*composite climatic stress variable from canopy temperature, vapour pressure deficit, and relative humidity is higher in lower canopy

Table 1. Summary of observed variation in thermally-relevant leaf traits with canopy height and/or between sun and shade leaves

trait	symbol	units	response	forest type(s)	reference(s)
Leaf anatomy and morphological traits					
leaf mass per area (or inverse of specific leaf area)	LMA (or $1/SLA$)	$g \cdot cm^{-2}$	↑ with height	temperate, tropical	Mau et al. 2018, Coble et al. 2017
			↑ with light	global	Hernandez et al. 2019, Mastubara et al. 2009, Martin et. al 2020, Coble et al. 2017, Slot et al. 2019
leaf area	LA	mm^2	↓ with height	temperate, tropical	Beaumont and Burns 2009, Kafuti et al. 2020
			↓ with light	tropical	Slot et al. 2019, Sack et al. 2006
stomatal density	$D_{stomata}$	mm^{-2}	↑ with height	tropical	Kafuti et al. 2020
			↑ with light	global	Valladares and Niinemets, 2008
leaf thickness	$LeaThi$	μm	↑ with height	global, temperate	Poorter et al. 2019, Van Wittenberghe et al. 2012
			↑ with light	global	Poorter et al. 2019
trichome density	$trichome$	mm^{-2}	↑ with height	tropical	Ichie et al. 2016, Perez-Estrada et al. 2000
			↑ with light	sutropical, temperate, tropical	Gregoriou et al. 2007, Levizou et al. 2005, Liakoura 1997
blade inclination angle (vertical)	ϕB	∘	↑ with height	temperate	Niinemets et al. 1998
			↑ with light	temperate	Niinemets et al. 1998
lobation	$lobation$	cm^2	↑ with height	temperate Quercus sp.	Sack et al. 2006, Baranski, 1975
			↑ with light	temperate Quercus sp.	Kusi and Karasi 2020, Sack et al. 2006
cuticle thickness	CT	μm	↑ with height	tropical, temperate	Panditharathna et al. 2008, Baltzer and Thomas 2005
			↑ with light	tropical, temperate	Panditharathna et al. 2008, Baltzer and Thomas 2005
Leaf biochemical and physiological traits					
			↑ with height	tropical, temperate	Coble and Cavaleri 2014, Scartazza et al. 2016, Hernandez et al. 2019
Nitrogen per leaf area	N_a	$g \cdot m^{-2}$	↑ with light	tropical, global	Martin et al. 2020, Hernandez et al. 2020, Poorter et al. 2019, Harley et al. 1996
			≈ with ???	tropical, temperate	Hernandez et al. 2020, Scartazza et al. 2016
Nitrogen per leaf mass	N_m	$mg \cdot g^{-1}$	≈ with light	temperate broadleaf	Harley et al. 1996, Bolstad et al. 1999
			↑ with height	tropical	M.A Cavaleri et al. 2008, J.Lloyd et al. 2009
Phosphorous per leaf area	P_a	$g \cdot m^{-2}$	↑ with light	tropical	Martin et al. 2020
			↑ with height	temperate	Scartazza et al. 2016, Niinemets et al. 1998
xanthophyll cycle pigments	VAZ	μmol m^{-2}	↑ with light	tropical, global	Mastubara et al. 2009, Valladares and Niinemets, 2008
			↑ with height	conifer, temperatre	Duursma and Marshall, 2006, Coble et al. 2017
carbon isotope composition	$\delta^{13}C$	‰	↑ with light	conifer	Duursma and Marshall, 2006
			↑ with height	tropical	Poorter et al. 1995
chlorophyll a/b ratio	$chla/b$	mol mol^{-1}	↑ with light	tropical, global	Matsubara et al. 2009, Niinemets et al. 1998, Valladares and Niinemets, 2008
			≈ with height	tropical	Poorter et al. 1995, Lee and Graham, 1986
PAR absorptance	ABS	% nm	≈ with light	tropical	Poorter et al. 1995, Lee

Table 2. Summary of observed variation in leaf metabolism and thermal responses across the vertical gradient and/or between sun and shade leaves

trait	symbol	units	response	forest type(s)	reference(s)
Stomatal conductance					
max stomatal conductance	$g_{s_{max}}$	$mmol^{-2}s^{-1}$	↑ with height	tropical, temperate	Kafuti et al. 2020, Van Wittenberghe et al. 2012, Roberts et al. 1990
			↓ with height	temperate	Coble and Cavaleri 2015; Ishii et al. 2008
			↑ with light	global, tropical	Valladares and Niinemets, 2008, Hernandez et al. 2019
stomatal conductance	g_s		↑ with light	tropical	Slot et al. 2019
optimum temperature of g_s	T_{opt} of g_s	°C	≈ with light	tropical	Slot et al. 2019
frequency of stomatal closure			↑ with height	tropical	Roberts et al. 1990
Photosynthesis					
photosynthetic capacity	A_A	$\mu mol \cdot m^{-2} \cdot s^{-1}$	↑ with height	temperate, tropical	Niinemets et al. 2015, Mau et al. 2018
			↑ with light	temperate	Coble et al. 2017, Hikosaka and Terashima 1995, Evans 1989
light-saturated net photosynthesis	A_{sat}		↑ with light	tropical	Slot et al. 2019
optimum temperature of A_{sat}	T_{opt} of A_{sat}	°C	≈↑ with light	tropical	Slot et al. 2019
light compensation point	LCP		↑ with light	tropical	Slot et al. 2019
maximal carboxylation rate	V_{cmax}	$\mu mol \cdot m^{-2}s^{-1}$	↑ with height	temperate	Scartazza et al. 2016
			↑ with light	global	Valladares and Niinemets, 2008
V_{cmax} at optimal temperatue	$V_{cmax}(T_{opt})$	$\mu mol \cdot m^{-2}s^{-1}$	≈ with light	tropical	Hernandez et al. 2020
electron transport rate	J_{max}	$\mu mol \cdot m^{-2}s^{-1}$	↑ with height	temperate	Scartazza et al. 2016
			↑ with light	global	Valladares and Niinemets, 2008
J_{max} at optimal temperature	$J_{max}(T_{opt})$	$\mu mol \cdot m^{-2}s^{-1}$	≈ with light	tropical	Hernandez et al. 2020
thermal damage threshold	T_{50}	°C	≈↑ with light	tropical	Slot et al. 2019
			↓ with height*	savanna	Curtis et. al, 2018
Respiration					
dark respiration at reference T	$R_{dark}(T_{ref})$	$\mu mol \cdot m^{-2}s^{-1}$	↑ with height	temperate	Scartazza et al. 2016
			↑ with light	tropical	Bolstad et al. 1999, Slot et al. 2019
		μmol (kg leaf)$^{-1}s^{-1}$	↑ with light	temperate	Bolstad et al. 1999
		μmol (kg N)$^{-1}s^{-1}$	↑ with light	temperate	Bolstad et al. 1999
temperature sensitivity of R_{dark}	Q_{10}	°C^{-1}	≈↓ with light	temperate	Bolstad et al. 1999
VOC production					
isoprene emission rate (in emitting species)	I	nmol m$^{-2}s^{-1}$	↑ with height	temperate	Harley et al. 1996, Harley et al. 1997
			↑ with light	temperate	Niinemets and Sun, 2014, Harley et al. 1996, Sharkey and Monson, 2014