SUPPLEMENTARY DATA

Fig. S1. Time course of ^{13}C discrimination (δ^{13}C) in garden cress (*Lepidium sativum*) plantlets grown from seed for up to 21 days after watering (DAW) in air or helox atmosphere at high (HH; A,D,G) or low humidity (LH; B,E,H), under total pressure reduced to one-half of normal pressure (RP: C,F,I), and at three different atmospheric CO_2 mixing ratios C_a: subambient (180 µmol mol^{-1}; A–C), ambient (400 µmol mol^{-1}; D–F) or superambient (800 µmol mol^{-1}; G–I). Isotopic compositions of CO_2 in the mixed atmosphere (δ_a) and of seed carbon (δ_s) were –28.19 ‰ and -28.13 ‰, respectively. Means and standard deviations (n = 3) are shown. The data indicate that (i) δ of cotyledons at 0, 7, 14 and 21 DAW follows a sigmoid-like time course and approaches the δ value of true leaves after 21 days; (ii) helox-grown plants were almost always depleted in ^{13}C compared to air-grown plants; (iii) ^{13}C discrimination increases (δ becomes more negative) with rising C_a; (iv) the discrimination in hypobaric plants (RP) is remarkably decreased (less negative δ) than in plants grown at normal atmospheric pressure with similar C_a (compare RP at 800/2 with LH at 400 and RP at 400/2 with LH at 180 µmol mol^{-1}).

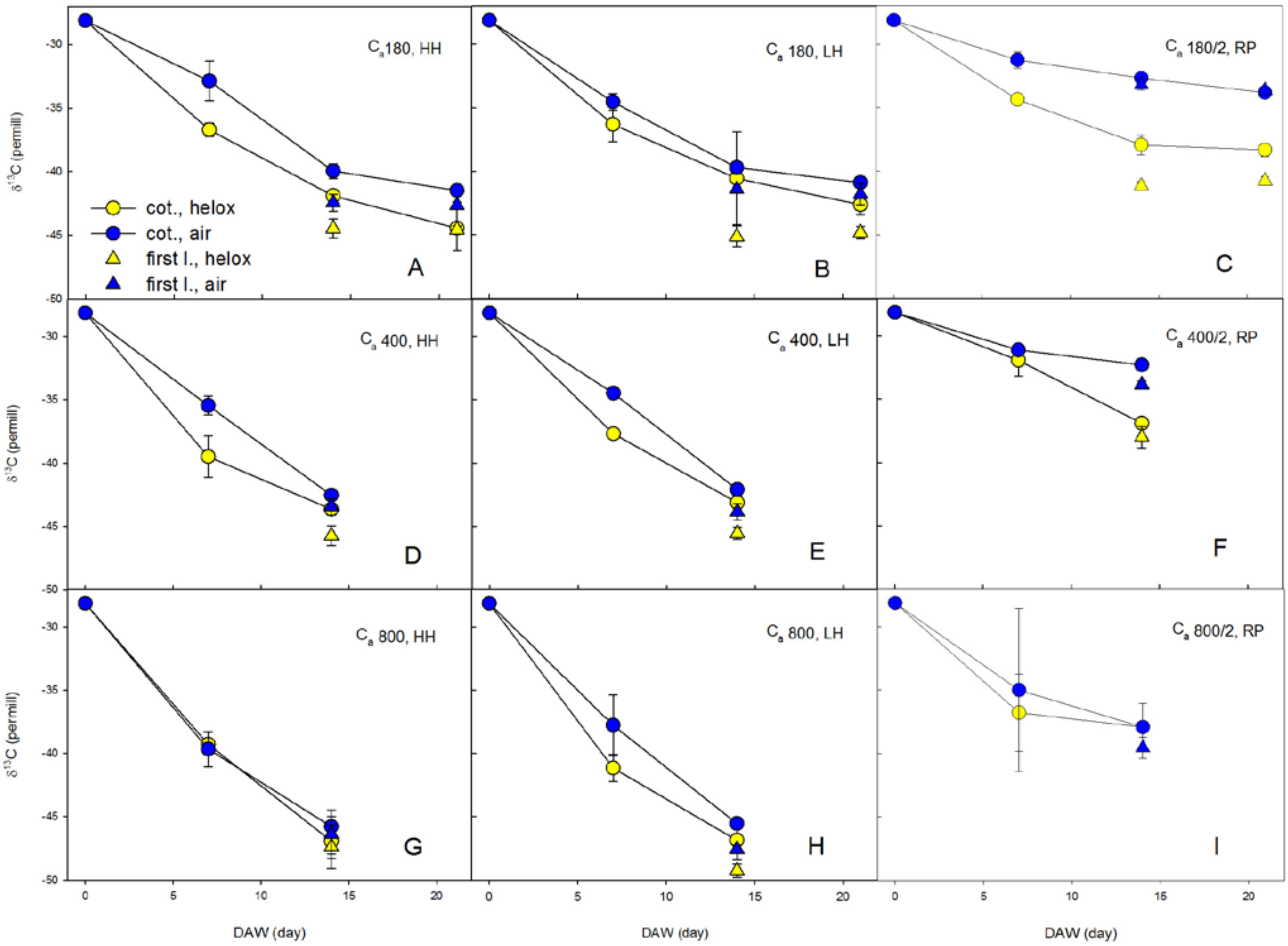

Fig. S2. Time course of stomatal density in garden cress (*Lepidium sativum*) plantlets grown from seed for up to 21 days after watering (DAW) in air or helox atmosphere at high (HH; A,D,G) or low humidity (LH; B,E,H), under total pressure reduced to one-half of normal pressure (RP; C,F,I), and at three different atmospheric CO_2 mixing ratios C_a: subambient (180 µmol mol^{-1}; A–C), ambient (400 µmol mol^{-1}; D–F) or superambient (800 µmol mol^{-1}; G–I). Data points are means of total number of stomata per mm^{-2} of projected leaf area (adaxial plus abaxial side) of counts on 60 areas in samples from three plants. Bars represent standard deviations. The data indicate that (i) stomatal density in cotyledons is insensitive to C_a as well as to atmospheric humidity and to reduced atmospheric pressure; (ii) stomatal density of true leaves decreases with increasing C_a and reduced atmospheric humidity; (iii) stomatal density on hypobaric plant leaves is increased compared to plants grown under normal pressure.

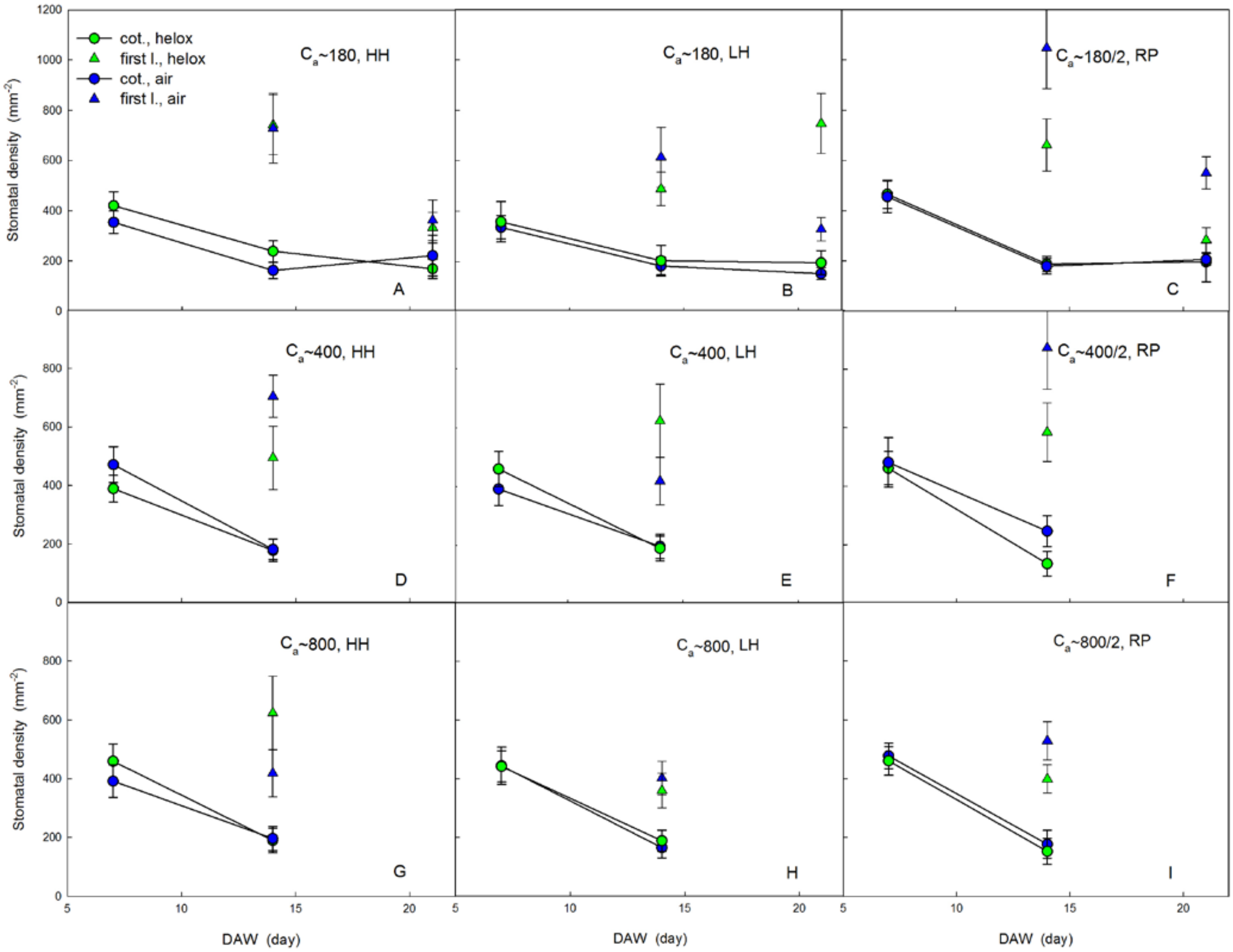

Fig. S3. Kinetics of seed-derived carbon in cotyledons of garden cress plants grown at three different ambient CO_2 concentrations from seeds for 14–21 days after the seed watering (DAW) in artificially mixed atmosphere. Other growth conditions are described in legend of Figs S1 and S2. Sigmoid regression curves are shown. The fraction of seed-derived carbon *f* was calculated from time-course of carbon isotope composition $\delta^{13}C$ in dry matter of the cotyledons and true leaves.

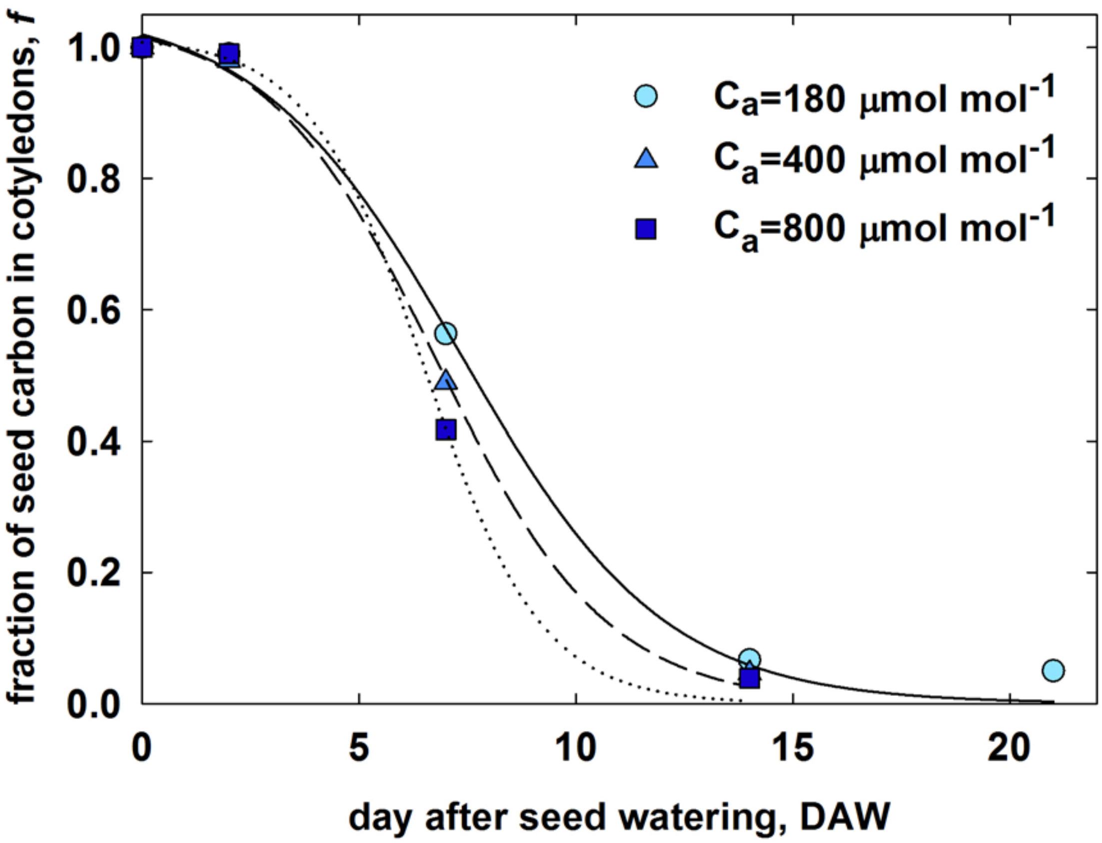

Fig. S4. Details of the stomatal density SD, pavement cell density PCD and stomatal index SI response of garden cress true leaves and cotyledons to leaf internal CO_2 concentration C_i. The plants were grown for 21 days at PPFD of 100, 170, 240, 310, 380, 450, 520, 590 µmol (photons) m^{-2} s^{-1}. The data showing total SD, PCD and SI values summed (SD, PCD) or averaged (SI) over both leaf sides are presented in Fig. 4 of the main text. Here, we present values separately for adaxial and abaxial leaf sides and in the form of differences between treatments (all irradiance levels except 310 µmol m^{-2} s^{-1}) and the "control" arbitrarily set as the optimum irradiance of 310 µmol m^{-2} s^{-1}.

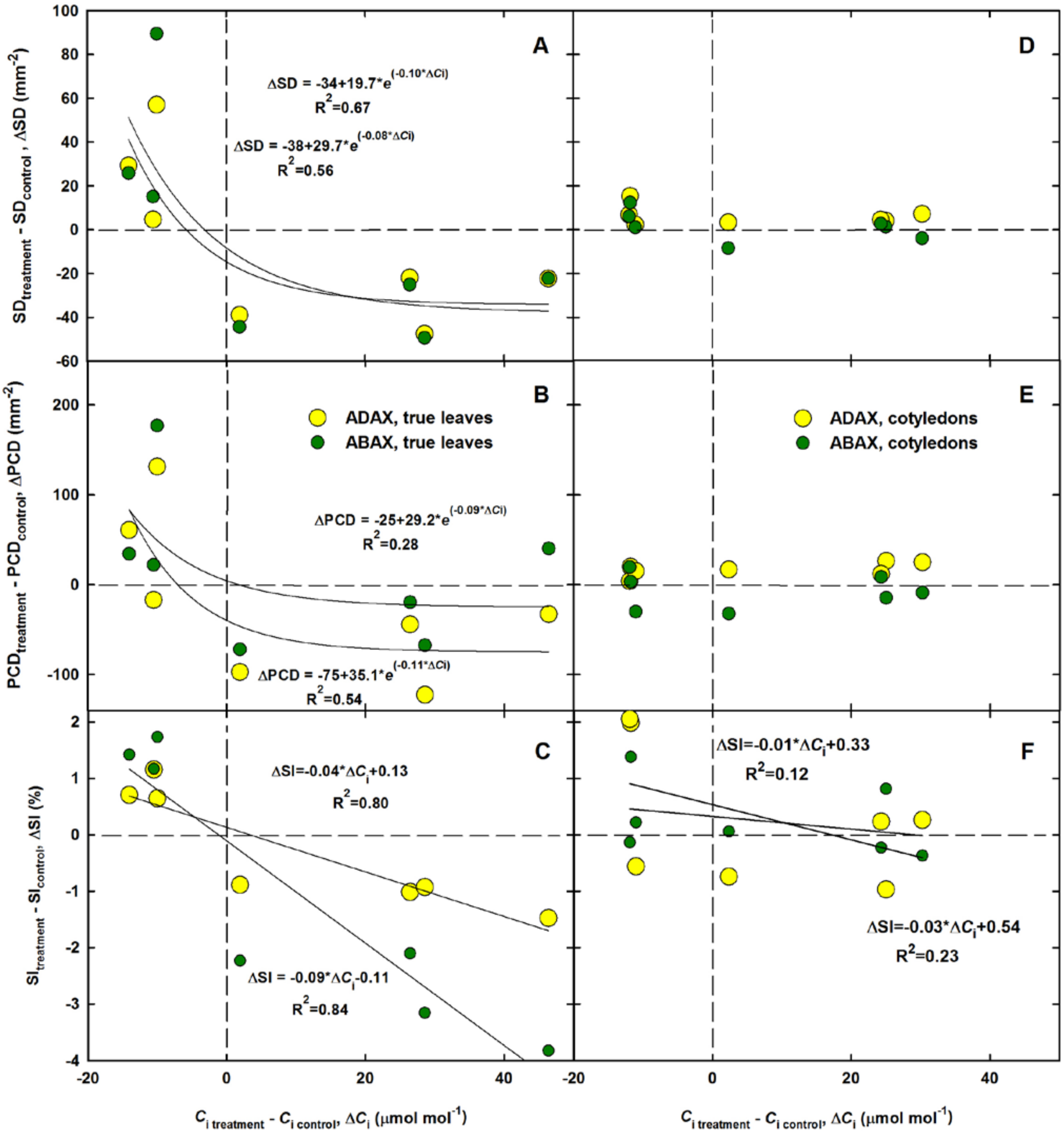

Table S1. Carbon isotope discrimination (δ) and stomatal density (SD) data compiled from published controlled factorial experiments with dicotyledonous plants. The differences of δ and SD between treatments (t) and the respective controls (c) were used in calculation of the treatment effect on leaf internal CO_2 concentration (C_i) using equation 3 and in plotting the C_i response of SD (Fig. 5).

No	species	variant	treatment/level		δ air [‰]	C_a	SD mm^{-2}	Δ or δ	C_i	diff. c-t δ [‰]	difference treat-control SD	C_i	SD [%]	Source
1	*Vigna sinensis*	control c			-8	380	440	16.1	180.0					
		treated t	P nutrition, soil water,		-8	380	244	19.4	231.7	3.4	-196	51.7	-45	Sekiya & Yano, 2008
2	*Glycine max*	c		-UV	-8	380	170	19.5	233.3					
		t	UV-B	+UV	-8	380	100	18.0	210.1	-1.5	-70	-23.2	-41	Gitz III *et al*., 2005
3	*Frenelopsis* (3 species)	c			-8	380	60	-27.8	237.9					
		t	salinity		-8	380	168	-20.8	129.8	-7.0	108	-108.1	180	Aucour *et al*., 2008
4	*Lycopersicon esculentum*	c		-ABA	-8	380	207	-29.6	265.8					
		t	ABA	+ABA	-8	380	248	-29.1	257.7	-0.5	41	-8.2	20	Bradford *et al*., 1983
5	*Solenites vimineus*	c		high (1896)	-8	380	45	-26.3	214.7					
		t	CO2	low (1512)	-8	380	38	-27.8	237.9	1.5	-7	23.2	-16	Yan *et al*., 2009
6	*Arabidopsis thal., Col.*	c		-UV	-8	380	563	22.9	285.9					
		t	UV-B	+UV	-8	380	369	24.3	307.2	1.4	-194	21.3	-34	Lake *et al*., 2009
7	*Parashorea chinensis*	c		50 m	-8	380	558	-27.8	237.1					
		t	tree height	35 m	-8	380	503	-29.1	258.4	1.4	-55	21.3	-10	He *et al*., 2008
8	*Oleandra pistillaris*	c		open	-8	380	229	-29.9	270.3					
		t	canopy	understorey	-8	380	167	-32.6	312.0	2.7	-62	41.7	-27	Takahashi & Mikami, 2006
9	*Ginkgo biloba*	c		lit	-8	380	96	-26.6	219.3					
		t		shaded	-8	380	79	-24.6	188.5	-2.0	-17	-30.9	-18	
		c		lit	-8	380	113	-29.3	261.1					
		t	irradiance	shaded	-8	380	91	-29.9	270.3	0.6	-22	9.3	-20	Sun *et al*., 2003

10	*Acacia koa*	control c		lit	-8	380	237	-28.0	241.1					
		treat. t		med. shaded	-8	380	207	-29.7	267.4	1.7	-30	26.2	-13	
		c		lit	-8	380	237	-28.0	241.1					
		t	irradiance, 100 % soil water capacity	shaded	-8	380	111	-31.8	299.8	3.8	-127	58.7	-53	
		c		lit	-8	380	263	-27.1	227.8					
		t		med. shaded	-8	380	237	-29.0	256.7	1.9	-26	29.0	-10	
		c		lit	-8	380	263	-27.1	227.8					
		t	Irradiance, 20 % soil water capacity	shaded	-8	380	123	-31.6	296.1	4.4	-140	68.3	-53	Craven *et al*., 2010
11	*Pinus sylvestris*	c		high (560)	-8	560	102	18.9	330.1					
		t	CO2	low (~360)	-8	360	127	20.6	236.3	1.7	25	-94	24	
		c		lit	-8	360	102	18.9	212.0					
		t	irradiance	shaded	-8	360	81	20.2	231.2	1.3	-21	19.2	-21	Beerling 1997
12	*Arabidopsis thal., Col.*	c		warm (25oC)	-8	380	240	-29.7	267.2					
		t	temperature	cold (5oC)	-8	380	470	-28.4	247.2	-1.3	230	-20.1	96	Gorsuch *et al*., 2010
13	*Pinus flexilis*	c		low (glacial)	-5	180	117	-22.3	94.5					
		t	CO2	high (holocene)	-6	280	97	-23.8	152.5	1.5	-20	58	-17	Van de Water *et al*., 1994
14	*Solanum tuberosum*	c		medium	-8	380	197	19.8	237.1					
		t	N nutr. DI	low	-8	380	115	20.0	240.2	0.2	-82	3.1	-42	
		c		medium	-8	380	197	19.8	237.1					
		t	N nutr. DI	high	-8	380	214	18.9	224.6	-0.8	17	-12.5	9	
		c		medium	-8	380	166	19.3	230.6					
		t	N nutr. PRD	low	-8	380	142	19.3	230.2	0.0	-24	-0.5	-14	
		c		medium	-8	380	166	19.3	230.6					
		t	N nutr. PRD	high	-8	380	157	19.5	233.3	0.2	-9	2.6	-5	Yan *et al*., 2012

15	*Vitis vinifera*	c		warm			117		275.4					Rogiers &Clarke, 2013
		t	root temp.	cool			128		262.3		11	-13	10	
16	*Betula mioluminifera*	c		low	-6	316	256	-29.1	240.6					Sun *et al.*, 2012
		t		high	-6	387	207	-30.9	321.7	1.7	-49	81	-19	
	Carpinus miofangiana	c		low	-6	316	278	-28.3	229.7					
		t	CO2	high	-6	387	244	-30.3	313.1	2.0	-34	83	-12	
17	*Medicago sativa,*	c		75	-8	380	118	-29.6	265.7					He *et al.*, 2012
		t		25	-8	380	185	-27.6	234.0	-2.1	67	-31.7	57	
	cv. Algonquin, Longdon, Xinjiangdaye	c		75	-8	380	154	-29.4	263.1					
		t		25	-8	380	182	-27.5	232.9	-2.0	28	-30.1	18	
		c	soil water capacity (%)	75	-8	380	139	-29.6	265.2					
		t		25	-8	380	152	-27.7	236.0	-1.9	13	-29.2	9	