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Section 1: A-c_i relationship measurements

We first stabilized photosynthetic rate and g_s under light saturation, ambient temperature and CO_2 conditions. We then fixed leaf temperature and changed CO_2 concentration to 11 levels ranging from 0 to 1500 μmol mol^{-1} and calculated V_{cmax} and J_{max} as follows;

$$P_c = V_{cmax} (c_i - \Gamma^*) / [c_i + K_c (1 + O / K_o)] - R_d \quad \text{(S1)}$$

$$P_r = J (c_i - \Gamma^*) / (4 c_i + 8\Gamma^*) - R_d \quad \text{(S2)}$$

where P_c and P_r (μmol m^{-2} s^{-1}) are the net photosynthetic rate at RuBP saturation (Rubisco limitation) and the rate at RuBP limitation at each intercellular CO_2 concentration (c_i), respectively. K_c and K_o (μmol mol^{-1}) are the Rubisco Michaelis–Menten constants for CO_2 and O_2, respectively, and Γ^* (μmol mol^{-1}) is the CO_2 compensation point without day respiration. We assumed that these three parameters were the same as the data obtained *in vivo* in previous studies (Table S2, von Caemmerer *et al.* 1994). J (μmol m^{-2} s^{-1}) is the electron transport rate, the maximum value of which is J_{max}, R_d is the day respiration rate (μmol m^{-2} s^{-1}), and O is the O_2 concentration in the chloroplast (210 mmol mol^{-1}). In these calculations we assumed that c_i = CO_2 concentration at the site of RuBP carboxylation, i.e., the infinite internal conductance of CO_2 (but see Harley *et al.* 1992*a*, Epron *et al.* 1995).

Photosynthetic rates were regressed with c_i using Equation S1 at a cuvette CO_2 concentration less than 500 μmol mol^{-1} to calculate V_{cmax} and R_d of each individual leaf. The J_{max} was calculated using Equation S2 and the calculated R_d of the leaf.

Section 2: Measurements of temperature dependencies of photosynthesis

To measure diurnal courses of photosynthetic traits, we used L-size saplings planted in a pot (12 L in volume) filled with brown forest soil. Potted saplings were grown near the monitored saplings and were watered weekly with nutrient solution to the field capacity (600 mg nitrogen, Hyponex, N: P: K = 5: 10: 5, Murakami-Bussan, Kamigori, Japan).

We measured the A–c_i relationship at different leaf temperatures using leaves of L-size saplings of *F. erecta* and *N. aciculata* (n = 6 per species) in summer (September) 2007 and in winter (March) 2008. In the morning, we measured the A–c_i relationship at a low leaf temperature and then increased the leaf temperature to conduct the next measurement. We measured the A–c_i relationship at five to seven different leaf temperatures (T, °C) (22–38°C in summer and 6–26°C in winter).

For the summer measurements of *N. aciculata*, we determined optimal leaf temperature for V_{cmax} and J_{max} (T_{opt}) through cubic regression of $f(T)$ with T using T>30°C data. We could not measure V_{cmax} and J_{max} at high T for *F. erecta* and *N. aciculata* in winter because of stomatal closure. Therefore, we assumed that T_{opt} of *N. aciculata* in winter and that of *F. erecta* were the same as that of *N. aciculata* in summer.

Using the measured V_{cmax} and J_{max} values, we expressed the temperature dependencies using the following equation (Farquhar *et al.* 1980; Harley *et al.* 1992*b*) (Fig. S3):

$$f(T) = f^{(25)}\exp[\frac{H_a}{298.15R}(1-\frac{298.15}{T})]\frac{1+\exp(\frac{298\Delta S - H_d}{298R})}{1+\exp(\frac{T\Delta S - H_d}{TR})} \quad \text{(S3)}$$

where $f(T)$ is the V_{cmax} or J_{max} at T, $f^{(25)}$ is the value of $f(T)$ scaled to a common temperature (25°C = 298.15 K), R is the gas constant (8.31 J mol^{-1} K^{-1}) and the coefficient H_a (J mol^{-1}) describes the rate of exponential increase in $f(T)$ with T below T_{opt}. H_d (J mol^{-1}) describes decrease in $f(T)$ with T above T_{opt}, and ΔS is an entropy factor. In this study, we set H_d = 200 000 J mol^{-1} (Medlyn *et al.* 2002). ΔS was calculated using H_a, H_d and T_{opt} (ΔS = $\frac{H_d}{T_{opt}} - \ln\left(\frac{H_a}{H_d - H_a}\right)$). The temperature dependencies of K_c, K_o and a relative specific factor for Rubisco, τ, which represents Γ^* = $O/2\tau$, were expressed with the H_a values using modified equation of Equation S3 (Table S2) ($f(T) = f^{(25)}\exp[\frac{H_a}{298.15R}(1-\frac{298.15}{T+273.15})]$).

Section 3: Measurements of light response of photosynthetic rates

To incorporate the light dependencies of photosynthesis in the calculation of daily carbon gain, we measured photosynthetic rates (P, μmol m^{-2} s^{-1}) at different light intensities. We first measured photosynthesis at PPFD = 2000 μmol m^{-2} s^{-1} under ambient environmental conditions. We then decreased PPFD stepwise through 10 levels to 0 μmol m^{-2} s^{-1}. We calculated the initial slope of the light-photosynthesis relationship, (apparent quantum yield, α), and the convexity (θ) for each sapling size and species by fitting the following equation to the light–photosynthesis relationship (n = 7–10 per measurement time) (Johnson and Thornley 1984):

$$P = \frac{P_{\max} + \alpha I + [(P_{\max} + \alpha I)^2 - 4\alpha I \theta P_{\max}]^{0.5}}{2\theta} - R_{\mathrm{n}} \qquad \text{(S4)}$$

where P_{max} is P at light saturation (μmol m^{-2} s^{-1}).

Section 4: Stomatal response to abiotic factors

To reveal the interactions among abiotic factors (ambient CO_2 concentration, relative humidity, incident solar radiation, leaf temperature), photosynthetic rate (P, μmol m^{-2} s^{-1}), and g_s, we measured diurnal courses of photosynthesis for potted M-size saplings of *F. erecta* (September 2006) and *N. aciculata* (August 2007 and March 2008). Leaf gas exchange was measured at 1-h intervals from soon after dawn until sunset (n = 15–20 per species for each measurement). Using the obtained data, we analyzed the relationships between g_s and P and abiotic factors as follows (Ball *et al.* 1987):

$$g_{\mathrm{s}} = m \frac{P \cdot \mathrm{RH}}{C_{\mathrm{s}}} + b \qquad \text{(S5)}$$

where RH (%) is relative humidity and C_s is CO_2 concentration at the leaf surface (μmol mol^{-1}). We calculated the parameter m, which describes the slope of the relationship, and *b* (Fig. S4).

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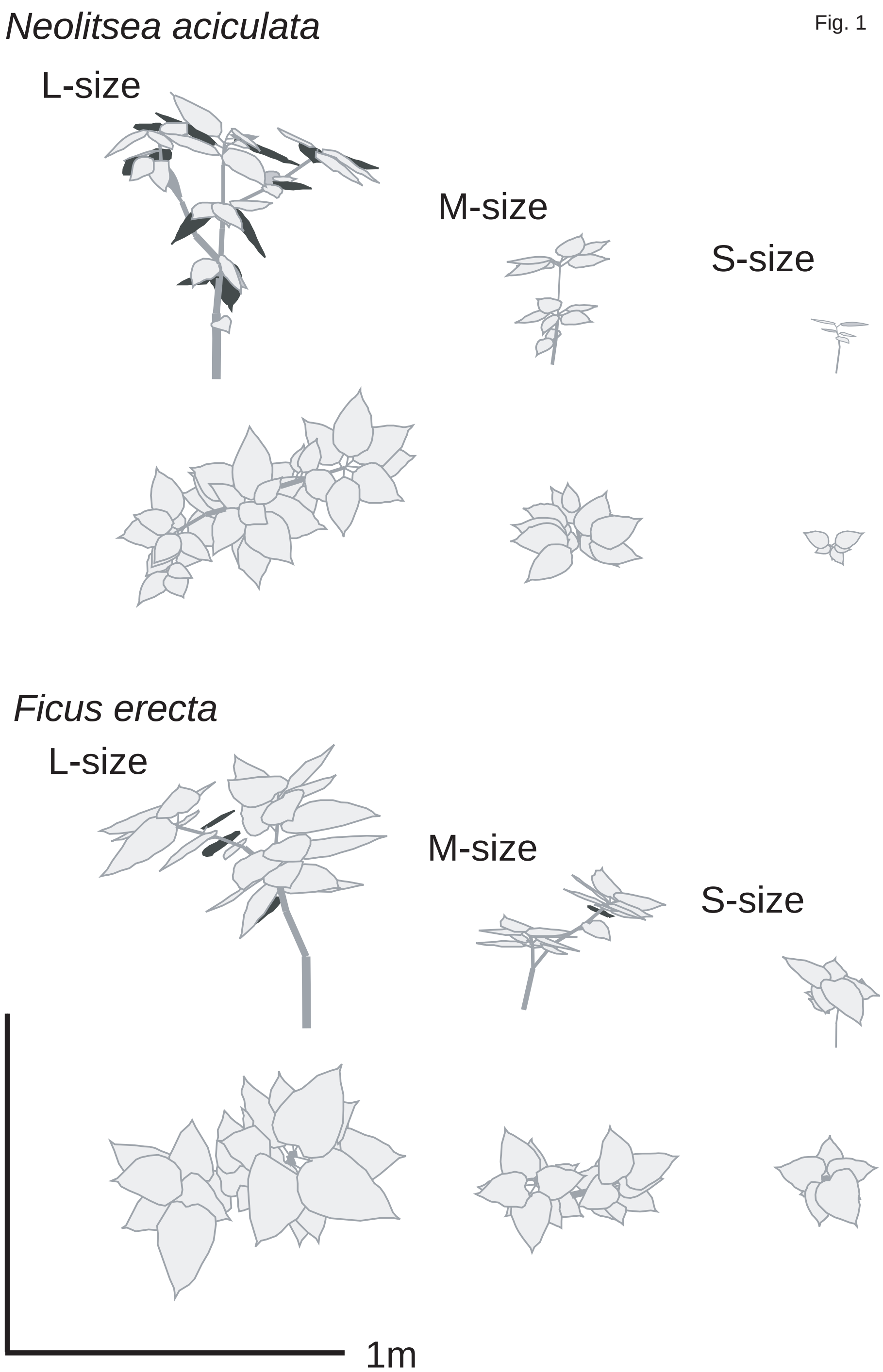

Fig. S1. Images of representative large (L), medium (M) and small (S)-size saplings of *Neolitsea aciculata* and *Ficus erecta*. Saplings are shown from side and above viewpoints of the crown. Dark gray shading shows leaves oriented in the opposite direction from the viewpoint.

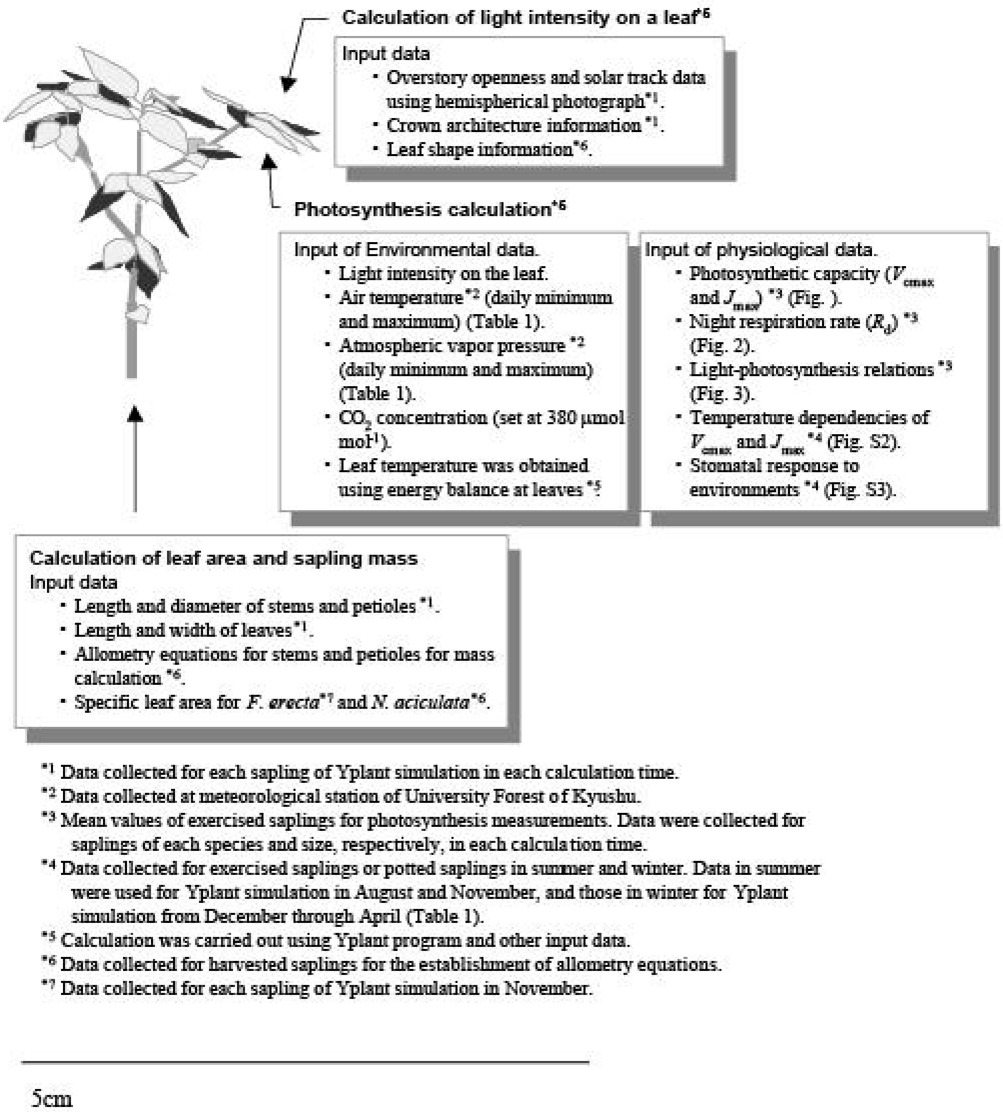

Fig. S2. Scheme of the analyses and measurements of this study.

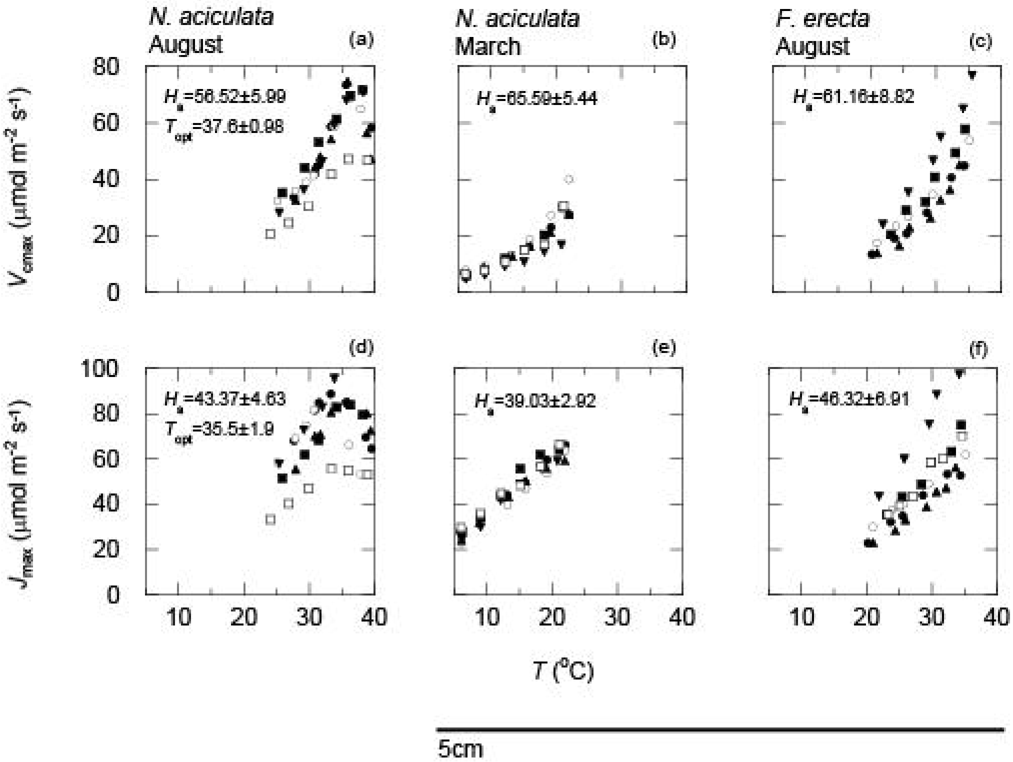

Fig. S3. Temperature dependencies of the maximum rate of RuBP carboxylation (V_{cmax}, a, b, c) and electron transport rate (J_{max}, d, e, f) for *N. aciculata* in summer (a, d), in winter (b, e) and *F. erecta* in summer (c, f). Each symbol represents the values of the same leaf. Numbers describe means ± standard deviation of the coefficient of Equation S3 (H_a and T_{opt}).

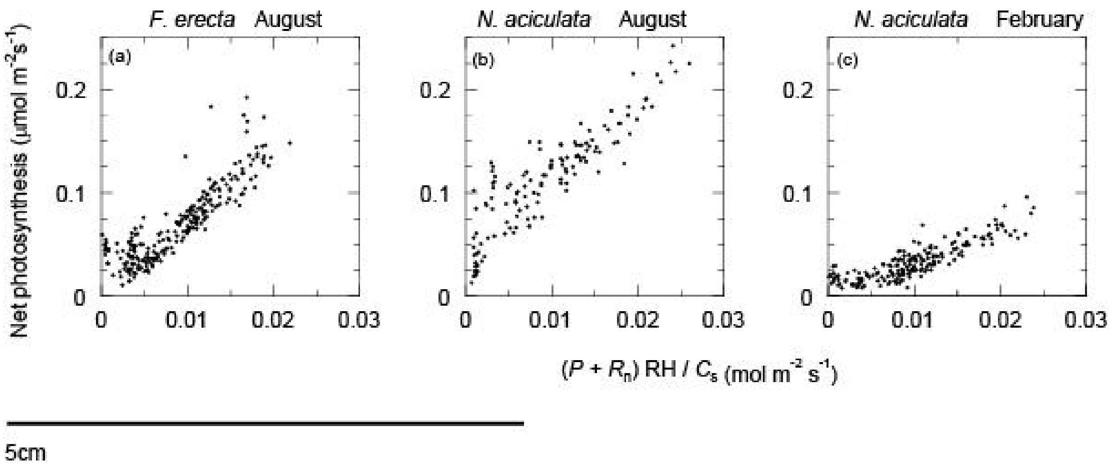

Fig. S4. The relationship among stomatal conductance (g_s), gross photosynthetic rates under ambient conditions ($P + R_n$), CO_2 concentration (C_s) and relative humidity at leaf surface (RH). Values are those obtained in the diurnal measurement of leaf gas exchange for *F. erecta* and *N. aciculata* in summer (a, b) and for *N. aciculata* in winter (c).

Table S1. Allometry equations and input values for non-destructive calculation of stem mass and petiole mass

*** indicates significant correlation at the level of $P = 0.001$. n.s. indicates that y was not significantly correlated with x at the level of $P = 0.05$

	Species	Size	n	R^2	Equation[A] or input value (g)[B]
Petiole	*F. erecta*	L	30	0.71^{***}	$y = 0.211x + 0.005$
		M	30	0.65^{***}	$y = 0.203x + 0.003$
		S	30	$0.18^{n.s.}$	0.02
	N. aciculata	L	30	$0.14^{n.s.}$	0.011
		M	30	$0.09^{n.s.}$	0.01
		S	30	$0.05^{n.s.}$	0.008
Stem	*F. erecta*	L	48	0.92^{***}	$y = 0.318x + 0.009$
		M	32	0.84^{***}	$y = 0.335x + 0.002$
		S	18	0.83^{***}	$y = 0.241x + 0.01$
	N. aciculata	L	46	0.95^{***}	$y = 0.387x + 0.011$
		M	24	0.94^{***}	$y = 0.42x + 0.028$
		S	18	0.76^{***}	$y = 0.294x + 0.012$

[A]y: stem or petiole mass (g), x: length · diameter^2 (cm^3) of the petiole or stem.

[B]Mean values of petiole mass were used for all petioles in cases where x–y correlation was not significant.

Table S2. Environmental parameters for the calculatation of daily course of photosynthesis in Yplant program in each calculation date

		Air temperature (^{o}C)		Vapor pressure (kPa)	
Date	(DOY[A])	Minimum	Maximum	Minimum	Maximum
25-Aug	(250)	26	33	2.5	2.9
7-Nov	(310)	12	22	1	1.2
17-Dec	(350)	9	16	0.9	1
1-Jan	(10)	3	12	0.6	0.7
10-Feb	(40)	3	7	0.6	0.7
11-Apr	(100)	12	24	0.9	2.1

[A]Day of year.

Table S3. List of Michaelis-Menten constants, the specific factor of Rubisco and the activation energy used in the Equations S1 and S2

	Values at 25°C	H_a (J mol^{-1})
K_c (μmol mol^{-1})	275[A]	80 500[B]
K_o (mmol mol^{-1})	420[A]	14 500[B]
Γ* (μmol mol^{-1})	40[A]	
τ	2321[A]	–29 000

[A]Harley *et al*. (1992), von Caemmerer *et al*. (1994).

Table S4. Parameters (means ± s.d.) for each species and season used in the calculation of diurnal course of photosynthesis

	Parameter	Species	Season	Mean	±	s.d.
H_a	V_{cmax}	*F. erecta*	Growing season	61.16	±	8.82
(J mol^{-1})		*N. aciculata*	Growing season	56.52	±	5.99
			winter	65.59	±	5.44
	J_{cmax}	*F. erecta*		46.32	±	6.91
		N. aciculata	Growing season	43.37	±	4.63
			winter	39.03	±	2.92
T_{opt} [A]	V_{cmax}			37.6	±	0.98
(^{o}C)	J_{max}			35.5	±	1.9
m		*F. erecta*	Growing season	6.23		
('%$^{-1}$)		*N. aciculata*	Growing season	6.95		
			winter	8.21		
b		*F. erecta*	Growing season	0.009		
(μmol m^{-2} s^{-1})		*N. aciculata*	Growing season	0.016		
			winter	0.006		

[A]Measured values for *N. aciculata* in growing season. We assumed that these values were the same in all saplings.

Table S5. Parameters for the analysis of hemispherical photograph and light capture by saplings

Parameters	Values or setting
Atmospheric transmission coefficient	0.79
Canopy transmission coefficient	0.10
Leaf absorptance	0.85
Leaf reflectance	0.10
Sky condition	Standard overcast condition
Sky section	160