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Supplementary Material

Maximised photosynthetic capacity and decreased hydraulic failure risk during aging in the clump bamboo, *Bambusa chungii*

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Validation of the modified thermal dissipation probe

The cut experiment was conducted in the South China Botanical Garden, Guangzhou, China. Three culms were randomly chosen (Table 1) and harvested during March 3–6, 2014 in the garden. To identify the distribution of the vascular bundles, the dye-injection method was adopted in the culm sectional area to visualize the water-conducting pathways at a tissue level (Tateishi et al. 2008). An aqueous solution of 1%

sarranine was injected into the culms of the samples at a height of 1.0 m above the ground for 1 hour. After injection of the dye solution, we harvested the culms and collected discs at 10 cm intervals along the culm. The vascular bundles in the discs were identified with an electron microscope (Figure 1). It was observed that the patterns of vascular bundles changed significantly along the culm segments, the tapering wall thickness was one of the most important differences among the vascular bundles.

Next, one segment with three nodes was removed from each culm. Both ends of the segment were covered with gauze and soaked with KCl solution (20 mmol L^{-1}) to prevent hydraulic failure caused by excessive evaporation. The segments were then immediately returned to laboratory and recut into 50 cm long segments and the ends shaved with a sharp razor blade to obtain a clean surface. The prepared segments were covered with funnels on each end and daubed with glass cement between the inner wall of the funnels and the external side of the bamboo wall to prevent water leakage. Each segment was fixed upside down on a supporting stand to simulate actual water flow within the culm.

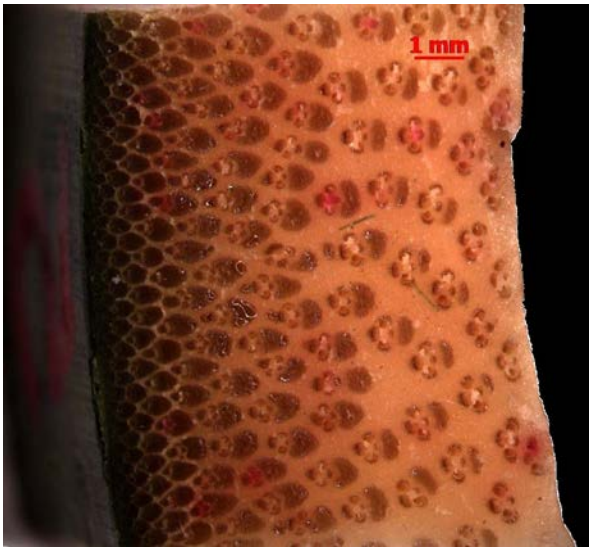

Fig. S1. The transverse surfaces of the culm of *Bambusa chungii* (The left is the outmost of the culm).

Table S1. Architecture parameters of the bamboo culms used for the cut experiment.

No.	*DBH* (cm)	*Height* (m)	*Depth* (cm)
S1	7.68	15.4	0.62
S2	7.30	13.9	0.60
S3	7.60	16.0	0.65

Depth: thickness of the culm wall, Height: height above ground.

Because the conductive depth was thinner than that of dicotyledonous woody plants (Table 1), we decided to use shortened TDP probes (5 mm) instead of the original probes (20 mm) based on a survey of culm wall thickness (7 ± 1.41 mm, $n = 91$) of *B. chungii* before the experiment. The modified Granier's sensors were inserted into the internode of the culms to measure sap flux density (J_S, g m^{-2} s^{-1}) in segments. The

heated sensor was inserted in the lower part of the segment and was provided with a constant direct current of 120 mA, and the reference probe was inserted in the upper part of the segment. The paired sensors were 10 cm apart and connected to a datalogger (DL2e, Delta-T Devices, Ltd., Cambridge, UK) which read data every 30 s and averaged and recorded the data every 5 min. The top end of the segment was connected to a bottle by a plastic pipe that was filled with purified water with a constant volume flowing through the segments (Figure 2a). To produce a pressure gradient, we changed the height of the water level (90 cm, 70 cm, 50 cm, 30 cm and 15 cm) by moving the bottle up and down, which alters the speed of water movement and creates a different sap flow rate in the segment. At the beginning of the experiment, the vertical distance between the water level and the top of the segments was 1 m and was kept constant for 1 h to reduce embolism in the conduits. The bottle was then moved down to different heights for 2 h. To provide a reference measurement for the TDP-derived sap flux density, a container was placed on a balance (0.001 g resolution) underneath the segment to collect and record the water (g 5 min^{-1}) flowing through the segment. The area-specific flow rate (J_g, g m^{-2} s^{-1}) was obtained by dividing the conductive area or the cross-section area (A_C, m^2) of the bamboo wall. The measured sap flow with modified TDP was compared against the collected water in the container on the balance to calibrate the parameters of the original Granier's equation.

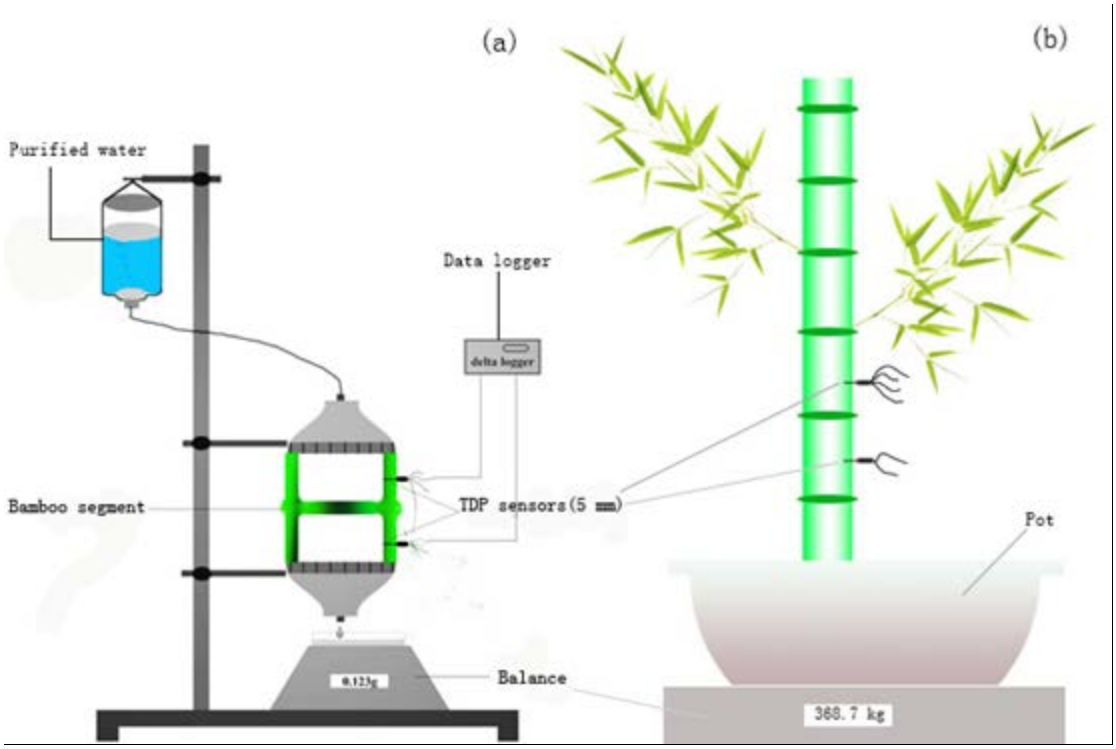

Fig. S2. Experimental setup (a) for the verification of thermal dissipation probe (TDP) measurements by comparing measured values against gravimetric readings on *B. chungii* and (b) outdoor pot culture experiments by comparing the cumulative sap flux measured with calibrated TDP probes with daily water loss.

The recorded voltage signals from the TDP sensors were converted into sap flux density (J_S, g m^{-2} s^{-1}) by the original equation of Granier (1987):

$$J_S = aK^b \quad (1)$$

where a and b are equation parameters (Granier 1987: a = 119, b = 1.231), and K is defined as

$$K = \frac{\Delta T_{max} - \Delta T}{\Delta T} \quad (2)$$

where ΔT_{max} (°C) is the temperature difference between the heated and reference probes under zero-flux conditions, and ΔT (°C) is the instantaneous temperature difference. To determine ΔT_{max} under laboratory conditions, the water supply was shut off to produce zero-flux and TDP data recorded throughout an entire night were used to calculate ΔT_{max}.

To determine parameters *a* and *b* in Equation 1 for the modified TDPs, we pooled the selected observations of J_S and J_g for all of the segments and randomly split the pooled dataset into two halves: one for deriving new parameters (Data set I) and the other for the validation (Data set II). In the validation dataset, we tested the performance of the new parameters *a* and *b*. We compared J_S values derived from the original and calibrated parameters to J_g in the validation dataset.