**, 13098–13103.

**Basu S, Ramegowda V, Kumar A, Pereira A**. 2016. Plant adaptation to drought stress. F1000Research **5**, 1554.

**Bauerle WL, Whitlow TH, Setter TL, Vermeylen FM**. 2004. Abscisic acid synthesis in *Acer rubrum* L. leaves—a vapor pressure deficit mediated response. Journal of the American Society for Horticultural Science **129**, 182–187.

**Benjamin JG, Nielsen DC**. 2006. Water deficit effects on root distribution of soybean, field pea and chickpea. Field Crops Research **97**, 248–253.

**Berg S, Ott H, Klapp SA, *et al.*** 2013. Real-time 3D imaging of Haines jumps in porous media flow. Proceedings of the National Academy of Sciences **110**, 3755–3759.

**Billon LM, Blackman CJ, Cochard H, Badel E, Hitmi A, Cartailler J, Souchal R, Torres-Ruiz JM**. 2020. The droughtbox: a new tool for phenotyping residual branch conductance and its temperature dependence during drought. Plant, Cell & Environment **43**, 1–11.

**Binks O, Meir P, Rowland L, Costa ACL, Vasconcelos SS, Oliveira AAR, Ferreira L, Christoffersen B, Nardini A, Mencuccini M**. 2016*a*. Plasticity in leaf-level water relations of tropical rainforest trees in response to experimental drought. New Phytologist **211**, 477–488.

**Binks O, Meir P, Rowland L, Da Costa ACL, Vasconcelos SS, De Oliveira AAR, Ferreira L, Mencuccini M**. 2016*b*. Limited acclimation in leaf anatomy

to experimental drought in tropical rainforest trees. (G Goldstein, Ed.). Tree Physiology **36**, 1550–1561.

**Blackman CJ, Brodribb TJ, Jordan GJ**. 2012. Leaf hydraulic vulnerability influences species' bioclimatic limits in a diverse group of woody angiosperms. Oecologia **168**, 1–10.

**Blackman CJ, Creek D, Maier C, *et al.*** 2019. Drought response strategies and hydraulic traits contribute to mechanistic understanding of plant dry-down to hydraulic failure. (F Meinzer, Ed.). Tree Physiology **39**, 910–924.

**Blum A**. 2017. Osmotic adjustment is a prime drought stress adaptive engine in support of plant production: Osmotic adjustment and plant production. Plant, Cell & Environment **40**, 4–10.

**Bonal D, Guehl J-M**. 2001. Contrasting patterns of leaf water potential and gas exchange responses to drought in seedlings of tropical rainforest species. Functional Ecology **15**, 490–496.

**Bosio F, Soffiatti P, Boeger MRT**. 2010. Ecological wood anatomy of Miconia Sellowiana (Melastomataceae) in three vegetation types of paraná state, Brazil. IAWA Journal **31**, 179–190.

**Bouche PS, Larter M, Domec J-C, Burlett R, Gasson P, Jansen S, Delzon S**. 2014. A broad survey of hydraulic and mechanical safety in the xylem of conifers. Journal of Experimental Botany **65**, 4419–4431.

**Bouda M, Windt CW, McElrone AJ, Brodersen CR**. 2019. In vivo pressure gradient heterogeneity increases flow contribution of small diameter vessels in grapevine. Nature Communications **10**, 5645.

**Bourbia I, Carins-Murphy MR, Gracie A, Brodribb TJ**. 2020. Xylem cavitation isolates leaky flowers during water stress in pyrethrum. New Phytologist, nph.16516.

**Bourbia I, Pritzkow C, Brodribb TJ**. 2021. Herb and conifer roots show similar high sensitivity to water deficit. Plant Physiology **186**, 1908–1918.

**Brackmann K, Qi J, Gebert M, *et al.*** 2018. Spatial specificity of auxin responses coordinates wood formation. Nature Communications **9**, 875.

**Brando PM, Balch JK, Nepstad DC, *et al.*** 2014. Abrupt increases in Amazonian tree mortality due to drought–fire interactions. Proceedings of the National Academy of Sciences **111**, 6347–6352.

**Brás TA, Seixas J, Carvalhais N, Jägermeyr J**. 2021. Severity of drought and heatwave crop losses tripled over the last five decades in Europe. Environmental Research Letters **16**, 065012.

**Bréda N, Cochard H, Dreyer E, Granier A**. 1993. Field comparison of transpiration, stomatal conductance and vulnerability to cavitation of Quercus petraea and Quercus robur under water stress. Annales des Sciences Forestières **50**, 571–582.

**Briggs LJ**. 1950. Limiting negative pressure of water. Journal of Applied Physics **21**, 721–722.

**Brodersen CR, Lee EF, Choat B, Jansen S, Phillips RJ, Shackel KA, McElrone AJ, Matthews MA**. 2011. Automated analysis of three-dimensional xylem networks using high-resolution computed tomography. New Phytologist **191**, 1168–1179.

**Brodersen CR, McElrone AJ, Choat B, Matthews MA, Shackel KA**. 2010. The dynamics of embolism repair in xylem: in vivo visualizations using high-resolution computed tomography. Plant Physiology **154**, 1088–1095.

**Brodribb TJ**. 2009. Xylem hydraulic physiology: the functional backbone of terrestrial plant productivity. Plant Science **177**, 245–251.

**Brodribb TJ**. 2017. Progressing from 'functional' to mechanistic traits. New Phytologist **215**, 9–11.

**Brodribb TJ, Bienaimé D, Marmottant P**. 2016*a*. Revealing catastrophic failure of leaf networks under stress. Proceedings of the National Academy of Sciences **113**, 4865–4869.

**Brodribb T, Brodersen CR, Carriqui M, Tonet V, Rodriguez Dominguez C, McAdam S**. 2021. Linking xylem network failure with leaf tissue death. New Phytologist **232**, 68–79.

**Brodribb TJ, Carriqui M, Delzon S, Lucani C**. 2017*a*. Optical measurement of stem xylem vulnerability. Plant Physiology **174**, 2054–2061.

**Brodribb TJ, Cochard H**. 2009. Hydraulic failure defines the recovery and point of death in water-stressed conifers. Plant Physiology **149**, 575–584.

**Brodribb T, Hill RS**. 1999. The importance of xylem constraints in the distribution of conifer species. New Phytologist **143**, 365–372.

**Brodribb TJ, Hill RS**. 2000. Increases in water potential gradient reduce xylem conductivity in whole plants. evidence from a low-pressure conductivity method. Plant Physiology **123**, 1021–1028.

**Brodribb TJ, Holbrook NM**. 2003. Stomatal closure during leaf dehydration, correlation with other leaf physiological traits. Plant Physiology **132**, 2166–2173.

**Brodribb TJ, Holbrook NM, Edwards EJ, Gutiérrez MV**. 2003. Relations between stomatal closure, leaf turgor and xylem vulnerability in eight tropical dry forest trees: Stomatal closure and xylem cavitation. Plant, Cell & Environment **26**, 443–450.

**Brodribb TJ, McAdam SA, Carins Murphy MR**. 2017*b*. Xylem and stomata, coordinated through time and space: functional linkages between xylem and stomata. Plant, Cell & Environment **40**, 872–880.

**Brodribb TJ, Powers J, Cochard H, Choat B**. 2020. Hanging by a thread? forests and drought. Science **368**, 261–266.

**Brodribb TJ, Skelton RP, McAdam S, Bienaimé D, Lucani C, Marmottant P**. 2016*b*. Visual quantification of embolism reveals leaf vulnerability to hydraulic failure. New Phytologist **209**, 1403–1409.

**Brown HR**. 2013*a*. The theory of the rise of sap in trees: some historical and conceptual remarks. Physics in Perspective **15**, 320–358.

**Brown HR**. 2013*b*. The Theory of the Rise of Sap in Trees: Some Historical and Conceptual Remarks. Physics in Perspective **15**, 320–358.

**Buckley TN**. 2005. The control of stomata by water balance. New Phytologist **168**, 275–292.

**Buckley TN**. 2019. How do stomata respond to water status? New Phytologist **224**, 21–36.

**Canelles Q, Aquilué N, James PMA, Lawler J, Brotons L**. 2021. Global review on interactions between insect pests and other forest disturbances. Landscape Ecology **36**, 945–972.

**Carlquist S**. 1966. Wood anatomy of Compositae: a summary, with comments on factors controlling wood evolution. Aliso: A Journal of Systematic and Floristic Botany **6**, 25–44.

**Carlquist S**. 1975. *Ecological strategies of xylem evolution*. Berkeley: University of California Press.

**Carlquist S**. 1977. Ecological factors in wood evolution: a floristic approach. American Journal of Botany **64**, 887–896.

**Carlquist S**. 1980. Further concepts in ecological wood anatomy, with comments on recent work in wood anatomy and evolution. Aliso: A Journal of Systematic and Floristic Botany **9**, 499–553.

**Carlquist S**. 1984. Vessel grouping in dicotyledon wood: significance and relationship to imperforate tracheary elements. Aliso **10**, 505–525.

**Carlquist S, Hoekman DA**. 1985. Ecological wood anatomy of the woody Southern Californian flora. IAWA Journal **6**, 319–347.

**Chaffey N, Cholewa E, Regan S, Sundberg B**. 2002. Secondary xylem development in *Arabidopsis*: a model for wood formation. Physiologia Plantarum **114**, 594–600.

**Chao K-J, Phillips OL, Gloor E, Monteagudo A, Torres-Lezama A, Martínez RV**. 2008. Growth and wood density predict tree mortality in Amazon forests. Journal of Ecology **96**, 281–292.

**Charrier G, Delzon S, Domec J-C, *et al.*** 2018. Drought will not leave your glass empty: Low risk of hydraulic failure revealed by long-term drought observations in world's top wine regions. Science Advances **4**, eaao6969.

**Charrier G, Torres-Ruiz JM, Badel E, *et al.*** 2016. Evidence for hydraulic vulnerability segmentation and lack of xylem refilling under tension. Plant Physiology **172**, 1657–1668.

**Chave J, Coomes D, Jansen S, Lewis SL, Swenson NG, Zanne AE**. 2009. Towards a worldwide wood economics spectrum. Ecology Letters **12**, 351–366.

**Chen K, Li G, Bressan RA, Song C, Zhu J, Zhao Y**. 2020. Abscisic acid dynamics, signaling, and functions in plants. Journal of Integrative Plant Biology **62**, 25–54.

**Chen I-T, Sessoms DA, Sherman Z, Choi E, Vincent O, Stroock AD**. 2016*a*. Stability limit of water by metastable vapor–liquid equilibrium with nanoporous silicon membranes. The Journal of Physical Chemistry B **120**, 5209–5222.

**Chen W, Yao Q, Patil GB, *et al.*** 2016*b*. Identification and comparative analysis of differential gene expression in soybean leaf tissue under drought and flooding stress revealed by RNA-Seq. Frontiers in Plant Science **7**, 1044.

**Choat B, Ball MC, Luly JG, Holtum JAM**. 2005. Hydraulic architecture of deciduous and evergreen dry rainforest tree species from north-eastern Australia. Trees **19**, 305–311.

**Choat B, Brodie TW, Cobb AR, Zwieniecki MA, Holbrook NM**. 2006. Direct measurements of intervessel pit membrane hydraulic resistance in two angiosperm tree species. American Journal of Botany **93**, 993–1000.

**Choat B, Brodribb TJ, Brodersen CR, Duursma RA, López R, Medlyn BE**. 2018. Triggers of tree mortality under drought. Nature **558**, 531–539.

**Choat B, Cobb AR, Jansen S**. 2008. Structure and function of bordered pits: new discoveries and impacts on whole-plant hydraulic function. New Phytologist **177**, 608–626.

**Choat B, Drayton WM, Brodersen C, Mattthews MA, Shackel KA, Wada H, Mcelrone AJ**. 2010. Measurement of vulnerability to water stress-induced cavitation in grapevine: a comparison of four techniques applied to a long-vesseled species: comparison of vulnerability curve technique in grapevine. Plant, Cell & Environment **33**, 1502–1512.

**Choat B, Jansen S, Brodribb TJ, *et al.*** 2012*a*. Global convergence in the vulnerability of forests to drought. Nature **491**, 752–755.

**Choat B, Jansen S, Brodribb TJ, *et al.*** 2012*b*. Global convergence in the vulnerability of forests to drought. Nature **491**, 752–755.

**Choi H, Hong J, Ha J, Kang J, Kim SY**. 2000. ABFs, a family of ABA-responsive element binding factors. Journal of Biological Chemistry **275**, 1723–1730.

**Choudhury S, Panda P, Sahoo L, Panda SK**. 2013. Reactive oxygen species signaling in plants under abiotic stress. Plant Signaling & Behavior **8**, e23681.

**Choudhury FK, Rivero RM, Blumwald E, Mittler R**. 2017. Reactive oxygen species, abiotic stress and stress combination. The Plant Journal **90**, 856–867.

**Clark JS, Iverson L, Woodall CW, *et al.*** 2016. The impacts of increasing drought on forest dynamics, structure, and biodiversity in the United States. Global Change Biology **22**, 2329–2352.

**Cochard H**. 2002. A technique for measuring xylem hydraulic conductance under high negative pressures. Plant, Cell and Environment **25**, 815–819.

**Cochard H**. 2006. Cavitation in trees. Comptes Rendus Physique **7**, 1018–1026.

**Cochard H, Badel E, Herbette S, Delzon S, Choat B, Jansen S**. 2013. Methods for measuring plant vulnerability to cavitation: a critical review. Journal of Experimental Botany **64**, 4779–4791.

**Cochard H, Cruiziat P, Tyree MT**. 1992. Use of positive pressures to establish vulnerability curves: further support for the air-seeding

hypothesis and implications for pressure-volume analysis. Plant Physiology **100**, 205–209.

**Cochard H, Damour G, Bodet C, Tharwat I, Poirier M, Améglio T**. 2005. Evaluation of a new centrifuge technique for rapid generation of xylem vulnerability curves. Physiologia Plantarum **124**, 410–418.

**Cochard H, Delzon S**. 2013. Hydraulic failure and repair are not routine in trees. Annals of Forest Science **70**, 659–661.

**Cochard H, Herbette S, Barigah T, Badel E, Ennajeh M, Vilagrosa A**. 2010. Does sample length influence the shape of xylem embolism vulnerability curves? a test with the cavitron spinning technique: shape of xylem embolism vulnerability curves. Plant, Cell & Environment **33**, 1543–1552.

**Corso D, Delzon S, Lamarque LJ, Cochard H, Torres-Ruiz JM, King A, Brodribb T**. 2020. Neither xylem collapse, cavitation, or changing leaf conductance drive stomatal closure in wheat. Plant, Cell & Environment **43**, 854–865.

**Creek D, Blackman CJ, Brodribb TJ, Choat B, Tissue DT**. 2018. Coordination between leaf, stem, and root hydraulics and gas exchange in three arid-zone angiosperms during severe drought and recovery: Coordination between hydraulics and gas exchange during drought and recovery. Plant, Cell & Environment **41**, 2869–2881.

**Creek D, Lamarque LJ, Torres-Ruiz JM, Parise C, Burlett R, Tissue DT, Delzon S**. 2020. Xylem embolism in leaves does not occur with open stomata: evidence from direct observations using the optical visualization technique. Journal of Experimental Botany **71**, 1151–1159.

**Crouchet SE, Jensen J, Schwartz BF, Schwinning S**. 2019. Tree mortality after a hot drought: distinguishing density-dependent and -independent drivers and why it matters. Frontiers in Forests and Global Change **2**, 21.

**Cruz De Carvalho MH**. 2008. Drought stress and reactive oxygen species: production, scavenging and signaling. Plant Signaling & Behavior **3**, 156–165.

**Cuneo IF, Barrios-Masias F, Knipfer T, Uretsky J, Reyes C, Lenain P, Brodersen CR, Walker MA, McElrone AJ**. 2021. Differences in grapevine rootstock sensitivity and recovery from drought are linked to fine root cortical lacunae and root tip function. New Phytologist **229**, 272–283.

**Cutler SR, Rodriguez PL, Finkelstein RR, Abrams SR**. 2010. Abscisic acid: emergence of a core signaling network. Annual Review of Plant Biology **61**, 651–679.

**Dayer S, Herrera JC, Dai Z, Burlett R, Lamarque LJ, Delzon S, Bortolami G, Cochard H, Gambetta GA**. 2020. The sequence and thresholds of leaf hydraulic traits underlying grapevine varietal differences in drought tolerance. Journal of Experimental Botany **71**, 4333–4344.

**De Guzman ME, Acosta-Rangel A, Winter K, Meinzer FC, Bonal D, Santiago LS**. 2021. Hydraulic traits of Neotropical canopy liana and tree species across a broad range of wood density: implications for predicting drought mortality with models. (M Ball, Ed.). Tree Physiology **41**, 24–34.

**De Roo L, Vergeynst L, De Baerdemaeker N, Steppe K**. 2016. Acoustic emissions to measure drought-induced cavitation in plants. Applied Sciences **6**, 71.

**Déjardin A, Laurans F, Arnaud D, Breton C, Pilate G, Leplé J-C**. 2010. Wood formation in Angiosperms. Comptes Rendus Biologies **333**, 325–334.

**Delzon S, Cochard H**. 2014. Recent advances in tree hydraulics highlight the ecological significance of the hydraulic safety margin. New Phytologist **203**, 355–358.

**Desikan R, Last K, Harrett-Williams R, Tagliavia C, Harter K, Hooley R, Hancock JT, Neill SJ**. 2006. Ethylene-induced stomatal closure in Arabidopsis occurs via AtrbohF-mediated hydrogen peroxide synthesis. The Plant Journal **47**, 907–916.

**Dixon HH, Joly J**. 1895. On the ascent of sap. Philosophical Transactions of the Royal Society of London. B **186**, 563–576.

**Domingues TF, Ometto JPHB, Nepstad DC, Brando PM, Martinelli LA, Ehleringer JR**. 2018. Ecophysiological plasticity of Amazonian trees to long-term drought. Oecologia **187**, 933–940.

**Dória LC, Meijs C, Podadera DS, Del Arco M, Smets E, Delzon S, Lens F**. 2019. Embolism resistance in stems of herbaceous Brassicaceae and Asteraceae is linked to differences in woodiness and precipitation. Annals of Botany **124**, 1–14.

**Dória LC, Podadera DS, Arco M, Chauvin T, Smets E, Delzon S, Lens F**. 2018. Insular woody daisies (*Argyranthemum*, Asteraceae) are more resistant to drought-induced hydraulic failure than their herbaceous relatives. Functional Ecology **32**, 1467–1478.

**Ebrahimian-Motlagh S, Ribone PA, Thirumalaikumar VP, Allu AD, Chan RL, Mueller-Roeber B, Balazadeh S**. 2017. JUNGBRUNNEN1 confers drought tolerance downstream of the HD-Zip I transcription factor AtHB13. Frontiers in Plant Science **8**, 2118.

**Eller C, de V. Barros F, R.L. Bittencourt P, Rowland L, Mencuccini M, S. Oliveira R**. 2018. Xylem hydraulic safety and construction costs determine tropical tree growth: Tree growth vs hydraulic safety trade-off. Plant, Cell & Environment **41**, 548–562.

**Emonet A, Hay A**. 2022. Development and diversity of lignin patterns. Plant Physiology **190**, 31–43.

**Ennajeh M, Nouiri M, Khemira H, Cochard H**. 2011. Improvement to the air-injection technique to estimate xylem vulnerability to cavitation. Trees **25**, 705–710.

**Esau K**. 1965. *Plant Anatomy*. New York: John Wiley.

**Esquivel-Muelbert A, Phillips OL, Brienen RJW, *et al.*** 2020. Tree mode of death and mortality risk factors across Amazon forests. Nature Communications **11**, 5515.

**Evert R**. 2006. *Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development*. John Wiley & Sons, Ltd.

**Ewers FW, Jacobsen AL, López-Portillo J**. 2023. Carlquist's indices for vulnerability and mesomorphy of wood: are they relevant today? IAWA Journal, 1–13.

**Fang Y, Liao K, Du H, Xu Y, Song H, Li X, Xiong L**. 2015. A stress-responsive NAC transcription factor SNAC3 confers heat and drought tolerance through modulation of reactive oxygen species in rice. Journal of Experimental Botany **66**, 6803–6817.

**Feldpausch TR, Phillips OL, Brienen RJW, *et al.*** 2016. Amazon forest response to repeated droughts: Amaon forest response to droughts. Global Biogeochemical Cycles **30**, 964–982.

**Fischer EM, Sippel S, Knutti R**. 2021. Increasing probability of record-shattering climate extremes. Nature Climate Change **11**, 689–695.

**Fletcher LR, Scoffoni C, Farrell C, Buckley TN, Pellegrini M, Sack L**. 2022. Testing the association of relative growth rate and adaptation to climate across natural ecotypes of *Arabidopsis*. New Phytologist **236**, 413–432.

**Förster S, Schmidt LK, Kopic E, *et al.*** 2019. Wounding-Induced Stomatal Closure Requires Jasmonate-Mediated Activation of GORK K+ Channels by a Ca2+ Sensor-Kinase CBL1-CIPK5 Complex. Developmental Cell **48**, 87–99.

**Fortunel C, Ruelle J, Beauchêne J, Fine PVA, Baraloto C**. 2014. Wood specific gravity and anatomy of branches and roots in 113 A mazonian rainforest tree species across environmental gradients. New Phytologist **202**, 79–94.

**Fu X, Meinzer FC**. 2019. Metrics and proxies for stringency of regulation of plant water status (iso/anisohydry): a global data set reveals coordination and trade-offs among water transport traits. (J Martinez-Vilalta, Ed.). Tree Physiology **39**, 122–134.

**Gao H, Chen Y-J, Zhang Y-J, Maenpuen P, Lv S, Zhang J-L**. 2019. Vessel-length determination using silicone and air injection: are there artifacts? (K Steppe, Ed.). Tree Physiology **39**, 1783–1791.

**Gauthey A, Peters JMR, Lòpez R, Carins-Murphy MR, Rodriguez-Dominguez CM, Tissue DT, Medlyn BE, Brodribb TJ, Choat B**. 2022.

Mechanisms of xylem hydraulic recovery after drought in *Eucalyptus saligna*. Plant, Cell & Environment **45**, 1216–1228.

**Gleason SM, Barnard DM, Green TR, *et al.*** 2022. Physiological trait networks enhance understanding of crop growth and water use in contrasting environments. Plant, Cell & Environment, pce.14382.

**Gleason SM, Blackman CJ, Cook AM, Laws CA, Westoby M**. 2014. Whole-plant capacitance, embolism resistance and slow transpiration rates all contribute to longer desiccation times in woody angiosperms from arid and wet habitats. Tree Physiology **34**, 275–284.

**Gleason SM, Butler DW, Ziemińska K, Waryszak P, Westoby M**. 2012. Stem xylem conductivity is key to plant water balance across Australian angiosperm species: Plant stem hydraulic traits. Functional Ecology **26**, 343–352.

**Gleason SM, Westoby M, Jansen S, *et al.*** 2016*a*. On research priorities to advance understanding of the safety–efficiency tradeoff in xylem: a response to Bittencourt et al.'s (2016) comment 'On xylem hydraulic efficiencies, wood space-use and the safety–efficiency tradeoff'. New Phytologist **211**, 1156–1158.

**Gleason SM, Westoby M, Jansen S, *et al.*** 2016*b*. Weak tradeoff between xylem safety and xylem-specific hydraulic efficiency across the world's woody plant species. New Phytologist **209**, 123–136.

**Goodsman DW, Lusebrink I, Landhäusser SM, Erbilgin N, Lieffers VJ**. 2013. Variation in carbon availability, defense chemistry and susceptibility to fungal invasion along the stems of mature trees. New Phytologist **197**, 586–594.

**Goulart HMD, van der Wiel K, Folberth C, Balkovic J, van den Hurk B**. 2021. Storylines of weather-induced crop failure events under climate change. Earth System Dynamics **12**, 1503–1527.

**Greenwood S, Ruiz-Benito P, Martínez-Vilalta J, *et al.*** 2017. Tree mortality across biomes is promoted by drought intensity, lower wood density and higher specific leaf area. (J Chave, Ed.). Ecology Letters **20**, 539–553.

**Guan X, Pereira L, McAdam SAM, Cao K, Jansen S**. 2021. No gas source, no problem: Proximity to pre-existing embolism and segmentation affect embolism spreading in angiosperm xylem by gas diffusion. Plant, Cell & Environment **44**, 1329–1345.

**Guan X, Werner J, Cao K -F., Pereira L, Kaack L, McAdam SAM, Jansen S**. 2022. Stem and leaf xylem of angiosperm trees experiences minimal embolism in temperate forests during two consecutive summers with moderate drought. Plant Biology, plb.13384.

**Hacke UG, Jansen S**. 2009. Embolism resistance of three boreal conifer species varies with pit structure. New Phytologist **182**, 675–686.

**Hacke UG, Sperry JS, Pockman WT, Davis SD, McCulloh KA**. 2001. Trends in wood density and structure are linked to prevention of xylem implosion by negative pressure. Oecologia **126**, 457–461.

**Hacke UG, Sperry JS, Wheeler JK, Castro L**. 2006. Scaling of angiosperm xylem structure with safety and efficiency. Tree Physiology **26**, 689–701.

**Hacke UG, Venturas MD, MacKinnon ED, Jacobsen AL, Sperry JS, Pratt RB**. 2014. The standard centrifuge method accurately measures vulnerability curves of long-vesselled olive stems. New Phytologist **205**, 116–127.

**Halperin O, Gebremedhin A, Wallach R, Moshelion M**. 2017. High-throughput physiological phenotyping and screening system for the characterization of plant-environment interactions. The Plant Journal **89**, 839–850.

**Hamann T, Smets E, Lens F**. 2011. A comparison of paraffin and resin-based techniques used in bark anatomy. Taxon **60**, 841–851.

**Hammond WM, Williams AP, Abatzoglou JT, Adams HD, Klein T, López R, Sáenz-Romero C, Hartmann H, Breshears DD, Allen CD**. 2022. Global field observations of tree die-off reveal hotter-drought fingerprint for Earth's forests. Nature Communications **13**, 1761.

**Hammond WM, Yu K, Wilson LA, Will RE, Anderegg WRL, Adams HD**. 2019. Dead or dying? Quantifying the point of no return from hydraulic failure in drought-induced tree mortality. New Phytologist **223**, 1834–1843.

**Hanin M, Brini F, Ebel C, Toda Y, Takeda S, Masmoudi K**. 2011. Plant dehydrins and stress tolerance: versatile proteins for complex mechanisms. Plant Signaling & Behavior **6**, 1503–1509.

**Hartmann H, Moura CF, Anderegg WRL, *et al.*** 2018. Research frontiers for improving our understanding of drought-induced tree and forest mortality. New Phytologist **218**, 15–28.

**Hasanuzzaman M, Hakeem KR, Nahar K, Alharby HF (Eds.)**. 2019. *Plant abiotic stress tolerance: agronomic, molecular and biotechnological approaches*. Cham: Springer International Publishing.

**Heuer B**. 2010. Role of proline in plant response to drought and salinity. In: Pessarakli M, ed. Books in Soils, Plants, and the Environment. Handbook of Plant and Crop Stress,Third Edition. CRC Press, 213–238.

**Hoekstra FA, Golovina EA, Buitink J**. 2001. Mechanisms of plant desiccation tolerance. Trends in Plant Science **6**, 431–438.

**Hoffmann WA, Marchin RM, Abit P, Lau OL**. 2011. Hydraulic failure and tree dieback are associated with high wood density in a temperate forest under extreme drought: tree responses to severe drought. Global Change Biology **17**, 2731–2742.

**Holloway-Phillips M-M, Brodribb TJ**. 2011. Minimum hydraulic safety leads to maximum water-use efficiency in a forage grass. Plant, Cell & Environment **34**, 302–313.

**Hwang K, Susila H, Nasim Z, Jung J-Y, Ahn JH**. 2019. Arabidopsis ABF3 and ABF4 transcription factors act with the NF-YC complex to regulate SOC1 expression and mediate drought-accelerated flowering. Molecular Plant **12**, 489–505.

**Ingram S, Salmon Y, Lintunen A, Hölttä T, Vesala T, Vehkamäki H**. 2021. Dynamic surface tension enhances the stability of nanobubbles in xylem sap. Frontiers in Plant Science **12**, 732701.

**Inoue Y, Ichie T, Kenzo T, Yoneyama A, Kumagai T, Nakashizuka T**. 2017. Effects of rainfall exclusion on leaf gas exchange traits and osmotic adjustment in mature canopy trees of Dryobalanops aromatica

(Dipterocarpaceae) in a Malaysian tropical rain forest. Tree Physiology **37**, 1301–1311.

**IPCC**. 2022. *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, NY, USA: Cambridge University Press.

**Isasa E, Link RM, Jansen S, Tezeh FR, Kaack L, Sarmento Cabral J, Schuldt B**. 2023. Addressing controversies in the xylem embolism resistance–vessel diameter relationship. New Phytologist, nph.18731.

**Jacobsen AL, Agenbag L, Esler KJ, Pratt RB, Ewers FW, Davis SD**. 2007*a*. Xylem density, biomechanics and anatomical traits correlate with water stress in 17 evergreen shrub species of the Mediterranean-type climate region of South Africa. Journal of Ecology **95**, 171–183.

**Jacobsen AL, Ewers FW, Pratt RB, Paddock WA, Davis SD**. 2005. Do xylem fibers affect vessel cavitation resistance? Plant Physiology **139**, 546–556.

**Jacobsen AL, Pratt RB**. 2012. No evidence for an open vessel effect in centrifuge-based vulnerability curves of a long-vesselled liana (*Vitis vinifera* ). New Phytologist **194**, 982–990.

**Jacobsen AL, Pratt RB, Davis SD, Ewers FW**. 2007*b*. Cavitation resistance and seasonal hydraulics differ among three arid Californian plant communities. Plant, Cell & Environment **30**, 1599–1609.

**Jacobsen AL, Pratt RB, Ewers FW, Davis SD**. 2007*c*. Cavitation resistance among 26 chaparral species of Southern California. Ecological Monographs **77**, 99–115.

**Jansen S, Choat B, Pletsers A**. 2009. Morphological variation of intervessel pit membranes and implications to xylem function in angiosperms. American Journal of Botany **96**, 409–419.

**Johnson KM, Brodersen C, Carins-Murphy MR, Choat B, Brodribb TJ**. 2020. Xylem embolism spreads by single-conduit events in three dry forest angiosperm stems. Plant Physiology **184**, 212–222.

**Johnson KM, Brodribb TJ**. 2023. Evidence for a trade-off between growth rate and xylem cavitation resistance in *Callitris rhomboidea*. (F Meinzer, Ed.). Tree Physiology, tpad037.

**Johnson DM, Katul G, Domec J**. 2022. Catastrophic hydraulic failure and tipping points in plants. Plant, Cell & Environment **45**, 2231–2266.

**Johnson KM, Lucani C, Brodribb TJ**. 2021. In vivo monitoring of drought-induced embolism in *Callitris rhomboidea* trees reveals wide variation in branchlet vulnerability and high resistance to tissue death. New Phytologist **233**, 207–218.

**Johnson DM, Wortemann R, McCulloh KA, Jordan-Meille L, Ward E, Warren JM, Palmroth S, Domec J-C**. 2016. A test of the hydraulic vulnerability segmentation hypothesis in angiosperm and conifer tree species. (N Phillips, Ed.). Tree Physiology **36**, 983–993.

**Joshi J, Stocker BD, Hofhansl F, Zhou S, Dieckmann U, Prentice IC**. 2022. Towards a unified theory of plant photosynthesis and hydraulics. Nature Plants **8**, 1304–1316.

**Joshi R, Wani SH, Singh B, Bohra A, Dar ZA, Lone AA, Pareek A, Singla-Pareek SL**. 2016. Transcription factors and plants response to drought stress: current understanding and future directions. Frontiers in Plant Science **7**, 1029.

**Kaack L, Altaner CM, Carmesin C, *et al.*** 2019. Function and three-dimensional structure of intervessel pit membranes in angiosperms: a review. IAWA Journal **40**, 673–702.

**Kaack L, Weber M, Isasa E, *et al.*** 2021. Pore constrictions in intervessel pit membranes provide a mechanistic explanation for xylem embolism resistance in angiosperms. New Phytologist **230**, 1829–1843.

**Kanduč M, Schneck E, Loche P, Jansen S, Schenk HJ, Netz RR**. 2020. Cavitation in lipid bilayers poses strict negative pressure stability limit in biological liquids. Proceedings of the National Academy of Sciences **117**, 10733–10739.

**Kannenberg SA, Driscoll AW, Malesky D, Anderegg WRL**. 2021. Rapid and surprising dieback of Utah juniper in the southwestern USA due to acute drought stress. Forest Ecology and Management **480**, 118639.

**Karami O, Rahimi A, Khan M, Bemer M, Hazarika RR, Mak P, Compier M, van Noort V, Offringa R**. 2020. A suppressor of axillary meristem maturation promotes longevity in flowering plants. Nature Plants **6**, 368–376.

**Karnovsky MJ**. 1965. A formaldehyde-glutaraldehyde fixative of high osmolality for use in electron microscopy. **27**, 137-138A.

**Khurmatov KK**. 1982. Heterogeneity of natural populations of *Arabidopsis thaliana* (pamiro-alay) in the flowering time. Arabidopsis Inf Serv. **19**, 62–66.

**Kim T-W, Jehanzaib M**. 2020. Drought risk analysis, forecasting and assessment under climate change. Water **12**, 1862.

**Kim J-S, Mizoi J, Yoshida T, *et al.*** 2011. An ABRE promoter sequence is involved in osmotic stress-responsive expression of the DREB2A gene, which encodes a transcription factor regulating drought-inducible genes in *Arabidopsis*. Plant and Cell Physiology **52**, 2136–2146.

**Kimura Y, Aoki S, Ando E, *et al.*** 2015. A flowering integrator, SOC1, affects stomatal opening in *Arabidopsis thaliana*. Plant and Cell Physiology **56**, 640–649.

**Klein T**. 2014. The variability of stomatal sensitivity to leaf water potential across tree species indicates a continuum between isohydric and anisohydric behaviours. (S Niu, Ed.). Functional Ecology **28**, 1313–1320.

**Klein T, Hartmann H**. 2018. Climate change drives tree mortality. (J Sills, Ed.). Science **362**, 758–758.

**Knipfer T, Bambach N, Hernandez MI, Bartlett MK, Sinclair G, Duong F, Kluepfel DA, McElrone AJ**. 2020. Predicting stomatal closure and turgor loss in woody plants using predawn and midday water potential. Plant Physiology **184**, 881–894.

**Ko J-H, Han K-H, Park S, Yang J**. 2004. Plant body weight-induced secondary growth in *Arabidopsis* and its transcription phenotype revealed by whole-transcriptome profiling. Plant Physiology **135**, 1069–1083.

**Kolb TE, Fettig CJ, Ayres MP, Bentz BJ, Hicke JA, Mathiasen R, Stewart JE, Weed AS**. 2016. Observed and anticipated impacts of drought on forest insects and diseases in the United States. Forest Ecology and Management **380**, 321–334.

**Kolb KJ, Sperry JS**. 1999. Differences in droiught adaptaion between subspecies of sagebrush (*Artemisia tridentata* ). Ecology **80**, 2373–2384.

**Konrad W, Katul G, Roth-Nebelsick A, Jensen KH**. 2019. Xylem functioning, dysfunction and repair: a physical perspective and implications for phloem transport. (T Holtta, Ed.). Tree Physiology **39**, 243–261.

**Koornneef M, Meinke D**. 2010. The development of *Arabidopsis* as a model plant. The Plant Journal **61**, 909–921.

**Koster KL, Leopold AC**. 1988. Sugars and desiccation tolerance in seeds. Plant Physiology **88**, 829–832.

**Kuromori T, Seo M, Shinozaki K**. 2018. ABA transport and plant water stress responses. Trends in Plant Science **23**, 513–522.

**Lamarque LJ, Delzon S, Toups H, *et al.*** 2020. Over-accumulation of abscisic acid in transgenic tomato plants increases the risk of hydraulic failure. Plant, Cell & Environment **43**, 548–562.

**Larter M, Brodribb TJ, Pfautsch S, Burlett R, Cochard H, Delzon S**. 2015. Extreme aridity pushes trees to their physical limits. Plant Physiology **168**, 804–807.

**Larter M, Pfautsch S, Domec J, Trueba S, Nagalingum N, Delzon S**. 2017. Aridity drove the evolution of extreme embolism resistance and the radiation of conifer genus *Callitris*. New Phytologist **215**, 97–112.

**Lata C, Prasad M**. 2011. Role of DREBs in regulation of abiotic stress responses in plants. Journal of Experimental Botany **62**, 4731–4748.

**Lawson T, Vialet-Chabrand S**. 2019. Speedy stomata, photosynthesis and plant water use efficiency. New Phytologist **221**, 93–98.

**Le DT, Nishiyama R, Watanabe Y, Mochida K, Yamaguchi-Shinozaki K, Shinozaki K, Tran L-SP**. 2011. Genome-wide survey and expression analysis of the plant-specific NAC transcription factor family in soybean during development and dehydration stress. DNA Research **18**, 263–276.

**Lemaire C, Blackman CJ, Cochard H, Menezes-Silva PE, Torres-Ruiz JM, Herbette S**. 2021*a*. Acclimation of hydraulic and morphological traits to water deficit delays hydraulic failure during simulated drought in poplar. Tree Physiology **41**, 2008–2021.

**Lemaire C, Quilichini Y, Brunel-Michac N, Santini J, Berti L, Cartailler J, Conchon P, Badel É, Herbette S**. 2021*b*. Plasticity of the xylem vulnerability to embolism in *Populus tremula x alba* relies on pit quantity properties rather than on pit structure. (J Martinez-Vilalta, Ed.). Tree Physiology **41**, 1384–1399.

**Lens F, Eeckhout S, Zwartjes R, Smets E, Janssens SB**. 2012*a*. The multiple fuzzy origins of woodiness within Balsaminaceae using an integrated approach. where do we draw the line? Annals of Botany **109**, 783–799.

**Lens F, Gleason SM, Bortolami G, Brodersen C, Delzon S, Jansen S**. 2022*a*. Functional xylem characteristics associated with drought-induced embolism in angiosperms. New Phytologist doi: 10.1111/nph.18447.

**Lens F, Gleason SM, Bortolami G, Brodersen C, Delzon S, Jansen S**. 2022*b*. Functional xylem characteristics associated with drought-induced embolism in angiosperms. New Phytologist **236**, 2019–2036.

**Lens F, Luteyn JL, Smets E, Jansen S**. 2004. Ecological trends in the wood anatomy of Vaccinioideae (Ericaceae s.l.). Flora - Morphology, Distribution, Functional Ecology of Plants **199**, 309–319.

**Lens F, Picon-Cochard C, Delmas CE, *et al.*** 2016. Herbaceous angiosperms are not more vulnerable to drought-induced embolism than angiosperm trees. Plant Physiology **172**, 661–667.

**Lens F, Schönenberger J, Baas P, Jansen S, Smets E**. 2007. The role of wood anatomy in phylogeny reconstruction of Ericales. Cladistics **23**, 229–294.

**Lens F, Smets E, Melzer S**. 2012*b*. Stem anatomy supports *Arabidopsis thaliana* as a model for insular woodiness: Letter. New Phytologist **193**, 12–17.

**Lens F, Sperry JS, Christman MA, Choat B, Rabaey D, Jansen S**. 2011*a*. Testing hypotheses that link wood anatomy to cavitation resistance and hydraulic conductivity in the genus *Acer*. New Phytologist **190**, 709–723.

**Lens F, Sperry JS, Christman MA, Choat B, Rabaey D, Jansen S**. 2011*b*. Testing hypotheses that link wood anatomy to cavitation resistance and hydraulic conductivity in the genus *Acer*. New Phytologist **190**, 709–723.

**Lens F, Tixier A, Cochard H, Sperry JS, Jansen S, Herbette S**. 2013. Embolism resistance as a key mechanism to understand adaptive plant strategies. Current Opinion in Plant Biology **16**, 287–292.

**Lesk C, Rowhani P, Ramankutty N**. 2016. Influence of extreme weather disasters on global crop production. Nature **529**, 84–87.

**Levionnois S, Jansen S, Wandji RT, Beauchêne J, Ziegler C, Coste S, Stahl C, Delzon S, Authier L, Heuret P**. 2021. Linking drought-induced xylem embolism resistance to wood anatomical traits in Neotropical trees. New Phytologist **229**, 1453–1466.

**Levionnois S, Ziegler C, Jansen S, Calvet E, Coste S, Stahl C, Salmon C, Delzon S, Guichard C, Heuret P**. 2020. Vulnerability and hydraulic segmentations at the stem–leaf transition: coordination across Neotropical trees. New Phytologist **228**, 512–524.

**Li S, Feifel M, Karimi Z, Schuldt B, Choat B, Jansen S**. 2015. Leaf gas exchange performance and the lethal water potential of five European species during drought. Tree Physiology **36**, 179–192.

**Li S, Lens F, Espino S, Karimi Z, Klepsch M, Schenk HJ, Schmitt M, Schuldt B, Jansen S**. 2016. Intervessel pit membrane thickness as a key dominant of embolism resistance in angiosperm xylem. IAWA Journal **37**, 152–171.

**Li Y, Li H, Li Y, Zhang S**. 2017. Improving water-use efficiency by decreasing stomatal conductance and transpiration rate to maintain higher ear photosynthetic rate in drought-resistant wheat. The Crop Journal **5**, 231–239.

**Li Y, Sperry JS, Shao M**. 2009. Hydraulic conductance and vulnerability to cavitation in corn (*Zea mays* L.) hybrids of differing drought resistance. Environmental and Experimental Botany **66**, 341–346.

**Liang X, Ye Q, Liu H, Brodribb TJ**. 2021. Wood density predicts mortality threshold for diverse trees. New Phytologist **229**, 3053–3057.

**Lima TRA, Carvalho ECD, Martins FR, *et al.*** 2018. Lignin composition is related to xylem embolism resistance and leaf life span in trees in a tropical semiarid climate. New Phytologist **219**, 1252–1262.

**Limousin J, Roussel A, Rodríguez-Calcerrada J, Torres-Ruiz JM, Moreno M, Jalon LG de, Ourcival J, Simioni G, Cochard H, Martin-StPaul N**. 2022. Drought acclimation of *Quercus ilex* leaves improves tolerance to moderate drought but not resistance to severe water stress. Plant, Cell & Environment **45**, 1967–1984.

**Liu Q, Luo L, Zheng L**. 2018. Lignins: Biosynthesis and Biological Functions in Plants. International Journal of Molecular Sciences **19**, 335.

**Lobin W**. 1983. The occurrence of *Arabidopsis thaliana* in the Cape Verde Islands. Arab Info Ser **20**, 119–123.

**Lobo A, Torres-Ruiz JM, Burlett R, *et al.*** 2018. Assessing inter- and intraspecific variability of xylem vulnerability to embolism in oaks. Forest Ecology and Management **424**, 53–61.

**Loepfe L, Martinez-Vilalta J, Piñol J, Mencuccini M**. 2007. The relevance of xylem network structure for plant hydraulic efficiency and safety. Journal of Theoretical Biology **247**, 788–803.

**Lohse D, Zhang X**. 2015. Surface nanobubbles and nanodroplets. Reviews of Modern Physics **87**, 981–1035.

**Lopez FB, Barclay GF**. 2017. Plant Anatomy and Physiology. Pharmacognosy. Elsevier, 45–60.

**Losso A, Bär A, Dämon B, *et al.*** 2019. Insights from *in vivo* micro- CT analysis: testing the hydraulic vulnerability segmentation in *Acer pseudoplatanus* and *Fagus sylvatica* seedlings. New Phytologist **221**, 1831–1842.

**Lübbe T, Lamarque LJ, Delzon S, Torres Ruiz JM, Burlett R, Leuschner C, Schuldt B**. 2022. High variation in hydraulic efficiency but not xylem safety between roots and branches in four temperate broad-leaved tree species. Functional Ecology **36**, 699–712.

**Lucas WJ, Groover A, Lichtenberger R, *et al.*** 2013. The plant vascular system: evolution, development and functions [F]. Journal of Integrative Plant Biology **55**, 294–388.

**Maherali H, Pockman WT, Jackson RB**. 2004. Adaptive variation in the vulnerability of woody plants to xylem cavitation. Ecology **85**, 2184–2199.

**Mantova M, Cochard H, Burlett R, Delzon S, King A, Rodriguez-Dominguez CM, Ahmed MA, Trueba S, Torres-Ruiz JM**. 2022*a*. On the path from xylem hydraulic failure to downstream cell death. New Phytologist **237**, 793–806.

**Mantova M, Herbette S, Cochard H, Torres-Ruiz JM**. 2022*b*. Hydraulic failure and tree mortality: from correlation to causation. Trends in Plant Science **27**, 335–345.

**Mantova M, Menezes-Silva PE, Badel E, Cochard H, Torres-Ruiz JM**. 2021. The interplay of hydraulic failure and cell vitality explains tree capacity to recover from drought. Physiologia Plantarum **172**, 247–257.

**Maris H, Balibar S**. 2000. Negative pressures and cavitation in liquid helium. Physics Today **53**, 29–34.

**Martínez-Cabrera HI, Jones CS, Espino S, Schenk HJ**. 2009. Wood anatomy and wood density in shrubs: responses to varying aridity along transcontinental transects. American Journal of Botany **96**, 1388–1398.

**Martinez-Vilalta J, Anderegg WRL, Sapes G, Sala A**. 2019. Greater focus on water pools may improve our ability to understand and anticipate drought-induced mortality in plants. New Phytologist **223**, 22–32.

**Martínez-Vilalta J, Garcia-Forner N**. 2017. Water potential regulation, stomatal behaviour and hydraulic transport under drought: deconstructing the iso/anisohydric concept: Deconstructing the iso/anisohydric concept. Plant, Cell & Environment **40**, 962–976.

**Martinez-Vilalta J, Mencuccini M, Alvarez X, Camacho J, Loepfe L, Pinol J**. 2012. Spatial distribution and packing of xylem conduits. American Journal of Botany **99**, 1189–1196.

**Martínez-Vilalta J, Santiago LS, Poyatos R, Badiella L, Cáceres M, Aranda I, Delzon S, Vilagrosa A, Mencuccini M**. 2021. Towards a statistically robust determination of minimum water potential and hydraulic risk in plants. New Phytologist **232**, 404–417.

**Martin-StPaul N, Delzon S, Cochard H**. 2017. Plant resistance to drought depends on timely stomatal closure. Ecology Letters **20**, 1437–1447.

**Martin-StPaul NK, Longepierre D, Huc R, Delzon S, Burlett R, Joffre R, Rambal S, Cochard H**. 2014. How reliable are methods to assess xylem vulnerability to cavitation? The issue of 'open vessel' artifact in oaks. Tree Physiology **34**, 894–905.

**Maruyama K, Todaka D, Mizoi J, *et al.*** 2012. Identification of Cis-Acting Promoter Elements in Cold- and Dehydration-Induced Transcriptional Pathways in Arabidopsis, Rice, and Soybean. DNA Research **19**, 37–49.

**Matiu M, Ankerst DP, Menzel A**. 2017. Interactions between temperature and drought in global and regional crop yield variability during 1961-2014. (JL Gonzalez-Andujar, Ed.). PLOS ONE **12**, e0178339.

**Matros A, Peshev D, Peukert M, Mock H-P, Van den Ende W**. 2015. Sugars as hydroxyl radical scavengers: proof-of-concept by studying the fate of sucralose in Arabidopsis. The Plant Journal **82**, 822–839.

**Mauri R, Cardoso AA, da Silva MM, Oliveira LA, Avila RT, Martins SCV, DaMatta FM**. 2020. Leaf hydraulic properties are decoupled from leaf area across coffee species. Trees **34**, 1507–1514.

**McCormack ML, Dickie IA, Eissenstat DM, *et al.*** 2015. Redefining fine roots improves understanding of below-ground contributions to terrestrial biosphere processes. New Phytologist **207**, 505–518.

**McDowell NG, Beerling DJ, Breshears DD, Fisher RA, Raffa KF, Stitt M**. 2011. The interdependence of mechanisms underlying climate-driven vegetation mortality. Trends in Ecology & Evolution **26**, 523–532.

**McDowell N, Pockman WT, Allen CD, *et al.*** 2008. Mechanisms of plant survival and mortality during drought: why do some plants survive while others succumb to drought? New Phytologist **178**, 719–739.

**McDowell NG, Sapes G, Pivovaroff A, *et al.*** 2022. Mechanisms of woody-plant mortality under rising drought, CO2 and vapour pressure deficit. Nature Reviews Earth & Environment **3**, 294–308.

**Mehrotra R, Bhalothia P, Bansal P, Basantani MK, Bharti V, Mehrotra S**. 2014. Abscisic acid and abiotic stress tolerance – Different tiers of regulation. Journal of Plant Physiology **171**, 486–496.

**Meinzer FC, Campanello PI, Domec J-C, Gatti MG, Goldstein G, Villalobos-Vega R, Woodruff DR**. 2008*a*. Constraints on physiological function associated with branch architecture and wood density in tropical forest trees. Tree Physiology **28**, 1609–1617.

**Meinzer FC, Johnson DM, Lachenbruch B, McCulloh KA, Woodruff DR**. 2009. Xylem hydraulic safety margins in woody plants: coordination of stomatal control of xylem tension with hydraulic capacitance. Functional Ecology **23**, 922–930.

**Meinzer FC, McCulloh KA, Lachenbruch B, Woodruff DR, Johnson DM**. 2010. The blind men and the elephant: the impact of context and scale in evaluating conflicts between plant hydraulic safety and efficiency. Oecologia **164**, 287–296.

**Meinzer FC, Woodruff DR, Domec J-C, Goldstein G, Campanello PI, Gatti MG, Villalobos-Vega R**. 2008*b*. Coordination of leaf and stem water transport properties in tropical forest trees. Oecologia **156**, 31–41.

**Melzer S, Lens F, Gennen J, Vanneste S, Rohde A, Beeckman T**. 2008. Flowering-time genes modulate meristem determinacy and growth form in *Arabidopsis thaliana*. Nature Genetics **40**, 1489–1492.

**Ménard D, Blaschek L, Kriechbaum K, *et al.*** 2022. Plant biomechanics and resilience to environmental changes are controlled by specific lignin chemistries in each vascular cell type and morphotype. The Plant Cell **34**, 4877–4896.

**Mencuccini M, Minunno F, Salmon Y, Martínez-Vilalta J, Hölttä T**. 2015. Coordination of physiological traits involved in drought-induced mortality of woody plants. New Phytologist **208**, 396–409.

**Messinger SM, Buckley TN, Mott KA**. 2006. Evidence for involvement of photosynthetic processes in the stomatal response to CO2. Plant Physiology **140**, 771–778.

**Meyra AG, Kuz VA, Zarragoicoechea GJ**. 2007. Geometrical and physicochemical considerations of the pit membrane in relation to air seeding: the pit membrane as a capillary valve. Tree Physiology **27**, 1401–1405.

**Mitchell PJ, O'Grady AP, Tissue DT, White DA, Ottenschlaeger ML, Pinkard EA**. 2013. Drought response strategies define the relative contributions of hydraulic dysfunction and carbohydrate depletion during tree mortality. New Phytologist **197**, 862–872.

**Monda K, Negi J, Iio A, Kusumi K, Kojima M, Hashimoto M, Sakakibara H, Iba K**. 2011. Environmental regulation of stomatal response in the *Arabidopsis* Cvi-0 ecotype. Planta **234**, 555–563.

**Mrad A, Johnson DM, Love DM, Domec J**. 2021. The roles of conduit redundancy and connectivity in xylem hydraulic functions. New Phytologist **231**, 996–1007.

**Nakashima K, Yamaguchi-Shinozaki K, Shinozaki K**. 2014. The transcriptional regulatory network in the drought response and its crosstalk in abiotic stress responses including drought, cold, and heat. Frontiers in Plant Science **5**, 170.

**Nardini A, Battistuzzo M, Savi T**. 2013. Shoot desiccation and hydraulic failure in temperate woody angiosperms during an extreme summer drought. New Phytologist **200**, 322–329.

**Netherer S, Matthews B, Katzensteiner K, *et al.*** 2015. Do water-limiting conditions predispose N orway spruce to bark beetle attack? New Phytologist **205**, 1128–1141.

**Neufeld HS, Grantz DA, Meinzer FC, Goldstein G, Crisosto GM, Crisosto C**. 1992. Genotypic Variability in Vulnerability of Leaf Xylem to Cavitation in Water-Stressed and Well-Irrigated Sugarcane. Plant Physiology **100**, 1020–1028.

**Nieminen KM, Kauppinen L, Helariutta Y**. 2004. A weed for wood? *Arabidopsis* as a genetic model for xylem development. Plant Physiology **135**, 653–659.

**Niklas KJ**. 1997. Mechanical properties of black locust (*Robinia pseudoacacia*) wood: correlations among elastic and rupture moduli, proportional limit, and tissue density and specific gravity. Annals of Botany **79**, 479–485.

**Nolan RH, Gauthey A, Losso A, *et al.*** 2021. Hydraulic failure and tree size linked with canopy die-back in eucalypt forest during extreme drought. New Phytologist **230**, 1354–1365.

**Nolf M, Pagitz K, Mayr S**. 2014. Physiological acclimation to drought stress in *Solidago canadensis*. Physiologia Plantarum **150**, 529–539.

**Nolf M, Rosani A, Ganthaler A, Beikircher B, Mayr S**. 2016. Herb hydraulics: inter and intraspecific variation in three *Ranunculus* species. Plant Physiology **170**, 2085–2094.

**O'Brien MJ, Leuzinger S, Philipson CD, Tay J, Hector A**. 2014. Drought survival of tropical tree seedlings enhanced by non-structural carbohydrate levels. Nature Climate Change **4**, 710–714.

**Oletić D, Rosner S, Bilas V**. 2023. Field-experiences of tracking plant's xylem embolism formation with embedded acoustic emission sensors. e-Journal of Nondestructive Testing **28**.

**Oliveira RS, Eller CB, Barros F de V, Hirota M, Brum M, Bittencourt P**. 2021. Linking plant hydraulics and the fast–slow continuum to understand resilience to drought in tropical ecosystems. New Phytologist **230**, 904–923.

**Olson ME, Pace MR, Anfodillo T**. 2023. The vulnerability to drought-induced embolism-conduit diameter link: breaching the anatomy-physiology divide. IAWA Journal, 1–20.

**Ozturk M, Turkyilmaz Unal B, García-Caparrós P, Khursheed A, Gul A, Hasanuzzaman M**. 2021. Osmoregulation and its actions during the drought stress in plants. Physiologia Plantarum **172**, 1321–1335.

**Pammenter NW, Van der Willigen C**. 1998. A mathematical and statistical analysis of the curves illustrating vulnerability of xylem to cavitation. Tree Physiology **18**, 589–593.

**Papastefanou P, Zang CS, Pugh TAM, Liu D, Grams TEE, Hickler T, Rammig A**. 2020. A dynamic model for strategies and dynamics of plant water-potential regulation under drought conditions. Frontiers in Plant Science **11**, 373.

**Park J, Go T, Ryu J, Lee SJ**. 2019. Air spreading through wetted cellulose membranes: Implications for the safety function of hydraulic valves in plants. Physical Review E **100**, 032409.

**Passardi F, Dobias J, Valério L, Guimil S, Penel C, Dunand C**. 2007. Morphological and physiological traits of three major *Arabidopsis thaliana* accessions. Journal of Plant Physiology **164**, 980–992.

**Passioura JB**. 1982. Water in the soil-plant-atmosphere continuum. In: Lange OL, Nobel PS, Osmond CB, Ziegler H, eds. Physiological Plant Ecology II. Berlin, Heidelberg: Springer Berlin Heidelberg, 5–33.

**Pereira H**. 2007. *Cork: Biology, Production and Uses*. Amsterdam: Elsevier.

**Pereira L, Bittencourt PRL, Oliveira RS, Junior MBM, Barros FV, Ribeiro RV, Mazzafera P**. 2016. Plant pneumatics: stem air flow is related to embolism – new perspectives on methods in plant hydraulics. New Phytologist **211**, 357–370.

**Pereira L, Bittencourt PRL, Pacheco VS, *et al.*** 2020. The pneumatron: an automated pneumatic apparatus for estimating xylem vulnerability to embolism at high temporal resolution. Plant, Cell & Environment **43**, 131–142.

**Pereira L, Domingues-Junior AP, Jansen S, Choat B, Mazzafera P**. 2018. Is embolism resistance in plant xylem associated with quantity and characteristics of lignin? Trees **32**, 349–358.

**Pfautsch S, Renard J, Tjoelker MG, Salih A**. 2015. Phloem as Capacitor: Radial Transfer of Water into Xylem of Tree Stems Occurs via Symplastic Transport in Ray Parenchyma. Plant Physiology **167**, 963–971.

**Pickard WF**. 1981. The ascent of sap in plants. Progress in Biophysics and Molecular Biology **37**, 181–229.

**Pittermann J**. 2010. The evolution of water transport in plants: an integrated approach. Geobiology **8**, 112–139.

**Pittermann J, Sperry JS, Wheeler JK, Hacke UG, Sikkema EH**. 2006. Mechanical reinforcement of tracheids compromises the hydraulic efficiency of conifer xylem. Plant, Cell and Environment **29**, 1618–1628.

**Pivovaroff AL, Sack L, Santiago LS**. 2014. Coordination of stem and leaf hydraulic conductance in southern C alifornia shrubs: a test of the hydraulic segmentation hypothesis. New Phytologist **203**, 842–850.

**Plavcová L, Hacke UG**. 2012. Phenotypic and developmental plasticity of xylem in hybrid poplar saplings subjected to experimental drought,

nitrogen fertilization, and shading. Journal of Experimental Botany **63**, 6481–6491.

**Plavcová L, Hacke UG, Sperry JS**. 2011. Linking irradiance-induced changes in pit membrane ultrastructure with xylem vulnerability to cavitation: Irradiance-induced changes in pit structure. Plant, Cell & Environment **34**, 501–513.

**Plavcová L, Jansen S**. 2015. The Role of Xylem Parenchyma in the Storage and Utilization of Nonstructural Carbohydrates. In: Hacke U, ed. Functional and Ecological Xylem Anatomy. Cham: Springer International Publishing, 209–234.

**Plavcová L, Jansen S, Klepsch M, Hacke UG**. 2013. Nobody's perfect: can irregularities in pit structure influence vulnerability to cavitation? Frontiers in Plant Science **4**, 453.

**Pockman WT, Sperry JS**. 2000. Vulnerability to xylem cavitation and the distribution of Sonoran Desert vegetation. American Journal of Botany **87**, 1287–1299.

**Pockman WT, Sperry JS, O'Leary JW**. 1995. Sustained and significant negative water pressure in xylem. Nature **378**, 715–716.

**Poorter L**. 2008. The Relationships of wood-, gas- and water fractions of tree stems to performance and life Hhstory variation in Tropical trees. Annals of Botany **102**, 367–375.

**Poorter L, McDonald I, Alarcón A, Fichtler E, Licona J, Peña-Claros M, Sterck F, Villegas Z, Sass-Klaassen U**. 2010. The importance of wood traits and hydraulic conductance for the performance and life history strategies of 42 rainforest tree species. New Phytologist **185**, 481–492.

**Powers JS, Vargas G. G, Brodribb TJ, *et al.*** 2020. A catastrophic tropical drought kills hydraulically vulnerable tree species. Global Change Biology **26**, 3122–3133.

**Pratt RB, Jacobsen AL**. 2017. Conflicting demands on angiosperm xylem: tradeoffs among storage, transport and biomechanics: Tradeoffs in xylem function. Plant, Cell & Environment **40**, 897–913.

**Pratt RB, Jacobsen AL, Ewers FW, Davis SD**. 2007*a*. Relationships among xylem transport, biomechanics and storage in stems and roots of nine Rhamnaceae species of the California chaparral. New Phytologist **174**, 787–798.

**Pratt RB, Jacobsen AL, Golgotiu KA, Sperry JS, Ewers FW, Davis SD**. 2007*b*. Life history type and water stress tolerance in nine California chaparral species (Rhamnaceae).pdf. Ecological Monographs **77**, 239–253.

**Puranik S, Sahu PP, Srivastava PS, Prasad M**. 2012. NAC proteins: regulation and role in stress tolerance. Trends in Plant Science **17**, 369–381.

**Rabara RC, Tripathi P, Rushton PJ**. 2014. The potential of transcription factor-based genetic engineering in improving crop tolerance to drought. OMICS: A Journal of Integrative Biology **18**, 601–614.

**Ragni L, Greb T**. 2018. Secondary growth as a determinant of plant shape and form. Seminars in Cell & Developmental Biology **79**, 58–67.

**Rahimi A, Karami O, Balazadeh S, Offringa R**. 2022. miR156-independent repression of the ageing pathway by longevity-promoting AHL proteins in Arabidopsis. New Phytologist **235**, 2424–2438.

**Ramel F, Sulmon C, Bogard M, Couée I, Gouesbet G**. 2009. Differential patterns of reactive oxygen species and antioxidative mechanisms during atrazine injury and sucrose-induced tolerance in Arabidopsis thaliana plantlets. BMC Plant Biology **9**, 28.

**Rawlings JO, Cure WW**. 1985. The Weibull Function as a Dose-Response Model to Describe Ozone Effects on Crop Yields [1]. Crop Science **25**, 807–814.

**Reiterer A, Burgert I, Sinn G, Tschegg S**. 2002. The radial reinforcement of the wood structure and its implication on mechanical and fracture mechanical properties—a comparison between two tree species. 935–940.

**Rissanen K, Hölttä T, Bäck J, Rigling A, Wermelinger B, Gessler A**. 2021. Drought effects on carbon allocation to resin defences and on resin

dynamics in old-grown Scots pine. Environmental and Experimental Botany **185**, 104410.

**Rockwell FE, Wheeler JK, Holbrook NM**. 2014. Cavitation and its discontents: opportunities for resolving current controversies. Plant Physiology **164**, 1649–1660.

**Rodriguez-Dominguez CM, Brodribb TJ**. 2020. Declining root water transport drives stomatal closure in olive under moderate water stress. New Phytologist **225**, 126–134.

**Rodriguez-Dominguez CM, Carins Murphy MR, Lucani C, Brodribb TJ**. 2018. Mapping xylem failure in disparate organs of whole plants reveals extreme resistance in olive roots. New Phytologist **218**, 1025–1035.

**Rodriguez-Dominguez CM, Forner A, Martorell S, *et al.*** 2022. Leaf water potential measurements using the pressure chamber: synthetic testing of assumptions towards best practices for precision and accuracy. Plant, Cell & Environment **45**, 2037–2061.

**Rosas T, Mencuccini M, Barba J, Cochard H, Saura-Mas S, Martínez-Vilalta J**. 2019. Adjustments and coordination of hydraulic, leaf and stem traits along a water availability gradient. New Phytologist **223**, 632–646.

**Rosenthal DM, Stiller V, Sperry JS, Donovan LA**. 2010. Contrasting drought tolerance strategies in two desert annuals of hybrid origin. Journal of Experimental Botany **61**, 2769–2778.

**Russo SE, Jenkins KL, Wiser SK, Uriarte M, Duncan RP, Coomes DA**. 2010. Interspecific relationships among growth, mortality and xylem traits of woody species from New Zealand: Tree growth, mortality and woody traits. Functional Ecology **24**, 253–262.

**Saha S, Holbrook NM, Montti L, Goldstein G, Cardinot GK**. 2009. Water relations of *Chusquea ramosissima* and *Merostachys claussenii* in Iguazu national park, Argentina. Plant Physiology **149**, 1992–1999.

**Sakuma Y, Maruyama K, Osakabe Y, Qin F, Seki M, Shinozaki K, Yamaguchi-Shinozaki K**. 2006*a*. Functional analysis of an *Arabidopsis*

transcription factor, DREB2A, involved in drought-responsive gene expression. The Plant Cell **18**, 1292–1309.

**Sakuma Y, Maruyama K, Qin F, Osakabe Y, Shinozaki K, Yamaguchi-Shinozaki K**. 2006*b*. Dual function of an *Arabidopsis* transcription factor DREB2A in water-stress-responsive and heat-stress-responsive gene expression. Proceedings of the National Academy of Sciences **103**, 18822–18827.

**Sakuraba Y, Kim Y-S, Han S-H, Lee B-D, Paek N-C**. 2015. The Arabidopsis transcription factor NAC016 promotes drought stress responses by repressing *AREB1* transcription through a trifurcate feed-forward regulatory loop involving NAP. The Plant Cell **27**, 1771–1787.

**Salleo S, Hinckley TM, Kikuta SB, Gullo MA, Weilgony P, Yoon T-M, Richter H**. 1992. A method for inducing xylem emboli in situ: experiments with a field-grown tree. Plant, Cell and Environment **15**, 491–497.

**Salmon Y, Torres-Ruiz JM, Poyatos R, Martinez-Vilalta J, Meir P, Cochard H, Mencuccini M**. 2015. Balancing the risks of hydraulic failure and carbon starvation: a twig scale analysis in declining Scots pine: Twig role in Scots pine drought-induced mortality. Plant, Cell & Environment **38**, 2575–2588.

**Sangüesa-Barreda G, Linares JC, Camarero JJ**. 2015. Reduced growth sensitivity to climate in bark-beetle infested Aleppo pines: Connecting climatic and biotic drivers of forest dieback. Forest Ecology and Management **357**, 126–137.

**Sapes G, Demaree P, Lekberg Y, Sala A**. 2021. Plant carbohydrate depletion impairs water relations and spreads via ectomycorrhizal networks. New Phytologist **229**, 3172–3183.

**Sapes G, Roskilly B, Dobrowski S, Maneta M, Anderegg WRL, Martinez-Vilalta J, Sala A**. 2019. Plant water content integrates hydraulics and carbon depletion to predict drought-induced seedling mortality. Tree Physiology **39**, 1300–1312.

**Schenk HJ, Espino S, Rich-Cavazos SM, Jansen S**. 2018. From the sap's perspective: the nature of vessel surfaces in angiosperm xylem. American Journal of Botany **105**, 172–185.

**Schenk HJ, Espino S, Romo DM, *et al.*** 2017. Xylem surfactants introduce a new element to the cohesion-tension theory. Plant Physiology **173**, 1177–1196.

**Schenk HJ, Michaud JM, Mocko K, Espino S, Melendres T, Roth MR, Welti R, Kaack L, Jansen S**. 2021. Lipids in xylem sap of woody plants across the angiosperm phylogeny. The Plant Journal **105**, 1477–1494.

**Schenk HJ, Steppe K, Jansen S**. 2015. Nanobubbles: a new paradigm for air-seeding in xylem. Trends in Plant Science **20**, 199–205.

**Schindelin J, Arganda-Carreras I, Frise E, *et al.*** 2012. Fiji: an open-source platform for biological-image analysis. Nature Methods **9**, 676–682.

**Scholz A, Klepsch M, Karimi Z, Jansen S**. 2013*a*. How to quantify conduits in wood? Frontiers in Plant Science **4**, 56.

**Scholz FG, Phillips NG, Bucci SJ, Meinzer FC, Goldstein G**. 2011. Hydraulic Capacitance: Biophysics and Functional Significance of Internal Water Sources in Relation to Tree Size. In: Meinzer FC, Lachenbruch B, Dawson TE, eds. Tree Physiology. Size- and Age-Related Changes in Tree Structure and Function. Dordrecht: Springer Netherlands, 341–361.

**Scholz A, Rabaey D, Stein A, Cochard H, Smets E, Jansen S**. 2013*b*. The evolution and function of vessel and pit characters with respect to cavitation resistance across 10 Prunus species. Tree Physiology **33**, 684–694.

**Schuldt B, Buras A, Arend M, *et al.*** 2020. A first assessment of the impact of the extreme 2018 summer drought on Central European forests. Basic and Applied Ecology **45**, 86–103.

**Schuldt B, Knutzen F, Delzon S, Jansen S, Müller-Haubold H, Burlett R, Clough Y, Leuschner C**. 2016. How adaptable is the hydraulic system of European beech in the face of climate change-related precipitation reduction? New Phytologist **210**, 443–458.

**Schweingruber FH**. 2006. Anatomical characteristics and ecological trends in the xylem and phloem of Brassicaceae and Resedacae. IAWA Journal **27**, 419–442.

**Schweingruber FH**. 2007. *Wood structure and environment*. Berlin; New York: Springer.

**Schweingruber FH, Börner A, Schulze E-D**. 2011. *Atlas of Stem Anatomy in Herbs, Shrubs and Trees*. Berlin, Heidelberg: Springer Berlin Heidelberg.

**Scoffoni C, Albuquerque C, Brodersen CR, Townes SV, John GP, Bartlett MK, Buckley TN, McElrone AJ, Sack L**. 2017. Outside-xylem vulnerability, not xylem embolism, controls leaf hydraulic decline during dehydration. Plant Physiology **173**, 1197–1210.

**Scoffoni C, Albuquerque C, Cochard H, *et al.*** 2018. The causes of leaf hydraulic vulnerability and its influence on gas exchange in *Arabidopsis thaliana*. Plant Physiology **178**, 1584–1601.

**Segala Alves E, Angyalossy-Alfonso V**. 2002. Ecological trends in the wood anatomy of some Brazilian species. 2. axial parenchyma, ray and fibres. IAWA Journal **23**, 391–418.

**Shahnejat-Bushehri S, Allu AD, Mehterov N, Thirumalaikumar VP, Alseekh S, Fernie AR, Mueller-Roeber B, Balazadeh S**. 2017. Arabidopsis NAC transcription factor JUNGBRUNNEN1 exerts conserved control over gibberellin and brassinosteroid metabolism and signaling genes in tomato. Frontiers in Plant Science **8**, 214.

**Shahnejat-Bushehri S, Mueller-Roeber B, Balazadeh S**. 2012. Arabidopsis NAC transcription factor JUNGBRUNNEN1 affects thermomemory-associated genes and enhances heat stress tolerance in primed and unprimed conditions. Plant Signaling & Behavior **7**, 1518–1521.

**Shahnejat-Bushehri S, Tarkowska D, Sakuraba Y, Balazadeh S**. 2016. Arabidopsis NAC transcription factor JUB1 regulates GA/BR metabolism and signalling. Nature Plants **2**, 1–9.

**Shinozaki K, Yamaguchi-Shinozaki K**. 2006. Gene networks involved in drought stress response and tolerance. Journal of Experimental Botany **58**, 221–227.

**Shinozaki K, Yamaguchi-Shinozaki K, Seki M**. 2003. Regulatory network of gene expression in the drought and cold stress responses. Current Opinion in Plant Biology **6**, 410–417.

**Simioni PF, Emilio T, Giles AL, Viana De Freitas G, Silva Oliveira R, Setime L, Pierre Vitoria A, Pireda S, Vieira Da Silva I, Da Cunha M**. 2023. Anatomical traits related to leaf and branch hydraulic functioning on Amazonian savanna plants. (A Martin, Ed.). AoB PLANTS **15**, plad018.

**Singh PK, Indoliya Y, Agrawal L, *et al.*** 2022. Genomic and proteomic responses to drought stress and biotechnological interventions for enhanced drought tolerance in plants. Current Plant Biology **29**, 100239.

**Skelton RP, Anderegg LDL, Diaz J, Kling MM, Papper P, Lamarque LJ, Delzon S, Dawson TE, Ackerly DD**. 2021. Evolutionary relationships between drought-related traits and climate shape large hydraulic safety margins in western North American oaks. Proceedings of the National Academy of Sciences **118**, e2008987118.

**Skelton RP, Anderegg LDL, Papper P, Reich E, Dawson TE, Kling M, Thompson SE, Diaz J, Ackerly DD**. 2019. No local adaptation in leaf or stem xylem vulnerability to embolism, but consistent vulnerability segmentation in a North American oak. New Phytologist **223**, 1296–1306.

**Skelton RP, Brodribb TJ, Choat B**. 2017. Casting light on xylem vulnerability in an herbaceous species reveals a lack of segmentation. New Phytologist **214**, 561–569.

**Skelton RP, West AG, Dawson TE**. 2015. Predicting plant vulnerability to drought in biodiverse regions using functional traits. Proceedings of the National Academy of Sciences **112**, 5744–5749.

**Słupianek A, Dolzblasz A, Sokołowska K**. 2021. Xylem Parenchyma—Role and Relevance in Wood Functioning in Trees. Plants **10**, 1247.

**Smith-Martin CM, Skelton RP, Johnson KM, Lucani C, Brodribb TJ**. 2020. Lack of vulnerability segmentation among woody species in a diverse dry sclerophyll woodland community. (A Sala, Ed.). Functional Ecology **34**, 777–787.

**Soma F, Takahashi F, Yamaguchi-Shinozaki K, Shinozaki K**. 2021. Cellular phosphorylation signaling and gene expression in drought stress responses: ABA-dependent and ABA-independent regulatory systems. Plants **10**, 756.

**Somssich M**. 2019. *A short history of* Arabidopsis thaliana *(L.) Heynh. Columbia-0*. PeerJ Preprints.

**Song J, Trueba S, Yin X-H, Cao K-F, Brodribb TJ, Hao G-Y**. 2022. Hydraulic vulnerability segmentation in compound-leaved trees: evidence from an embolism visualization technique. Plant Physiology **189**, 204–214.

**Sorek Y, Greenstein S, Hochberg U**. 2022. Seasonal adjustment of leaf embolism resistance and its importance for hydraulic safety in deciduous trees. Physiologia Plantarum **174**, e13785.

**Sperry JS**. 1995. Limitations on Stem Water Transport and Their Consequences. Plant Stems. Elsevier, 105–124.

**Sperry JS**. 2003. Evolution of water transport and xylem structure. International Journal of Plant Sciences **164**, S115–S127.

**Sperry JS, Christman MA, Torres-Ruiz JM, Taneda H, Smith DD**. 2012. Vulnerability curves by centrifugation: is there an open vessel artefact, and are 'r' shaped curves necessarily invalid?: Vulnerability curves by centrifugation. Plant, Cell & Environment **35**, 601–610.

**Sperry JS, Hacke UG**. 2004. Analysis of circular bordered pit function I. Angiosperm vessels with homogenous pit membranes. American Journal of Botany **91**, 369–385.

**Sperry JS, Hacke UG, Pittermann J**. 2006. Size and function in conifer tracheids and angiosperm vessels. American Journal of Botany **93**, 1490–1500.

**Sperry JS, Hacke UG, Wheeler JK**. 2005. Comparative analysis of end wall resistivity in xylem conduits. Plant, Cell and Environment **28**, 456–465.

**Sperry JS, Meinzer FC, McCULLOH KA**. 2008. Safety and efficiency conflicts in hydraulic architecture: scaling from tissues to trees. Plant, Cell & Environment **31**, 632–645.

**Sperry JS, Saliendra NZ**. 1994. Intra- and inter-plant variation in xylem cavitation in Betula occidentalis. Plant, Cell and Environment **17**, 1233–1241.

**Sperry JS, Tyree MT**. 1988. Mechanism of water stress-induced xylem embolism. Plant Physiology **88**, 581–587.

**Steudle E**. 2001*a*. The cohesion-tension mechanism and the acquisition of water by plant roots. Annual Review of Plant Physiology and Plant Molecular Biology **52**, 847–875.

**Steudle E**. 2001*b*. The cohesion-tension mechanism and the acquisition of water by plant roots. Annual review of plant physiology and plant molecular biology **52**, 847–875.

**Stiller V**. 2002. Cavitation fatigue and its reversal in sunflower (*Helianthus annuus* L.). Journal of Experimental Botany **53**, 1155–1161.

**Stiller V**. 2009. Soil salinity and drought alter wood density and vulnerability to xylem cavitation of baldcypress (*Taxodium distichum* (L.) Rich.) seedlings. Environmental and Experimental Botany **67**, 164–171.

**Sultan B, Defrance D, Iizumi T**. 2019. Evidence of crop production losses in West Africa due to historical global warming in two crop models. Scientific Reports **9**, 12834.

**Swemmer A**. 2020. Locally high, but regionally low: the impact of the 2014–2016 drought on the trees of semi-arid savannas, South Africa. African Journal of Range & Forage Science **37**, 31–42.

**Tak H, Negi S, Ganapathi TR**. 2017. Banana NAC transcription factor MusaNAC042 is positively associated with drought and salinity tolerance. Protoplasma **254**, 803–816.

**Takasaki H, Maruyama K, Kidokoro S, Ito Y, Fujita Y, Shinozaki K, Yamaguchi-Shinozaki K, Nakashima K**. 2010. The abiotic stress-responsive

NAC-type transcription factor OsNAC5 regulates stress-inducible genes and stress tolerance in rice. Molecular Genetics and Genomics **284**, 173–183.

**Temperli C, Bugmann H, Elkin C**. 2013. Cross-scale interactions among bark beetles, climate change, and wind disturbances: a landscape modeling approach. Ecological Monographs **83**, 383–402.

**Thirumalaikumar VP, Devkar V, Mehterov N, Ali S, Ozgur R, Turkan I, Mueller-Roeber B, Balazadeh S**. 2018. NAC transcription factor JUNGBRUNNEN1 enhances drought tolerance in tomato. Plant Biotechnology Journal **16**, 354–366.

**Thoen MPM, Davila Olivas NH, Kloth KJ, *et al.*** 2017. Genetic architecture of plant stress resistance: multi-trait genome-wide association mapping. New Phytologist **213**, 1346–1362.

**Thonglim A, Bortolami G, Delzon S, Larter M, Offringa R, Keurentjes JJB, Smets E, Balazadeh S, Lens F**. 2022. Drought response in Arabidopsis displays synergistic coordination between stems and leaves. (J Zhang, Ed.). Journal of Experimental Botany **74**, 1004–1021.

**Thonglim A, Delzon S, Larter M, Karami O, Rahimi A, Offringa R, Keurentjes JJB, Balazadeh S, Smets E, Lens F**. 2020. Intervessel pit membrane thickness best explains variation in embolism resistance amongst stems of *Arabidopsis thaliana* accessions. Annals of Botany **128**, 171–182.

**Tixier A, Cochard H, Badel E, Dusotoit-Coucaud A, Jansen S, Herbette S**. 2013. *Arabidopsis thaliana* as a model species for xylem hydraulics: does size matter? Journal of Experimental Botany **64**, 2295–2305.

**Tng DYP, Apgaua DMG, Ishida YF, Mencuccini M, Lloyd J, Laurance WF, Laurance SGW**. 2018. Rainforest trees respond to drought by modifying their hydraulic architecture. Ecology and Evolution **8**, 12479–12491.

**Tobin MF, Pratt RB, Jacobsen AL, Guzman MED**. 2012. Xylem vulnerability to cavitation can be accurately characterised in species with long vessels using a centrifuge method. Plant Biology **15**, 496–504.

**Todaka D, Shinozaki K, Yamaguchi-Shinozaki K**. 2015. Recent advances in the dissection of drought-stress regulatory networks and strategies for development of drought-tolerant transgenic rice plants. Frontiers in Plant Science **6**, 84.

**Tomasella M, Petrussa E, Petruzzellis F, Nardini A, Casolo V**. 2019. The possible role of non-structural carbohydrates in the regulation of tree hydraulics. International Journal of Molecular Sciences **21**, 144.

**Tombesi S, Nardini A, Frioni T, Soccolini M, Zadra C, Farinelli D, Poni S, Palliotti A**. 2015. Stomatal closure is induced by hydraulic signals and maintained by ABA in drought-stressed grapevine. Scientific Reports **5**, 12449.

**Torres-Ruiz JM, Cochard H, Choat B, *et al.*** 2017. Xylem resistance to embolism: presenting a simple diagnostic test for the open vessel artefact. New Phytologist **215**, 489–499.

**Torres-Ruiz JM, Cochard H, Mayr S, Beikircher B, Diaz-Espejo A, Rodriguez-Dominguez CM, Badel E, Fernández JE**. 2014. Vulnerability to cavitation in *Olea europaea* current-year shoots: further evidence of an open-vessel artifact associated with centrifuge and air-injection techniques. Physiologia Plantarum **152**, 465–474.

**Tran L-SP, Nakashima K, Sakuma Y, Simpson SD, Fujita Y, Maruyama K, Fujita M, Seki M, Shinozaki K, Yamaguchi-Shinozaki K**. 2004. Isolation and functional analysis of *Arabidopsis* stress-inducible NAC transcription factors that bind to a drought-responsive cis-element in the early responsive to dehydration stress 1 Promoter. The Plant Cell **16**, 2481–2498.

**Trontin C, Tisné S, Bach L, Loudet O**. 2011. What does *Arabidopsis* natural variation teach us (and does not teach us) about adaptation in plants? Current Opinion in Plant Biology **14**, 225–231.

**Trueba S, Delzon S, Isnard S, Lens F**. 2019. Similar hydraulic efficiency and safety across vesselless angiosperms and vessel-bearing species with scalariform perforation plates. Journal of Experimental Botany **70**, 3227–3240.

**Trueba S, Pouteau R, Lens F, Feild TS, Isnard S, Olson ME, Delzon S**. 2017. Vulnerability to xylem embolism as a major correlate of the environmental distribution of rain forest species on a tropical island. Plant, Cell & Environment **40**, 277–289.

**Tyree MT, Alexander J, Machado J-L**. 1992. Loss of hydraulic conductivity due to water stress in intact juveniles of Quercus rubra and Populus deltoides. Tree Physiology **10**, 411–415.

**Tyree MT, Ewers FW**. 1991. The hydraulic architecture of trees and other woody plants. New Phytologist **119**, 345–360.

**Tyree MT, Fiscus EL, Wullschleger SD, Dixon MA**. 1986. Detection of xylem cavitation in corn under field conditions. Plant Physiology **82**, 597–599.

**Tyree MT, Sperry JS**. 1989. Vulnerability of xylem to cavitation and embolism. Annual Review of Plant Physiology and Plant Molecular Biology **40**, 19–36.

**Tyree MT, Stephen D. D, Herve C**. 1994. Biophysical perspectives of xylem evolution: is there a tradeoff of hydraulic efficiency for vulnerability to dysfunction? IAWA Journal **15**, 335–360.

**Tyree MT, Zimmermann MH**. 2002. *Xylem structure and the ascent of sap*. Berlin, Heidelberg: Springer Berlin Heidelberg.

**Uno Y, Furihata T, Abe H, Yoshida R, Shinozaki K, Yamaguchi-Shinozaki K**. 2000. *Arabidopsis* basic leucine zipper transcription factors involved in an abscisic acid-dependent signal transduction pathway under drought and high-salinity conditions. Proceedings of the National Academy of Sciences **97**, 11632–11637.

**Urli M, Porte AJ, Cochard H, Guengant Y, Burlett R, Delzon S**. 2013. Xylem embolism threshold for catastrophic hydraulic failure in angiosperm trees. Tree Physiology **33**, 672–683.

**Venturas MD, Sperry JS, Hacke UG**. 2017*a*. Plant xylem hydraulics: what we understand, current research, and future challenges. Journal of Integrative Plant Biology **59**, 356–389.

**Venturas MD, Sperry JS, Hacke UG**. 2017*b*. Plant xylem hydraulics: What we understand, current research, and future challenges: Plant xylem hydraulics. Journal of Integrative Plant Biology **59**, 356–389.

**Venturas MD, Todd HN, Trugman AT, Anderegg WRL**. 2021. Understanding and predicting forest mortality in the western United States using long-term forest inventory data and modeled hydraulic damage. New Phytologist **230**, 1896–1910.

**Vergeynst LL, Dierick M, Bogaerts JAN, Cnudde V, Steppe K**. 2015*a*. Cavitation: a blessing in disguise? New method to establish vulnerability curves and assess hydraulic capacitance of woody tissues. Tree Physiology **35**, 400–409.

**Vergeynst LL, Sause MGR, De Baerdemaeker NJF, De Roo L, Steppe K**. 2016. Clustering reveals cavitation-related acoustic emission signals from dehydrating branches. (N Phillips, Ed.). Tree Physiology **36**, 786–796.

**Vergeynst LL, Sause MGR, Hamstad MA, Steppe K**. 2015*b*. Deciphering acoustic emission signals in drought stressed branches: the missing link between source and sensor. Frontiers in Plant Science **6**.

**Vermeirssen V, De Clercq I, Van Parys T, Van Breusegem F, Van De Peer Y**. 2015. *Arabidopsis* ensemble reverse-engineered gene regulatory network discloses interconnected transcription factors in oxidative stress. The Plant Cell **26**, 4656–4679.

**Violle C, Navas M-L, Vile D, Kazakou E, Fortunel C, Hummel I, Garnier E**. 2007. Let the concept of trait be functional! Oikos **116**, 882–892.

**Volaire F, Lens F, Cochard H, Xu H, Chacon-Doria L, Bristiel P, Balachowski J, Rowe N, Violle C, Picon-Cochard C**. 2018. Embolism and mechanical resistances play a key role in dehydration tolerance of a perennial grass *Dactylis glomerata* L. Annals of Botany **122**, 325–336.

**Wall S, Vialet-Chabrand S, Davey P, Van Rie J, Galle A, Cockram J, Lawson T**. 2022. Stomata on the abaxial and adaxial leaf surfaces contribute differently to leaf gas exchange and photosynthesis in wheat. New Phytologist **235**, 1743–1756.

**Wang J, Li Q, Mao X, Li A, Jing R**. 2016*a*. Wheat transcription factor TaAREB3 participates in drought and freezing tolerances in *Arabidopsis*. International Journal of Biological Sciences **12**, 257–269.

**Wang G, Zhang S, Ma X, Wang Y, Kong F, Meng Q**. 2016*b*. A stress-associated NAC transcription factor (SlNAC35) from tomato plays a positive role in biotic and abiotic stresses. Physiologia Plantarum **158**, 45–64.

**Wang R, Zhang L, Zhang S, Cai J, Tyree MT**. 2014. Water relations of *Robinia pseudoacacia* L.: do vessels cavitate and refill diurnally or are r-shaped curves invalid in *Robinia* ? Plant, Cell & Environment **37**, 2667–2678.

**Waring KM, Reboletti DM, Mork LA, Huang C-H, Hofstetter RW, Garcia AM, Fulé PZ, Davis TS**. 2009. Modeling the Impacts of Two Bark Beetle Species Under a Warming Climate in the Southwestern USA: Ecological and Economic Consequences. Environmental Management **44**, 824–835.

**Wason JW, Anstreicher KS, Stephansky N, Huggett BA, Brodersen CR**. 2018. Hydraulic safety margins and air-seeding thresholds in roots, trunks, branches and petioles of four northern hardwood trees. New Phytologist **219**, 77–88.

**Welsch M**. 2022. Untersuchung des Stresstoleranz-Regulationsnetzwerks des NAC-Transkriptionsfaktors JUNGBRUNNEN1 (JUB1) Investigation of the stress tolerance regulatory network integration of the NAC transcription factor JUNGBRUNNEN1 (JUB1). Universität Potsdam.

**West AG, Hultine KR, Jackson TL, Ehleringer JR**. 2007. Differential summer water use by Pinus edulis and Juniperus osteosperma reflects contrasting hydraulic characteristics. Tree Physiology **27**, 1711–1720.

**Wheeler JK, Huggett BA, Tofte AN, Rockwell FE, Holbrook NM**. 2013. Cutting xylem under tension or supersaturated with gas can generate PLC and the appearance of rapid recovery from embolism: Sampling induced embolism. Plant, Cell & Environment **36**, 1938–1949.

**Wheeler JK, Sperry JS, Hacke UG, Hoang N**. 2005. Inter-vessel pitting and cavitation in woody Rosaceae and other vesselled plants: a basis for a

safety versus efficiency trade-off in xylem transport. Plant, Cell and Environment **28**, 800–812.

**Wheeler TD, Stroock AD**. 2008. The transpiration of water at negative pressures in a synthetic tree. Nature **455**, 208–212.

**Wiley E, Rogers BJ, Hodgkinson R, Landhäusser SM**. 2016. Nonstructural carbohydrate dynamics of lodgepole pine dying from mountain pine beetle attack. New Phytologist **209**, 550–562.

**Willson CJ, Manos PS, Jackson RB**. 2008. Hydraulic traits are influenced by phylogenetic history in the drought-resistant, invasive genus *Juniperus* (Cupressaceae). American Journal of Botany **95**, 299–314.

**Wu A, Allu AD, Garapati P, *et al.*** 2012. *JUNGBRUNNEN1* , a Reactive Oxygen Species–Responsive NAC Transcription Factor, Regulates Longevity in *Arabidopsis*. The Plant Cell **24**, 482–506.

**Xu Z-Y, Kim SY, Hyeon DY, *et al.*** 2013. The *Arabidopsis* NAC transcription factor ANAC096 cooperates with bZIP-type transcription factors in dehydration and osmotic stress responses. The Plant Cell **25**, 4708–4724.

**Yamaguchi-Shinozaki K, Shinozaki K**. 2005. Organization of cis-acting regulatory elements in osmotic- and cold-stress-responsive promoters. Trends in Plant Science **10**, 88–94.

**Yang J, M Michaud J, Jansen S, Schenk HJ, Zuo YY**. 2020. Dynamic surface tension of xylem sap lipids. Tree Physiology **40**, 433–444.

**Yoshida T, Fujita Y, Maruyama K, Mogami J, Todaka D, Shinozaki K, Yamaguchi-Shinozaki K**. 2015. Four Arabidopsis AREB ABF transcription factors function predominantly in gene. Plant, Cell & Environment **38**, 35–49.

**Yoshida T, Fujita Y, Sayama H, Kidokoro S, Maruyama K, Mizoi J, Shinozaki K, Yamaguchi-Shinozaki K**. 2010. AREB1, AREB2, and ABF3 are master transcription factors that cooperatively regulate ABRE-dependent ABA signaling involved in drought stress tolerance and require ABA for full activation. The Plant Journal **61**, 672–685.

**Yu S-M**. 1999. Cellular and Genetic Responses of Plants to Sugar Starvation. Plant Physiology **121**, 687–693.

**Zhang F-P, Brodribb TJ**. 2017. Are flowers vulnerable to xylem cavitation during drought? Proceedings of the Royal Society B: Biological Sciences **284**, 20162642.

**Zhang Y, Carmesin C, Kaack L, *et al.*** 2020. High porosity with tiny pore constrictions and unbending pathways characterize the 3D structure of intervessel pit membranes in angiosperm xylem. Plant, Cell & Environment **43**, 116–130.

**Zhang Y-J, Rockwell FE, Graham AC, Alexander T, Holbrook NM**. 2016. Reversible leaf xylem collapse: a potential "circuit breaker" against cavitation. Plant Physiology **172**, 2261–2274.

**Zheng J, Martínez-Cabrera HI**. 2013. Wood anatomical correlates with theoretical conductivity and wood density across China: evolutionary evidence of the functional differentiation of axial and radial parenchyma. Annals of Botany **112**, 927–935.

**Zimmerman MH, Brown CL**. 1971. *Trees: structure and function*. New York, USA: Springer-Verlag.

**Zimmermann MH**. 1983. *Xylem Structure and the Ascent of Sap*. Berlin-Heidelberg, Germany: Springer-Verlag.

# ACKNOWLEDGEMENTS

*In December 2018, my Ph.D. journey began as I left the bright hot days of Thailand for the chilly winters in the Netherlands. This transition was both challenging and eye-opening, as it introduced me to a whole new world. I can honestly say that it was tough, but it turned out to be an amazing experience. I am grateful for all the obstacles that came my way because, with each difficulty, I discovered wonderful people and learned valuable lessons. Every hurdle shaped me into the person I am today. Therefore, I want to express my heartfelt gratitude to the amazing people and institutions who have been a constant source of support and guidance throughout my incredible PhD journey, especially during the difficult times brought on by the COVID-19 pandemic. Their presence and contributions have deeply touched my heart.*

*First and foremost, I am forever thankful to my daily supervisor, Dr. Frederic Lens. Your guidance, knowledge, and patience have been priceless to me. Despite the personal challenges we faced, you always encouraged me, shared your insights, and stood by my side throughout every step of this journey. I am also grateful to my fellow researchers and colleagues who directly collaborated on this PhD project. Your time and valuable contributions were not only helpful but also your positive and uplifting vibes cheered me up during the hard times. Special thanks also go to the technicians from Naturalis Biodiversity Center, Leiden University, and the University of Bordeaux for their mentorship and assistance in processing numerous samples with perfect results.*

*To the incredible Functional Traits group, thank you for your support and empathy, both academically and emotionally. Despite the physical distance imposed by the pandemic, our intellectual connections remained strong. Engaging in meaningful discussions, sharing constructive feedback, and creating a supportive environment enriched my understanding and shaped my research in incredible ways. Together, we have proven that even in the darkest times, collaboration and friendship can bring light. A big thanks to all the fellow PhDs at Naturalis –without citing names (to not forget anyone).*

*You were always kind and cheerful, even though I could not attend all the activities. You all made my journey full of joy turning this cold part of the world warmer ☺. Special thanks also go to the 'spicy girls' - Dewi, Deyi, Eka, Le Qin, and Richa - for making me feel at home. Our time was amazing, and you filled the Netherlands with smiles and laughter. It was truly priceless.*

*To my cherished family, your unconditional love and unwavering support have been my pillar of strength and my driving force throughout this journey. A very special thanks to Pablo for always being there for me. Your love, belief in me, and patience during tough moments have carried me through the most challenging times. And to Pablo's family, thank you for being a second home that I can always come to. I deeply appreciate it. Muchas Gracias!*

# CURRICULUM VITAE

**Ajaree Thonglim** was born on January 14th, 1993, in Nakhon Pathom, Thailand. She completed her 4-year bachelor's degree in biology with First-class honors in 2015 at Kasetsart University, Thailand. During her undergraduate course, she studied the morphological and anatomical features of the leaves of various species of the genus *Cycas* L. and used these traits to build a species identification key. Driven by her fascination with plant anatomy and functional traits, she pursued a master's degree in Botany at Kasetsart University, investigating the anatomical adaptation of mangrove species in the genus *Rhizophora* (Rhizophoraceae), and she successfully completed her MSc degree in 2018. Throughout her bachelor's and master's studies, she actively shared her research findings at scientific meetings, particularly those organized by the Botanical Society of Thailand. During her university education, a scholarship from the Development and Promotion of Science and Technology Talents Project (DPST) was awarded to her, jointly administered by the Ministry of Science and Technology, the Ministry of Education, and The Institute for the Promotion of Teaching Science and Technology (IPST). Later in 2018, she received another scholarship from the same funding agency. This scholarship granted her the opportunity to pursue her PhD at Leiden University and Naturalis Biodiversity Center in the Netherlands under the supervision of Dr. Frederic Lens and Prof. Dr. Erik Smets. Her PhD project was focused on drought-responsive strategies in different genotypes of *Arabidopsis thaliana*, with a small focus on *Solanum lycopersicum*.

During her PhD, she had the opportunity to regularly visit the laboratory of Dr. Sylvain Delzon at the University of Bordeaux, France, where she conducted water transport measurements on stems under special laboratory conditions that simulate drought stress. She also collaborated

with Dr. Giovanni Bortolami at Naturalis Biodiversity Center on a project involving root pressure and used advanced X-ray scanning technology at the University of Ghent, Belgium, to examine the impact of root pressure on drought recovery in tomato plants. She actively participated in international scientific meetings and adapted to the challenges posed by the COVID-19 pandemic by presenting her research online. Her PhD research resulted in two peer-reviewed SCI papers published as first author, with another manuscript in preparation for publication. The findings of her research are compiled in this thesis, showcasing her dedication and contributions to the scientific community.

# List of publications

## Articles in peer-reviewed proceedings and journals

**Thonglim A.**, Jintana V., Kermanee P. 2017. Root anatomy of *Rhizophora apiculata* Blume. Proceedings of 55th Kasetsart University Annual Conference: Plants, Animals, Veterinary Medicine, Fisheries, Agricultural Extension and Home Economics. Bangkok (Thailand). 296-303.

**Thonglim A.**, Delzon S., Larter M., Karami O., Rahimi A., Offringa R., Keurentjes J. J., Balazadeh S., Smets E., Lens F. 2021. Intervessel pit membrane thickness best explains variation in embolism resistance amongst stems of *Arabidopsis thaliana* accessions. Annals of Botany, 128(2): 171-182.

**Thonglim A**., Bortolami G., Delzon S., Larter M., Offringa R., Keurentjes, J. J., Smets E., Balazadeh S., Lens F. 2023. Drought response in Arabidopsis displays synergistic coordination between stems and leaves. Journal of Experimental Botany, 74(3): 1004-1021.

## Abstracts

**Thonglim A.**, Kermanee P. 2015. Morphology and anatomy of leaves in the genus *Cycas* L. The 7th International Kasetsart University Science and Technology Annual Research Symposiums, Bangkok, Thailand, 28-29 May 2015. (Poster presentation)

**Thonglim A.**, Kermanee P. 2015. Morphology and anatomy of leaves in some species of the genus *Cycas L.* The 9th Botanical Conference of Thailand, Bangkok, Thailand. 3-5 June 2015. (Poster presentation)

**Thonglim A.**, Jintana V., Kermanee P. 2015. Root anatomy of primary and prop roots of *Rhizophora apiculata*. The 10th Science and Technology Conference for Youth 2015, Pathum Thani, Thailand, 4-6 November 2015. (Oral and Poster presentations)

**Thonglim A.**, Delzon S., Lens F. 2019. Embolism resistance in herbaceous and woody accessions of *Arabidopsis thaliana*. Fourth Xylem International Meeting, Padua, Italy, 25-27 September 2019. (Poster presentation)

**Thonglim A.**, Delzon S., Larter M., Karami O., Rahimi A., Offringa R., Keurentjes J. J., Balazadeh S., Smets E., Lens F. 2020. Intervessel pit membrane thickness functionally explains best the differences in embolism formation in stems amongst *Arabidopsis thaliana* accessions. Botanical Society of America Conference (virtual), 27-31 July 2020. (Oral presentation)

**Thonglim A**., Bortolami G., Delzon S., Larter M., Offringa R., Keurentjes, J. J., Smets E., Balazadeh S., Lens F. 2022. Different drought response strategies in six *Arabidopsis* genotypes with contrasting stem lignification. Fifth Xylem International Meeting, Würzburg, Germany,
19-21 September 2022. (Poster presentation)

**Thonglim A**., Bortolami G., Delzon S., Larter M., Offringa R., Karami O., Rahimi A., Keurentjes J. J., Smets E., Balazadeh S., Lens F. 2022. Disentangling drought tolerance in six *Arabidopsis* genotypes with contrasting stem lignification. The 2022 International Youth Forum for Wood Anatomy and the 9th IAWA-China Group Annual Meeting, Guangzhou, China, 9-12 December 2022. (Oral presentation)