

## Supplementary Material

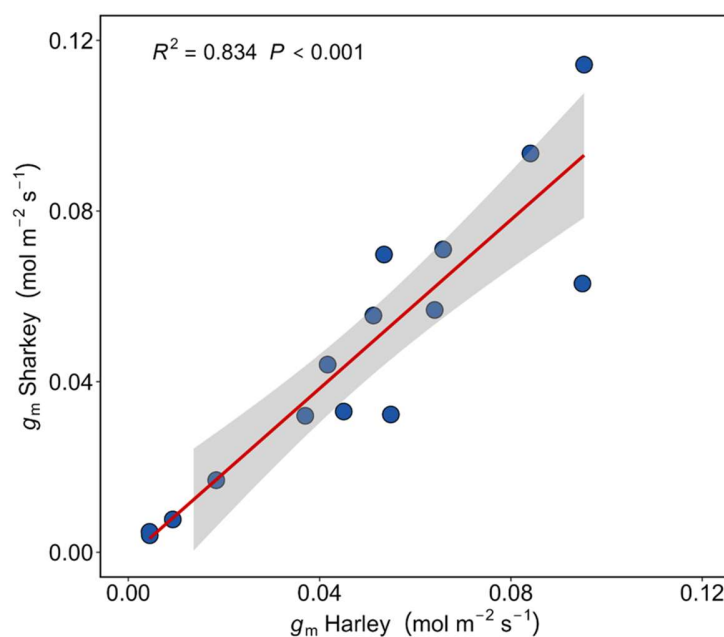


**Fig. S1.** Correlation analysis between  $g_m$  Sharkey and  $g_m$  Harley.  $g_m$  Sharkey was derived from fitting the  $A_n-C_c$  curve according to Sharkey's method, while  $g_m$  Harley was calculated using Harley's variable J method.

Table S1. Temperature-dependent changes in vapor pressure deficit (VPD) under the experimental conditions (RH = 60%).

| Temperature (°C) | VPD (kPa) |
|------------------|-----------|
| 25               | 1.37      |
| 30               | 1.74      |
| 35               | 2.27      |
| 40               | 2.84      |
| 45               | 3.32      |

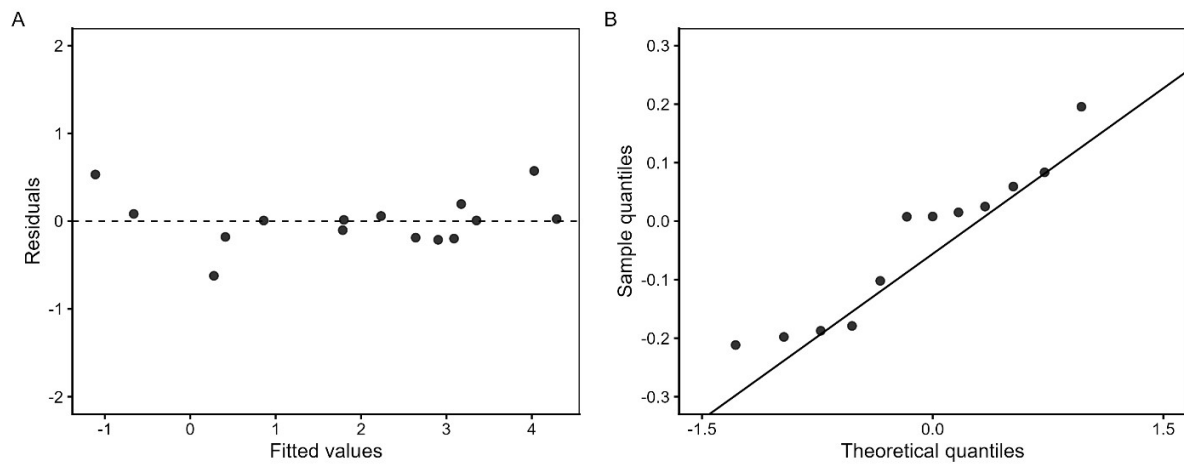


Figure S2. Diagnostic plots for the GAMM fitted to the relationship between net photosynthetic rate ( $A_n$ ) and temperature under  $150 \mu\text{mol mol}^{-1} \text{CO}_2$ . (A) Residuals versus fitted values; (B) Normal Q-Q plot.

Table S2. Significance analysis of temperature  $\times$   $\text{CO}_2$  ( $C_a$ ) interaction.

| Parameter                                                            | $F$    | $P$   |
|----------------------------------------------------------------------|--------|-------|
| $A_n$ ( $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ )        | 11.79  | <0.05 |
| $g_s$ ( $\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ )           | 4.51   | 0.051 |
| $g_m$ ( $\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ )           | 10.47  | <0.05 |
| iWUE ( $\mu\text{mol CO}_2\cdot\text{mol}^{-1} \text{H}_2\text{O}$ ) | 5.17   | <0.05 |
| $g_m/g_s$                                                            | 8.18   | <0.05 |
| $C_c/C_a$                                                            | 106.07 | <0.05 |
| $C_i/C_a$                                                            | 9.51   | <0.05 |
| $J_a$ ( $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ )        | 10.92  | <0.05 |
| NPQ                                                                  | 6.47   | <0.05 |
| $q_L$                                                                | 14.10  | <0.05 |
| $l_s$                                                                | 7.25   | <0.05 |
| $l_m$                                                                | 10.37  | <0.05 |
| $l_b$                                                                | 21.00  | <0.05 |

$F$ : test statistic for between-group differences;  $P$ : probability of observing the current results under the null hypothesis.

Table S3 Significance letters for each parameter under different  $C_a$  concentrations at the same temperature, based on Duncan's multiple range test.

| Temperature (°C) | $C_a$<br>( $\mu\text{mol}\cdot\text{mol}^{-1}$ ) | $A_n$<br>( $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) | $g_s$<br>( $\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) | $g_m$<br>( $\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) | iWUE<br>( $\mu\text{mol}\cdot\text{mol}^{-1}\cdot\text{H}_2\text{O}$ ) | $g_m/g_s$ | $C_c/C_a$ | $C_i/C_a$ | $J_a$<br>( $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) | NPQ | $q_L$ | $l_s$ | $l_m$ | $l_b$ |
|------------------|--------------------------------------------------|------------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------|-----------|-----------|-----------|------------------------------------------------------------------|-----|-------|-------|-------|-------|
| 25               | 150                                              | d                                                                | b                                                             | a                                                             | d                                                                      | a         | a         | c         | a                                                                | a   | b     | a     | c     | b     |
| 25               | 300                                              | c                                                                | b                                                             | a                                                             | c                                                                      | a         | ab        | d         | a                                                                | a   | a     | a     | d     | ab    |
| 25               | 500                                              | b                                                                | a                                                             | b                                                             | bc                                                                     | b         | ab        | b         | a                                                                | a   | a     | b     | b     | a     |
| 25               | 650                                              | ab                                                               | a                                                             | b                                                             | ab                                                                     | b         | b         | ab        | a                                                                | a   | a     | bc    | a     | a     |
| 25               | 800                                              | a                                                                | a                                                             | b                                                             | a                                                                      | b         | b         | a         | a                                                                | a   | a     | c     | a     | a     |
| 30               | 150                                              | d                                                                | b                                                             | ab                                                            | c                                                                      | b         | a         | a         | b                                                                | a   | b     | a     | c     | d     |
| 30               | 300                                              | c                                                                | b                                                             | a                                                             | b                                                                      | a         | b         | b         | ab                                                               | a   | a     | a     | d     | b     |
| 30               | 500                                              | b                                                                | a                                                             | bc                                                            | b                                                                      | c         | b         | a         | a                                                                | a   | a     | b     | b     | a     |
| 30               | 650                                              | ab                                                               | a                                                             | c                                                             | ab                                                                     | c         | b         | a         | a                                                                | a   | a     | b     | ab    | ab    |
| 30               | 800                                              | a                                                                | b                                                             | c                                                             | a                                                                      | c         | b         | a         | a                                                                | a   | a     | b     | a     | c     |
| 35               | 150                                              | d                                                                | ab                                                            | ab                                                            | d                                                                      | a         | a         | a         | c                                                                | a   | c     | a     | a     | b     |
| 35               | 300                                              | c                                                                | bc                                                            | a                                                             | cd                                                                     | a         | b         | b         | b                                                                | a   | b     | a     | a     | ab    |
| 35               | 500                                              | b                                                                | a                                                             | ab                                                            | bc                                                                     | a         | c         | b         | a                                                                | b   | a     | a     | a     | a     |
| 35               | 650                                              | ab                                                               | abc                                                           | ab                                                            | ab                                                                     | a         | cd        | b         | a                                                                | b   | a     | a     | a     | ab    |
| 35               | 800                                              | a                                                                | c                                                             | b                                                             | a                                                                      | a         | d         | b         | a                                                                | b   | a     | a     | a     | b     |
| 40               | 150                                              | c                                                                | a                                                             | b                                                             | d                                                                      | a         | a         | a         | d                                                                | a   | d     | a     | a     | c     |
| 40               | 300                                              | c                                                                | b                                                             | a                                                             | cd                                                                     | a         | b         | b         | cd                                                               | a   | c     | a     | b     | b     |
| 40               | 500                                              | b                                                                | a                                                             | a                                                             | bc                                                                     | a         | c         | b         | bc                                                               | ab  | b     | a     | b     | a     |
| 40               | 650                                              | ab                                                               | ab                                                            | a                                                             | ab                                                                     | a         | d         | b         | ab                                                               | b   | a     | a     | b     | ab    |
| 40               | 800                                              | a                                                                | b                                                             | ab                                                            | a                                                                      | a         | d         | b         | a                                                                | b   | a     | a     | b     | b     |
| 45               | 150                                              | d                                                                | d                                                             | a                                                             | b                                                                      | a         | a         | a         | c                                                                | d   | b     | a     | c     | a     |
| 45               | 300                                              | c                                                                | e                                                             | d                                                             | ab                                                                     | b         | b         | b         | b                                                                | e   | a     | b     | a     | c     |
| 45               | 500                                              | b                                                                | a                                                             | bc                                                            | ab                                                                     | b         | c         | b         | ab                                                               | c   | a     | b     | b     | b     |
| 45               | 650                                              | ab                                                               | b                                                             | b                                                             | a                                                                      | b         | c         | b         | ab                                                               | b   | a     | b     | b     | b     |
| 45               | 800                                              | a                                                                | c                                                             | cd                                                            | a                                                                      | b         | d         | b         | a                                                                | a   | a     | b     | ab    | bc    |

Table S4 Significance letters for each parameter under different temperature concentrations at the same  $C_a$ , based on Duncan's multiple range test.

| $C_a$<br>( $\mu\text{mol mol}^{-1}$ ) | Temperature<br>( $^{\circ}\text{C}$ ) | $A_n$<br>( $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) | $g_s$<br>( $\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) | $g_m$<br>( $\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) | iWUE<br>( $\mu\text{mol CO}_2\cdot\text{mol}^{-1}\text{H}_2\text{O}$ ) | $g_m/g_s$ | $C_o/C_a$ | $C_i/C_a$ | $J_a$<br>( $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) | $F_v/F_m$ | NPQ | $q_L$ | $l_s$ | $l_m$ | $l_b$ |
|---------------------------------------|---------------------------------------|------------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------|-----------|-----------|-----------|------------------------------------------------------------------|-----------|-----|-------|-------|-------|-------|
| 150                                   | 25                                    | a                                                                | a                                                             | a                                                             | a                                                                      | a         | d         | e         | c                                                                | a         | a   | c     | a     | bc    | b     |
| 150                                   | 30                                    | a                                                                | a                                                             | a                                                             | b                                                                      | ab        | cd        | d         | ab                                                               | a         | b   | b     | ab    | bc    | b     |
| 150                                   | 35                                    | b                                                                | a                                                             | a                                                             | c                                                                      | b         | bc        | c         | a                                                                | a         | bc  | a     | b     | b     | b     |
| 150                                   | 40                                    | c                                                                | a                                                             | b                                                             | d                                                                      | c         | b         | b         | bc                                                               | b         | bc  | a     | c     | a     | b     |
| 150                                   | 45                                    | d                                                                | a                                                             | b                                                             | e                                                                      | c         | a         | a         | d                                                                | c         | c   | c     | d     | c     | a     |
| 300                                   | 25                                    | a                                                                | a                                                             | a                                                             | a                                                                      | a         | b         | c         | c                                                                | a         | a   | bc    | a     | c     | a     |
| 300                                   | 30                                    | a                                                                | a                                                             | a                                                             | a                                                                      | ab        | b         | c         | ab                                                               | a         | b   | b     | a     | c     | a     |
| 300                                   | 35                                    | a                                                                | a                                                             | ab                                                            | a                                                                      | ab        | b         | c         | a                                                                | a         | b   | a     | a     | c     | a     |
| 300                                   | 40                                    | b                                                                | a                                                             | b                                                             | b                                                                      | b         | b         | b         | bc                                                               | b         | b   | a     | a     | b     | a     |
| 300                                   | 45                                    | c                                                                | a                                                             | c                                                             | c                                                                      | c         | a         | a         | d                                                                | c         | b   | c     | b     | a     | a     |
| 500                                   | 25                                    | ab                                                               | a                                                             | ab                                                            | a                                                                      | a         | b         | b         | c                                                                | a         | a   | b     | a     | c     | ab    |
| 500                                   | 30                                    | a                                                                | a                                                             | ab                                                            | a                                                                      | a         | b         | b         | b                                                                | a         | b   | b     | a     | bc    | ab    |
| 500                                   | 35                                    | a                                                                | a                                                             | a                                                             | a                                                                      | a         | b         | b         | a                                                                | a         | c   | a     | a     | bc    | bc    |
| 500                                   | 40                                    | b                                                                | a                                                             | b                                                             | a                                                                      | a         | b         | b         | ab                                                               | b         | bc  | a     | a     | ab    | c     |
| 500                                   | 45                                    | c                                                                | a                                                             | c                                                             | b                                                                      | b         | a         | a         | d                                                                | c         | bc  | b     | b     | a     | a     |
| 650                                   | 25                                    | a                                                                | a                                                             | b                                                             | a                                                                      | ab        | b         | b         | c                                                                | a         | a   | b     | a     | a     | b     |
| 650                                   | 30                                    | a                                                                | a                                                             | ab                                                            | a                                                                      | ab        | b         | bc        | bc                                                               | a         | b   | b     | a     | a     | b     |
| 650                                   | 35                                    | a                                                                | a                                                             | a                                                             | a                                                                      | a         | b         | c         | a                                                                | a         | c   | a     | a     | a     | bc    |
| 650                                   | 40                                    | a                                                                | a                                                             | b                                                             | a                                                                      | a         | b         | bc        | ab                                                               | b         | c   | a     | a     | a     | c     |
| 650                                   | 45                                    | b                                                                | a                                                             | c                                                             | b                                                                      | b         | a         | a         | d                                                                | c         | b   | b     | b     | a     | a     |
| 800                                   | 25                                    | a                                                                | a                                                             | b                                                             | ab                                                                     | ab        | ab        | ab        | b                                                                | a         | a   | c     | bc    | ab    | a     |
| 800                                   | 30                                    | a                                                                | a                                                             | ab                                                            | a                                                                      | ab        | bc        | bc        | b                                                                | a         | a   | c     | ab    | ab    | b     |
| 800                                   | 35                                    | a                                                                | a                                                             | a                                                             | a                                                                      | a         | c         | c         | a                                                                | a         | b   | b     | a     | b     | bc    |
| 800                                   | 40                                    | a                                                                | a                                                             | ab                                                            | a                                                                      | a         | c         | c         | a                                                                | b         | b   | a     | ab    | ab    | c     |
| 800                                   | 45                                    | b                                                                | a                                                             | c                                                             | b                                                                      | b         | a         | a         | c                                                                | c         | a   | c     | c     | a     | a     |