# SUPPLEMENTARY DATA

Plant material and experimental set-up for an additional experiment to validate reuslts.

Tomato plants (*Solanum lycopersicum* ‘Admiro’) were grown in a greenhouse compartment (720 $m^2$) at the Research Station for Vegetable Production, Sint-Katelijne Waver, Belgium. Plants were sown on 2 November 2009, grafted on ‘Emperador’ and transplanted into 14.6-L rockwool slabs (Master, Grodan, Hedehusene, Denmark) on 6 January 2010 to reach a final plant density of 3 $m^{-2}$. A nutrient solution was supplied to the plants using a drip irrigation system based on sums of solar radiation, to attain a daily drainage of ~30–50%. Trusses were pruned to five fruits per truss. Two plants were selected to be continuously monitored from 17 August until 31 August (DOY 229–243) 2010, both located in the centre of the greenhouse. At the start of the measurements the plants were ~8 m long. The youngest part of 2.5 m was vertically supported, whereas the oldest part of the stem of 5.5 m was de-leafed and rested horizontally as is common practice in greenhouse tomato culture.

Sap flow rates ($F_{stem}$) and stem diameter ($D_{stem}$) variations were measured continuously at two different heights on each plant with heat balance sap flow sensors (SGA13-WS, Dynamax Inc., Houston, TX, USA) and Linear Variable Displacement Transducers (LVDT; 2.5 DF, Solartron Metrology, Bognor Regis, UK), respectively: plant S1 at 5.5 and 7 m from the roots and plant S2 at 4.5 and 7 m from the roots. Additionally, the diameter of the third fruit ($D_{fruit}$) of one truss on each plant was measured using LVDT sensors (2.5 DF, Solartron Metrology, Bognor Regis, UK). The monitored truss was located at ~7 m from the roots.

The model simulations were run as presented in the manuscript except from two necessary modifications: (1) plants S1 and S2 carried on average nine trusses of five fruits on each plant; and (2) because the distance between two measurement points was quite high, $F_{stem}$ measurements were conducted at both levels within the plant and the measured $F_{stem}$ at level 2 was used as input for the model simulations at level 2.

Parameter values, specific for the two extra plants (plants S1 and S2) are given in Table S1, whereas other parameter values were equal to the values presented in Table 1.

In this Supplementary Data graphs are included to depict the measured $F_{stem}$ and $D_{stem}$ for both plants at two levels (Fig. S1), the simulations of $D_{stem}$, fruit diameter ($D_{fruit}$), total xylem water potential ($\Psi^{tot}_{xylem}$), osmotic ($\Psi^{\pi}_{phloem}$) and hydrostatic water potential ($\Psi^{p}_{phloem}$) in the phloem (Fig. S2) and the resulting daily loading and unloading rates for plants S1 and S2 (Fig. S3).

Table S1. Parameter values and initial conditions of the stem model used for plants S1 and S2

| | Plant S1 | | Plant S2 | |
|---|---|---|---|---|
| Parameter | Level 1 | Level 2 | Level 1 | Level 2 |
| $D_{stem}(0)$ (mm) | 13.99 | 13.39 | 12.58 | 12.42 |
| $D_{fruit}(0)$ (mm) | 47.02 | | 44.70 | |
| $\varepsilon_0$ ($m^{-1}$) | 926 | 1829 | 951 | 1400 |
| $\phi_{phloem}(0)$ ($MPa^{-1}$ $h^{-1}$) | $299.97\times10^{-5}$ | $987.42\times10^{-5}$ | 0 | $981.22\times10^{-5}$ |
| $C_{phloem}(0)$ (g $g^{-1}$) | 0.13 | | 0.13 | |

$D_{stem}(0)$ and $D_{fruit}(0)$ were measured, whereas the other parameters were optimized via model calibration.

Fig. S1. Sap flow rates ($F_{stem}$) at level 1 (A) and 2 (B) and stem diameter ($D_{stem}$) at level 1 (C) and 2 (D) for plants S1 and S2. Level 1 is located below the canopy and level 2 is within the canopy. Data of plant S1 correspond to the left *y*-axis, data of plant S2 to the right.

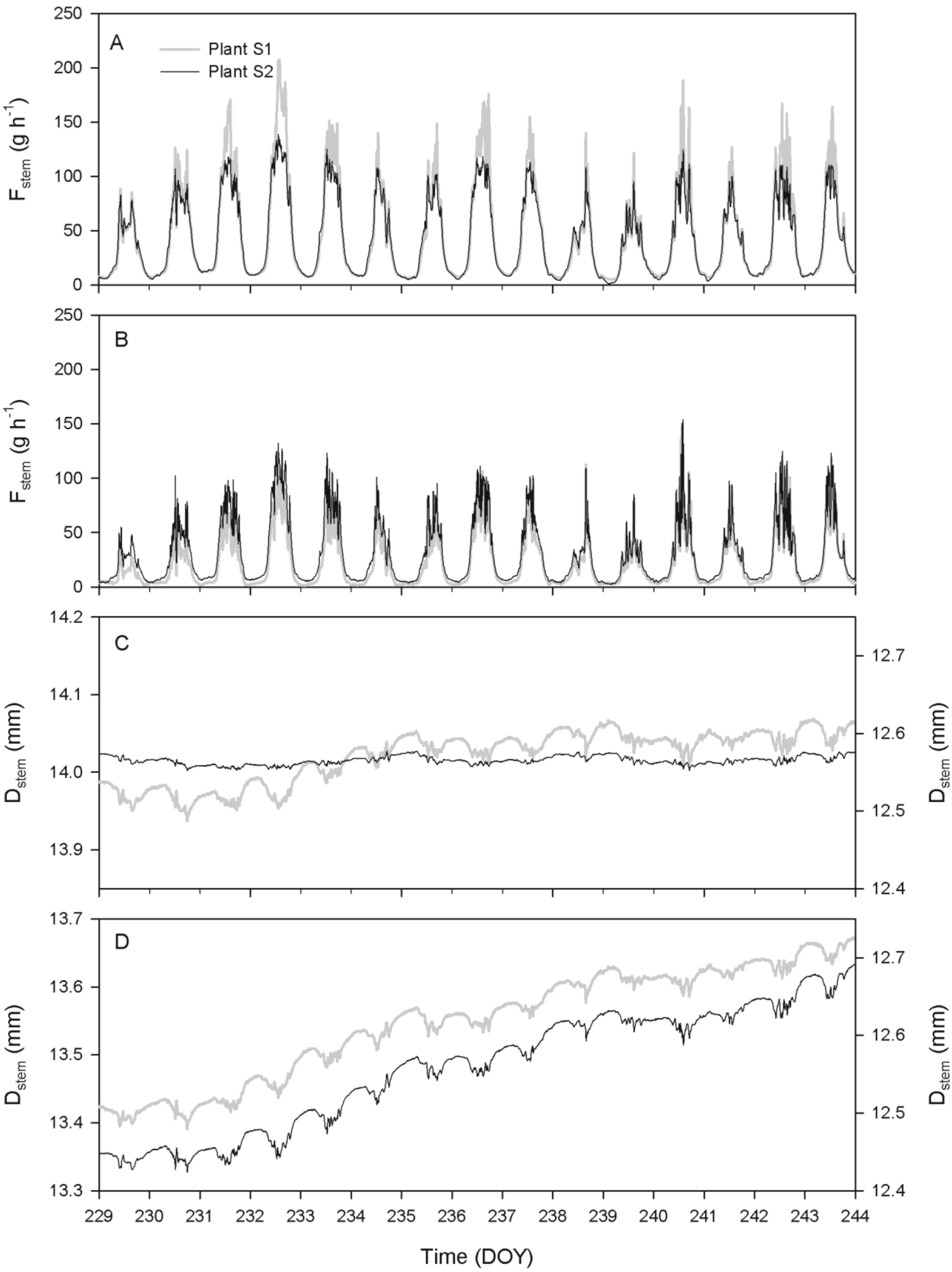

Fig. S2. Simulated and measured stem diameter ($D_{stem}$) for level 2 (~7 m from roots), simulated and measured fruit diameter on a truss located ~7 m from the roots ($D_{fruit}$) and simulated xylem water potential ($\Psi^{tot}_{xylem}$), phloem osmotic potential ($\Psi^{\pi}_{phloem}$) and phloem hydrostatic potential ($\Psi^{p}_{phloem}$) for plant S1 (A, C, E) and plant S2 (B, D, F) (DOY, day of the year).

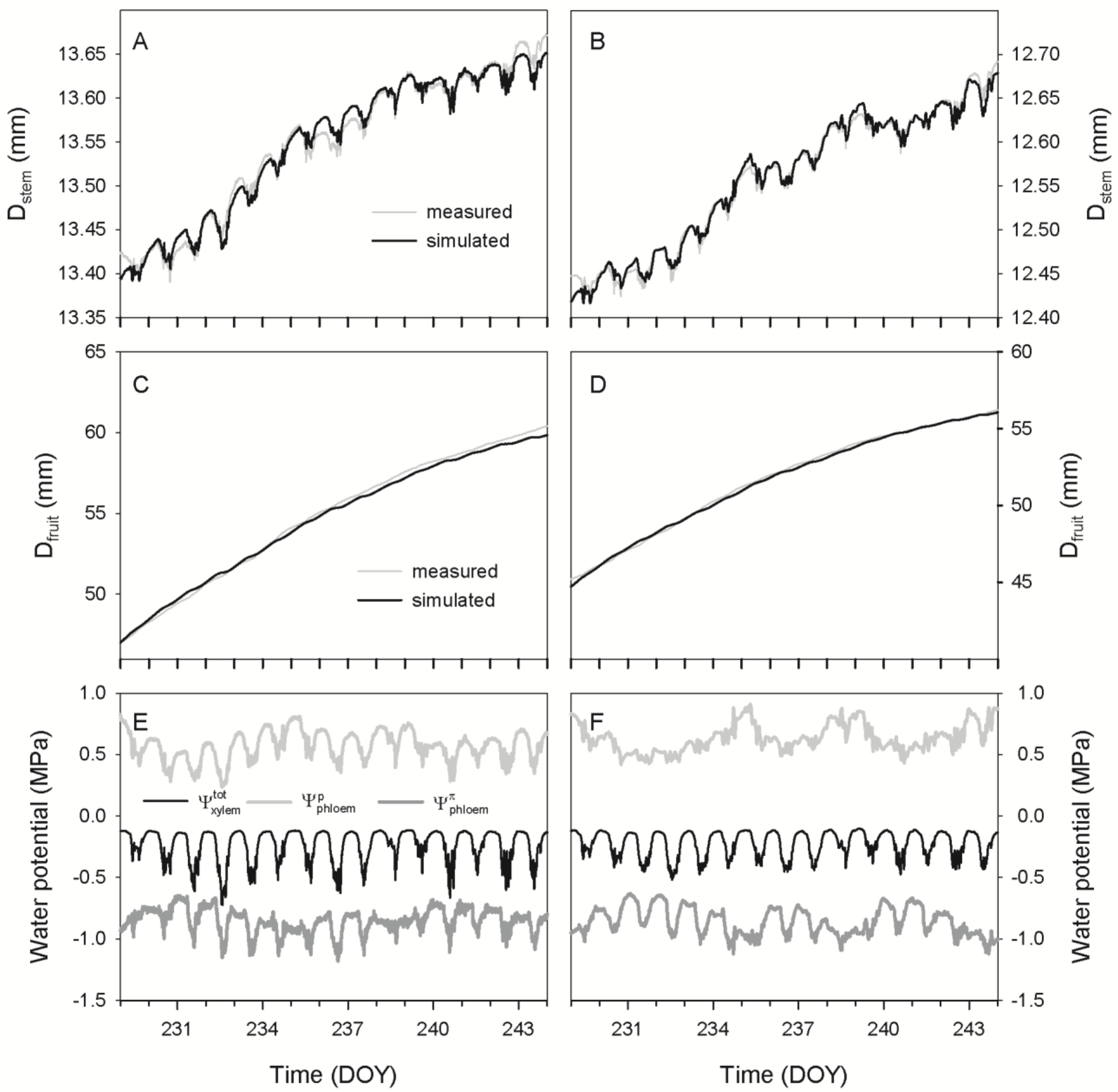

Fig. S3. Simulated daily loading and unloading rates using the *flow and storage* model for plant S1 (A) and plant S2 (B) (DOY: day of the year).