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Appendix from A. D. McKown et al., "Decoding Leaf Hydraulics with a Spatially Explicit Model: Principles of Venation Architecture and Implications for Its Evolution"

(Am. Nat., vol. 175, no. 4, p. 447)

Supplemental Material

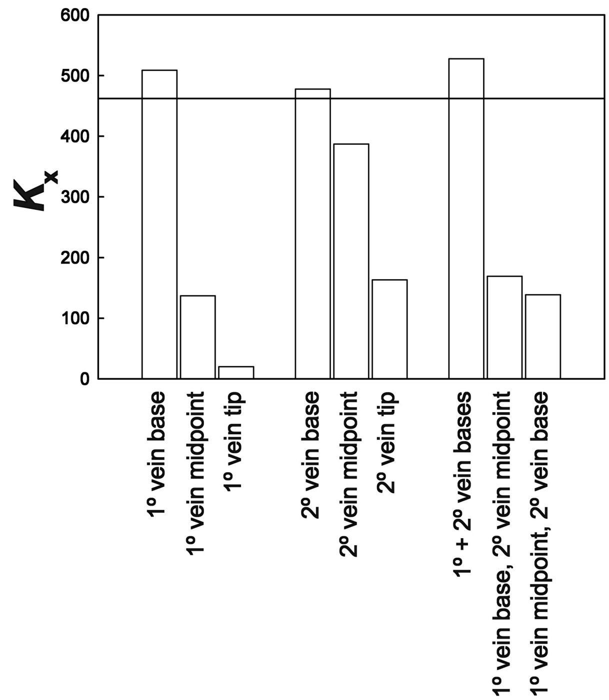

Figure A1: Response of leaf xylem hydraulic conductance (K_x) for simulations of leaves with tapering removed in 1° and 2° veins. Leaves were based on the *Juglans* leaflet, but the conductivities of the 1° and/or 2° veins were set to that of their base, midpoint, or tip conductivities. The horizontal line represents the modeled K_x of the tapering *Juglans* leaflet for comparison.

Table A1

Nomenclature for traits relating to, or describing, leaf venation architecture

Trait	Definition
Major veins	Synonymous with lower-order veins, here referring to 1° and 2° vein orders
Minor veins	Synonymous with higher-order veins, here referring to 3° and higher vein orders
Nonsectoriality	Vein system composed of a single conduit open to all connecting branches
Sectoriality	Vein system in which each vein order may be composed of multiple conduits, each of which may branch to only certain downstream vein orders; in our model, "sectorial" indicates that 1° veins are composed of multiple conduits, each of which branches off to form a 2° vein
Vein conductivity	Cross-sectional hydraulic conductivity (flow rate per pressure driving force, normalized by length; units: mmol m s^{-1} MPa^{-1}) of a vein in a given vein order; this is a function of the number of xylem conduits (vessels and/or tracheids) and their sizes
Vein density	Vein length per leaf area (typically in units of mm/mm^2 or cm/cm^2)
Vein hierarchy	Vein system with different vein conductivities across vein orders; in this model, the 1° vein has greatest conductivity and successively higher vein orders have lower conductivities
Vein order	Classification of veins depending on size and branching. In a typical dicotyledonous leaf, one or more first-order (1°) veins run from the petiole toward the leaf apex, with second-order (2°) veins branching off at intervals, and third-order (3°) veins forming a reticulate mesh, with three to seven additional orders of small, reticulate minor veins (Hickey 1973; Ellis et al. 2009). Lower-order veins contain more and larger xylem conduits (Esau 1965; Jeje 1985; Canny 1990; Cochard et al. 2004; Coomes et al. 2008), while the higher-order veins account for the bulk of vein density (Plymale and Wylie 1944; Esau 1965; Sack and Frole 2006). The classification of vein orders by size and branching is only approximate: the 1° and 2° veins are often easily identified, but distinguishing other orders can be subjective as vein diameters vary continuously (Bohn et al. 2002)
Vein tapering	Reduction of hydraulic conductivity along the length of a vein, typically in 1° and 2° veins, due to a reduction of conduit number and/or diameter along the vein (Jeje and Zimmermann 1979; Canny 1990)

Table A2
Parameterization for leaf simulations in the program K_leaf

Leaf simulation, sectoriality (yes or no)	Tapering	Vein conductivity	Other
Juglans:			
No	1°, 2°	*Juglans* data set	NA
Yes	2°		
No vein order hierarchy (all veins):			
No	No	All veins = .5, .35, .25, .15, .1, .05, .025, .01, .005, .001, .0001, or .00001	NA
Yes	No		
No vein order hierarchy (individual vein orders 1°, 2°, 3°, 4°, 5°, or 6°):			
No	No	Individual vein order = .5, .25, .1, .01, or .001; all other veins = .005	NA
Yes	No		
No vein order hierarchy (grouped-vein orders 1°/2°, 1°/2°/3°, 1°/2°/3°/4°, or 1°/2°/3°/4°/5°):			
No	No	Grouped-vein order = .5, .25, .1, .01, or .001; all other veins = .005	NA
Yes	No		
Vein order hierarchy (individual vein orders 1°, 2°, 3°, 4°, 5°, or 6°):			
No	1°, 2°	*Juglans* data set	Multiplicative factor of each vein order = .5 ×, 1 ×, 2 ×, 3 ×, or 4 ×
Yes	2°		
Vein order hierarchy (grouped-veins orders 1°/2°, 1°/2°/3°, 1°/2°/3°/4°, 1°/2°/3°/4°/5°, or all veins):			
No	1°, 2°	*Juglans* data set	Multiplicative factor of each vein order group = .5 ×, 1 ×, 2 ×, 3 ×, or 4 ×
Yes	2°		
Vein order hierarchy (grouped-veins orders 1°/2°, 3°/4°/5°, 4°/5°, or 4°/5°6°):			
No	1°, 2°	*Juglans* data set	Multiplicative factor of each vein order group = .5 ×, 1 ×, 2 ×, 3 ×, or 4 ×
Yes	2°		
1° vein without tapering:			
No	2°	1° veins = .5, .05, .005, .0025; all other veins = *Juglans*	NA
2° veins without tapering:			
No	1°	2° veins = .01, .005, .001; all other veins = *Juglans*	NA
1° and 2° veins without tapering:			
No	No	1° = .5, 2° = .01; 1° = .05, 2° = .01; 1° = .5, 2° = .001; all other veins = *Juglans*	NA

Table A2 (*Continued*)

Leaf simulation, sectoriality (yes or no)	Tapering	Vein conductivity	Other
Major vein density modifications (leaf area):[a]			
Yes	1°, 2°	*Juglans* data set	Leaf shape = elliptical; leaf size (mm × mm) = 140 × 61.3, 120 × 52.5, 100 × 43.8, 80 × 35, 53.3 × 23.3, or 40 × 17.5; no. 2° veins = 12; minor vein areole (μm × μm) = 550 × 550
No	No	1° veins = .25, 2° veins = .01, 3°+ veins = .00001	
Yes	2°	*Juglans* data set	
No	No	1° veins = .25, 2° veins = .01, 3°+ veins = .00001	
2° vein density modifications (2° vein numbers):[a]			
No	1°, 2°	*Juglans* data set	No. 2° veins = 4, 8, 12, 16, 20, 24, 28, 32, 36, or 42; minor vein areole (μm × μm) = 550 × 550
No	No	1° veins = .25, 2° veins = .01, 3°+ veins = .00001	
Yes	2°	*Juglans* data set	
Yes	No	1°/2° veins = .25, 3°+ veins = .00001	
Minor vein density modifications (areole size):			
No	1°, 2°	*Juglans* data set	Minor vein areole (μm × μm) = 550 × 550, 600 × 600, 650 × 650, 700 × 700, 750 × 750, 800 × 800, 850 × 850, 900 × 900, or 950 × 950
No	No	1° veins = .25, 2° veins = .01, 3°+ veins = .00001	
Yes	No	*Juglans* data set	
Yes	No	1°/2° veins = .25, 3°+ veins = .00001	
2° vein density × minor vein density factorial:[a]			
No	1°, 2°	*Juglans* data set	No. 2° veins = 8, 16, 24, or 32; minor vein areole (μm × μm) = 550 × 550, 600 × 600, 650 × 650, or 700 × 700
No	No	1°/2° veins = .25, 3°+ veins = .00001	
2° vein conductivity × minor vein density factorial:			
No	1°, 2°	2° veins = .1, .01, .001, .0001; all other veins = *Juglans*	Minor vein areole (μm × μm) = 550 × 550, 600 × 600, 650 × 650, or 700 × 700
Yes	2°	1°/2° veins = .1, .01, .001, .0001; all other veins = *Juglans*	

Note: In all simulations, xylem hydraulic efficiency = 1, and imposed evaporation = 2 mmol s^{-1} m^{-2}.

[a] 2° vein distribution designated as "regular" instead of a polynomial distribution, as described for *Juglans regia*.