Appendix S1. Traits, functional type, and methods. Trait functions depend on the context of other structures, the Rationale column describes potential significance we had in mind when selecting traits. *N* = number of trees

Trait	Definition	Units	Method	Functional category	*N*			Rationale
					Control	*Irrigation-stop*	*Irrigated*	
Twigs								
Duct distance	Distance between resin ducts in the cortex	µm	microCT	resin transport	9	10	6	Resin duct spacing indicates the level of investment in defense against insects and wound response
Max epidermal cell	Diameter of the largest epidermal cell in the outermost layer	µm	microCT	surface conductivity	9	10	6	Thicker epidermal cells may reduce surface conductivity, thereby reducing water loss
Max epidermis	Maximum epidermal thickness including all cell layers	µm	microCT	surface conductivity	9	10	6	Epidermal thickness may reduce water loss and possibly limit sucking insect damage
Max tracheid diameter	Lumen diameter of the largest earlywood tracheid	µm	microCT	hydraulic conductivity	9	10	6	Tracheid diameter is directly related to hydraulic conductivity and may also express hydraulic limitations on cellular expansion
Min epidermal cell	Diameter of the smallest epidermal cell in the outermost layer	µm	microCT	surface conductivity	9	10	6	Thinner epidermal cells may promote water uptake during wetting events but could also result in increased surface conductivity and thus water loss
Min epidermis	Minimum epidermal thickness including all cell layers	µm	microCT	surface conductivity	9	10	6	Minimum epidermal thickness may indicate sensitivity to water loss across the twig surface and vulnerability to insects
Min tracheid diameter	Lumen diameter of the smallest latewood tracheid	µm	microCT	hydraulic limitation	9	10	6	The smallest tracheids are indicative of end-of-growing-season hydraulic limitation and overall conductivity of the secondary xylem
Phloem thickness	Thickness of the phloem layer	µm	microCT	productivity	9	10	6	A larger investment in phloem indicates a larger export of photosynthate and is thus reflective of local productivity
Ray density	Number of rays per wood area	count/µm 2	microCT	productivity	9	10	6	Ray are involved in distributing, storing, and mobilizing carbohydrates as well as eventual heartwood formation, their abundance indicates productivity
Resin duct area	Mean area of individual resin ducts	µm2	microCT	resin transport	9	10	6	Larger resin ducts have a greater conductivity, which may be especially important when cold temperatures increase viscosity
Resin duct fraction	Fraction of wood area that is resin duct	µm2/µm2	microCT	resin investment	9	10	6	A larger relative area devoted to resin ducts suggests a prioritization of resin production and storage over other processes
Tracheid length	Maximum tracheid length in longitudinal plane	µm	microCT	hydraulic limitation	9	10	6	Tracheid length may be determined by hydraulic limitations on cellular expansion with shorter tracheids resulting in increased hydraulic resistance
Tracheid wall thickness	Typical trachied wall thickness in the secondary xylem	µm	microCT	hydraulic limitation	9	10	6	Thicker walls are associated with higher water stress and may help reduce air seeding and/or buckling, they also imply a greater cost per cell
Tracheids per file	Number of secondary xylem tracheids per radial row	count	microCT	hydraulic capacity	9	10	6	The number of tracheid ranks produced in a given year (these were all first-year twigs) indicates structural investment in hydraulic tissues. This is a cell-size independent measurement of the expense of hydraulic capacity.
Twig radius	Radius of the full twig cross section at its widest point	µm	microCT	surface:volume	8	10	6	Twigs with a larger xs area have a greater volume per surface area and are thus less prone to water loss and thermal stress
Vascular radius	Radius of the woody portion of stem, including metaxylem and pith	µm	microCT	hydraulic capacity	8	10	6	An indicator of hydraulic capacity that is independent of both cell size and number
Wood fraction	Fraction of twig cross section that is wood, including metaxylem	µm2/µm2	microCT	hydraulic capacity	8	10	6	Indicates relative total investment in hydraulic capacity as a tradeoff for other tissues
Wood thickness	Thickness of the secondary xylem	µm	microCT	hydraulic capacity	9	10	6	Secondary xylem thickness is related to total hydraulic capacity and possibly thermal buffering
Leaves								
% thick TT	% of transfusion tissue area that is thick-walled	%	microCT& xs	hydraulic conductivity	9&1	10	6&4	The thick-walled transfusion tissue is associated with hydraulic conductivity and capacity outside the xylem, it has an additional role in thermal buffering
% thin TT	% of transfusion tissue area that is thin-walled	%	microCT& xs	water-stress tolerance	9&1	10	6&4	The thin-walled transfusion tissue is expected to buckle first during acute water stress, providing an emergency supply of water that may protect other tissues from damage by allowing time for stomatal closure while reducing the transmission of tension
Abaxial stomatal density	Number of abaxial stomata per abaxial surface area	count/µm 2	acrylic imprint	productivity/water use	10	10	10	High stomatal density is associated with greater photosynthetic rates at the expense of water loss
Adaxial stomata per abaxial stomata	Adaxial stomatal density per abaxial stomatal density	(count/µm2)/(count/µm2)	acrylic imprint	productivity/water use	10	10	10	Under conditions of water stress we might expect a larger fraction of stomata to occur on the more sheltered adaxial surface
Adaxial stomatal density	Number of adaxial stomata per adaxial surface area	count/µm 2	acrylic imprint	productivity/water use	10	10	10	High stomatal density is associated with greater photosynthetic rates at the expense of water loss
Amyloplasts	Number of amyloplasts per transfusion parenchyma	count	microCT	local investment	9	10	6	Localized starch storage suggests an investment in leaf maintenance, possibly indicating higher replacement costs and greater organ-level autonomy
Distance between stomata	Distance between stomata in the same row	µm	acrylic imprint	productivity/water use	10	10	10	The distance between stomata is related to leaf photosynthetic and cooling capacity at the expense of water loss and pathogen susceptibility
Epidermal cell length	Length of the largest visible epidermal cell	µm	acrylic imprint	hydraulic limitation	10	10	10	Indicates hydraulic limitations on cellular expansion, also informs whether stomatal size is a constraint or an acclimation
Fibers	Number of fibers above the xylem	count	microCT	water-stress tolerance	9	10	6	Unlike phloem fibers which thwart sucking insects, those above the xylem may have a capacitive effect
Guard cell length	Length of a typical stomatal guard cell	µm	acrylic imprint	productivity/water use	10	10	10	Large stomata close slower under stress but exchange gas more efficiently. Stomatal size may also be an index of hydraulic limitations
Leaf thickness	Leaf thickness at mid-leaf	µm	microCT& xs	water-stress tolerance	9&1	10	6&4	Thicker leaves lose water slower and have greater thermal mass
Leaf width	Leaf width at mid-leaf	µm	microCT& xs	productivity	9&1	10	6&4	Leaf width is associated with enhanced light capture and thus productivity
Leaf xs area	Leaf cross-sectional area	µm2	microCT& xs	local investment	9&1	10	6&4	Leaf xs area is related to the investment
Perimeter	Perimeter of the leaf cross-section	µm	microCT& xs	productivity	9&1	10	6&4	The leaf perimeter represents the light interceptive surface per unit leaf length and thus is tied to potential productivity
Perimeter per area	Perimeter per xs area	µm2/µm2	microCT& xs	surface:volume	9&1	10	6&4	The perimeter per xs area of a leaf is an indicator of both water storage per potential evaporative loss and heat sink capacity
Phloem area	Cross-sectional area of the phloem (both bundles)	µm2	microCT& xs	productivity	9&1	10	6&4	A larger investment in phloem indicates a larger export of photosynthate and is thus reflective of local productivity
Stomatal pore index	Guard cell length per leaf surface area considering both surfaces	µm/µm2	acrylic imprint	productivity/water use	10	10	10	The stomatal pore index reflects transpirational capacity and thus both productivity and water use efficiency, it is negatively associated with foliar water uptake
Thick TT area	Area of the thick-walled transfusion tissue in leaf cross-section	µm2	microCT& xs	hydraulic conductivity	9&1	10	6&4	Radial hydraulic conductivity and capacity
Thin TT area	Area of the thin-walled transfusion tissue (TT) in leaf cross-section	µm2	microCT& xs	water-stress tolerance	9&1	10	6&4	Emergency hydraulic reserves
Total TT area	Transfusion tissue area per leaf xs area	µm2	microCT& xs	hydraulic capacity	9&1	10	6&4	Investment in local water storage capacity and thermal mass relative to other tissues
Transfusion tracheid area	Mean area of transfusion tracheid lumens	µm2	microCT	water-stress tolerance	9	10	6	Larger tracheids have greater conductivity and buckle under lower tension
Transfusion tracheid circularity	Mean circularity of transfusion tracheids	0-1 index	microCT	water-stress tolerance	9	10	6	Low tracheid circularity may reflect past buckling and should increase propensity to buckle again
TT area per leaf area	Total transfusion tissue cross-sectional area	µm2/µm2	microCT& xs	hydraulic capacity	9&1	10	6&4	Leaf-level water storage capacity and thermal mass
Vascular area per leaf area	The sum of xylem and transfusion tissue areas per leaf xs area	µm2/µm2	microCT& xs	hydraulic capacity	9&1	10	6&4	Total hydraulic capacity
Vascular cylinder area	Area of the vascular cylinder (everything within the endodermis)	µm2	microCT& xs	hydraulic capacity	9&1	10	6&4	Investment in non-photosynthetic tissue, a mix of hydraulic capacity and the storage and export of photosynthate
Vascular cylinder width	Width of the vascular cylinder (everything within the endodermis)	µm	microCT& xs	hydraulic conductivity	9&1	10	6&4	Radial hydraulic conductivity and heat-sink potential
Xylem area	Cross-sectional area of the xylem (both bundles)	µm2	microCT& xs	hydraulic conductivity	9&1	10	6&4	Investment of the tree in provisioning soil-sourced water to the leaf
Xylem area per leaf area	Xylem area per leaf xs area	µm2/µm2	microCT& xs	hydraulic capacity	9&1	10	6&4	Investment of the tree in provisioning soil-sourced water to the leaf relative to leaf return to the tree
Xylem tracheid diameter	Lumen diameter of a typical xylem tracheid	µm	microCT& xs	hydraulic conductivity	9&1	10	6&4	Hydraulic conductivity of the xylem is exponentially related to tracheid diameter