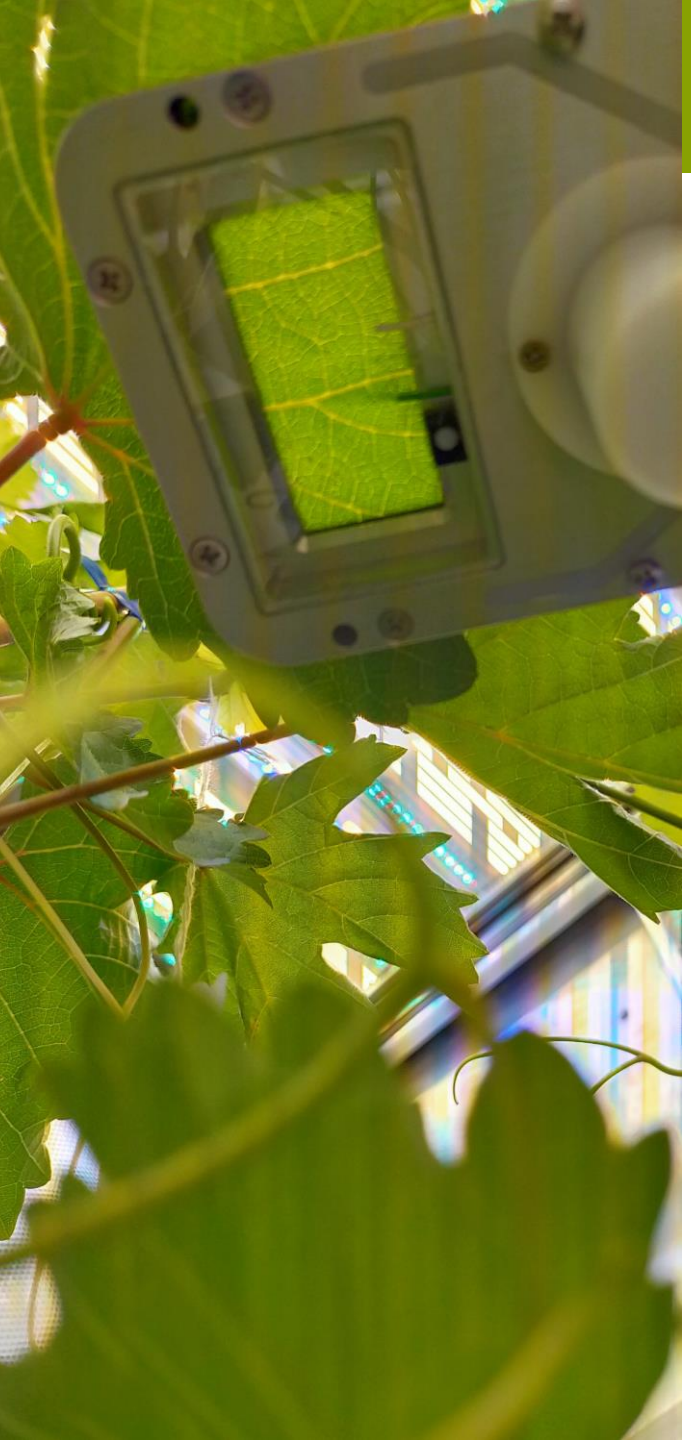

Interactive effects of high temperatures and drought on grapevine physiology during a simulated heat wave

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+ water deficit

1) Understand interactive effects of heat and drought stress on grapevine gas exchange and fluorescence at leaf level

Hypothesis: the combination of these two stressors amplifies the negative effects of heat and drought in a non-additive fashion

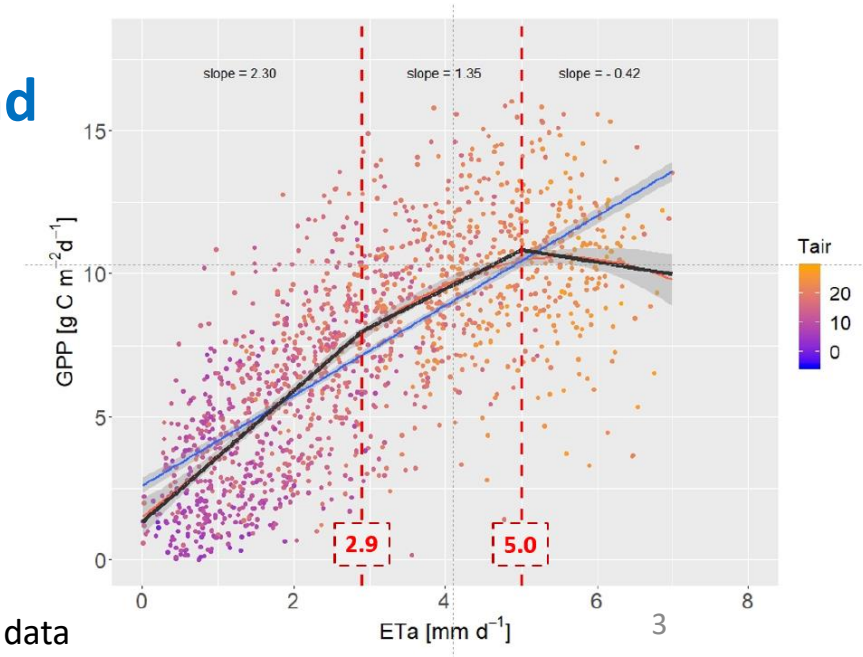
+ water deficit

1) Understand interactive effects of heat and drought stress on grapevine gas exchange and fluorescence at leaf level

Hypothesis: the combination of these two stressors amplifies the negative effects of heat and drought in a non-additive fashion

2) Investigate possible decoupling between photosynthesis and transpiration at leaf level during a heat wave

Hypothesis: Tight stomatal control in response to low soil water potential (isohydric behavior) prevents decoupling



Apple orchard. Zanotelli et al., unpublished data

Heat wave simulation and drought treatment in grapevine potted plants

d

- Four fully controlled environmental chambers
- 2-year-old grapevine plants cv. Sauvignon/SO4 (4 per chamber)
- Factorial experiment
  - Heat / control
  - Well watered / dry plants
- 6 replicates per treatment
- Gas exchange: GFS-3000, Walz GmbH
- Fluorescence system: Imaging-PAM Mini, Walz GmbH
- Lysimeters
- Soil water content and potential sensors

TREATMENTS:
CW = control (no heated) well watered
HW = heat well watered
CD = control dry
HD = heat dry

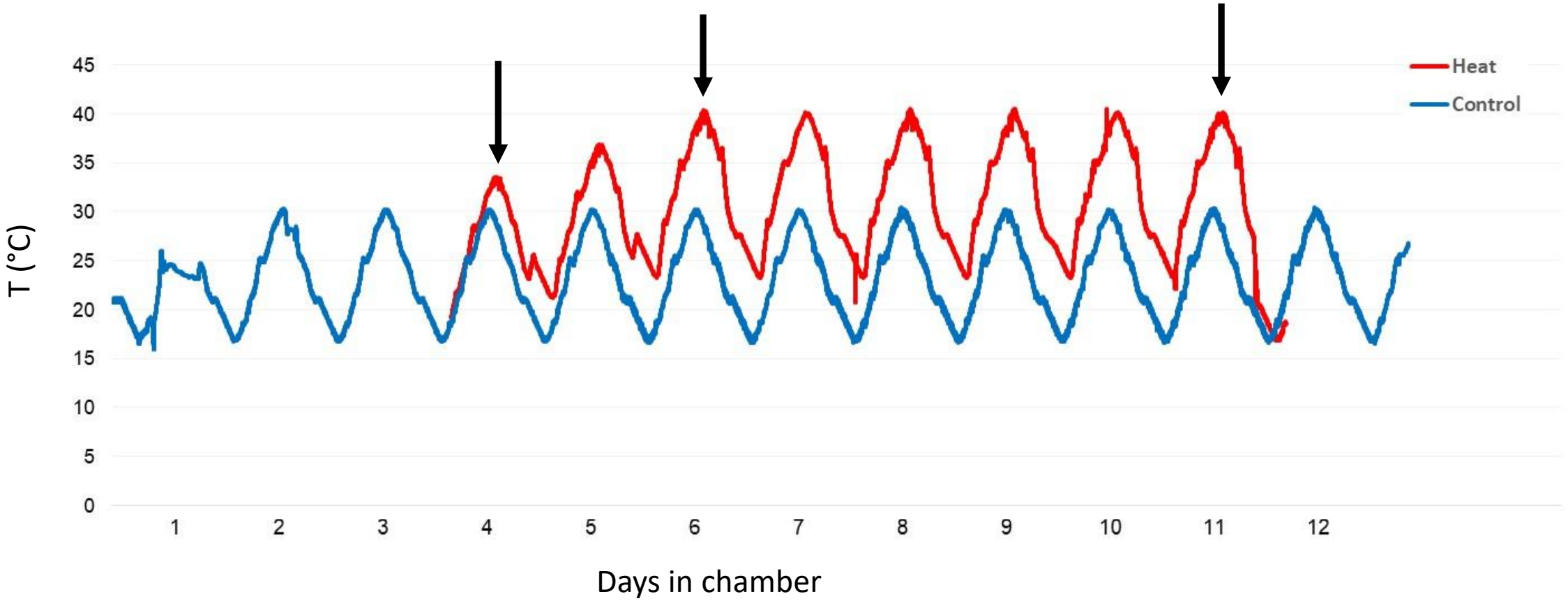


Fig. 1: Air temperature in heat versus control chambers throughout the experiment.

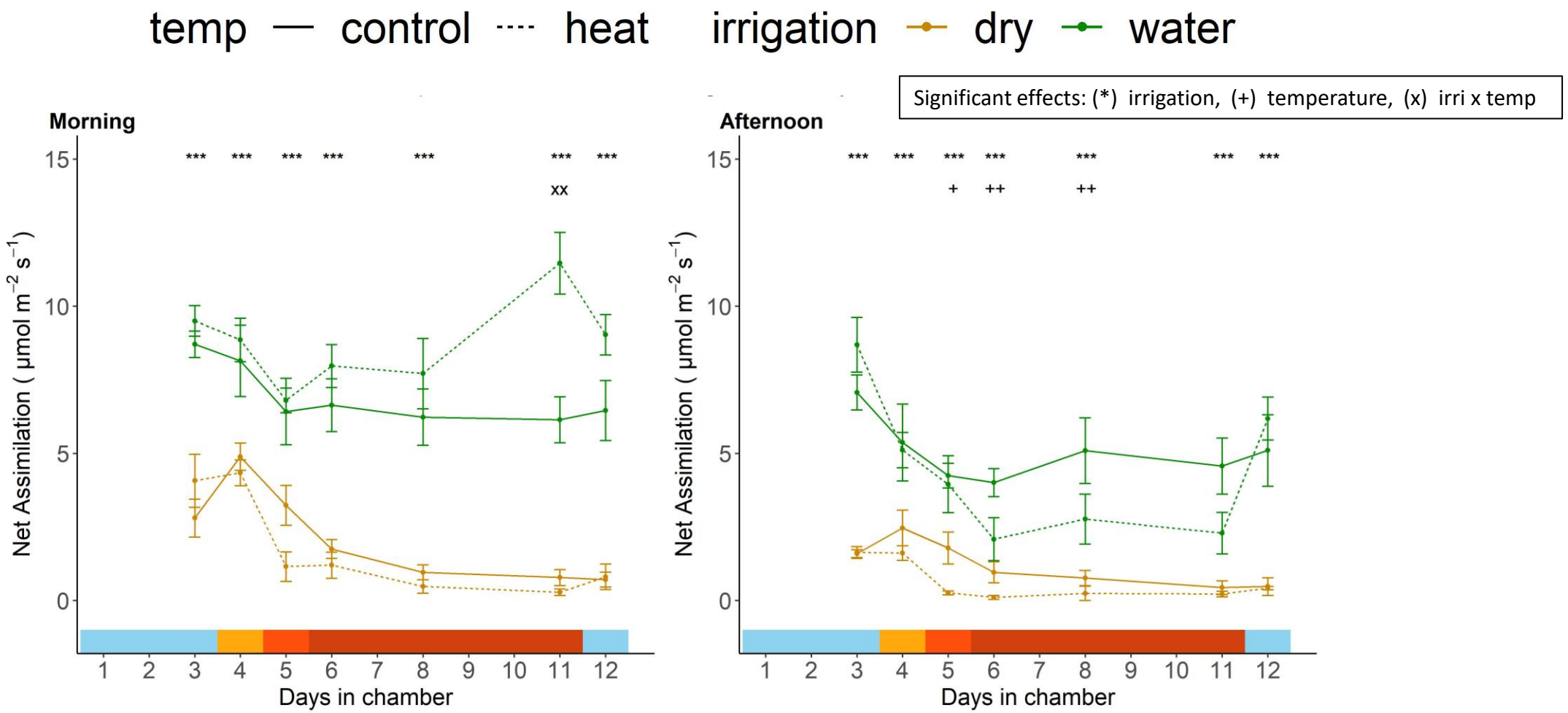


Fig. 2: Leaf photosynthesis measured during the morning (10 am-12 pm) and afternoon (3 pm-5 pm) across the experiment. Symbols *, +, x: represent significant effect of irrigation, temperature, and the interaction between the two factors. One, two and three symbols indicate significance level: P< 0.05, <0.01 and <0.001 respectively.

Only well watered plants recovered photosynthesis and yield of PSII at the end of the heat wave

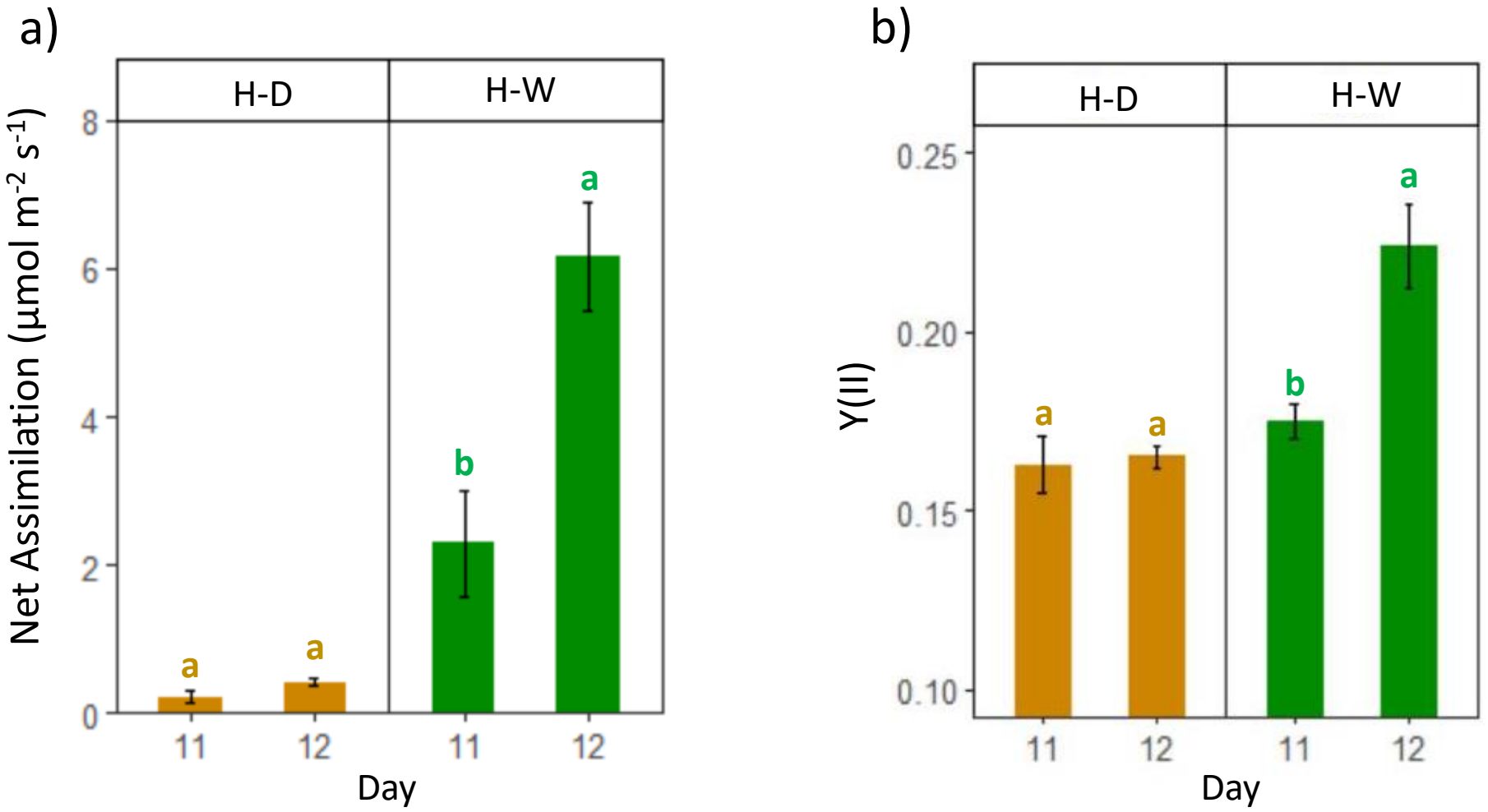


Fig. 3: Leaf photosynthesis (a) and yield of photosystem II (b) measured in the afternoon (3 pm-5 pm) at the end of the heat wave (day 11 to 12).

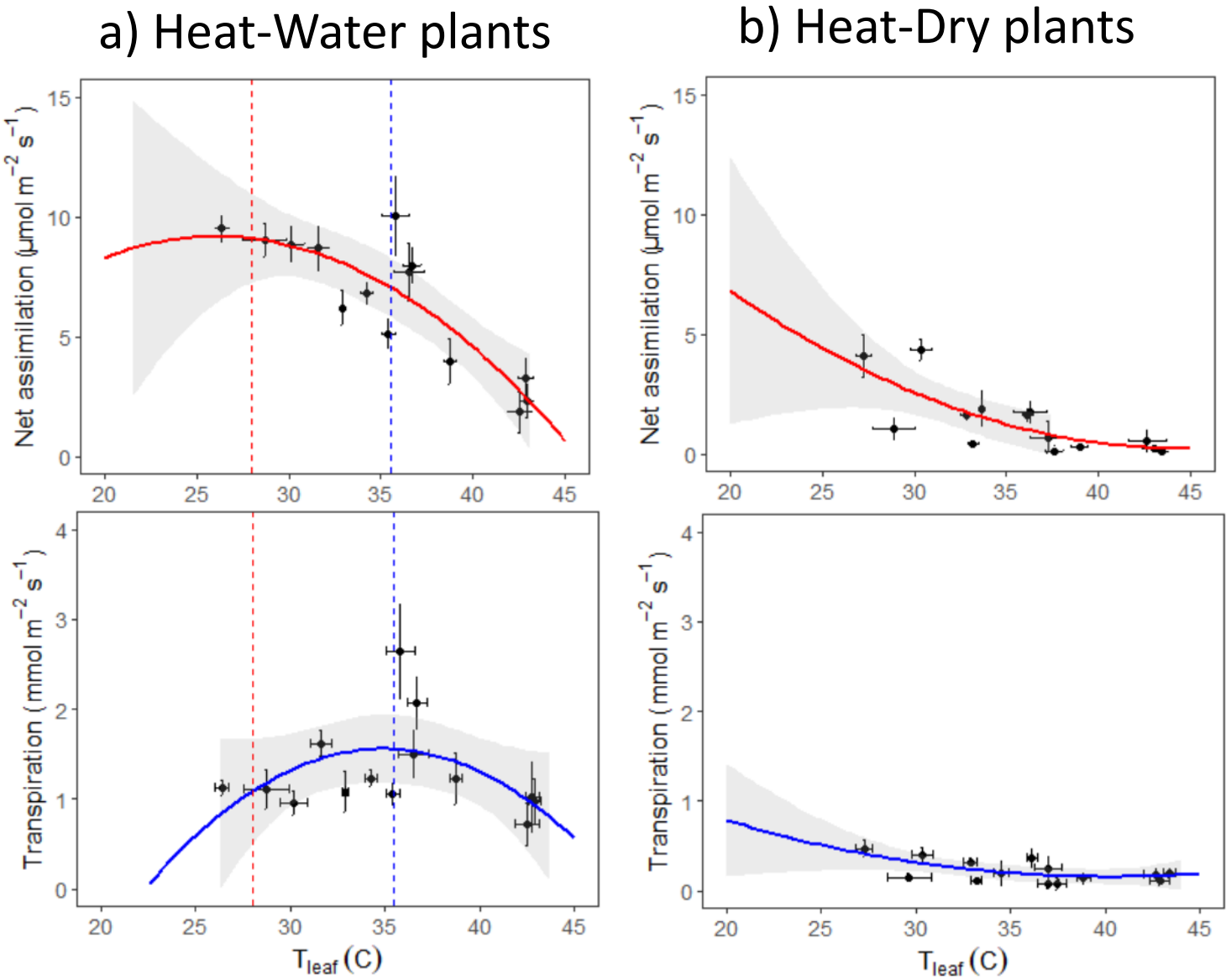


Fig. 4: Relationship between leaf photosynthesis (top) and transpiration (bottom) with leaf temperature in heat-water (a) and heat-dry plants (b). Vertical dashed lines indicate the maximum in photosynthesis (red) and transpiration (blue) curves. Averages ± se.

1) Interactive effects of heat and drought stress

- Stronger effect of drought than heat on Pn
- Well-watered plants were affected by heat wave during the afternoon, but not during the morning
- The heat stress, superimposed on the drought stress, did not further aggravate the effects on assimilation (effects not additive).
- Well-watered plants were able to fully recover Pn at the end of the 6-day heat wave.

1) **Interactive effects of heat and drought stress**
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   - The heat stress, superimposed on the drought stress, did not further aggravate the effects on assimilation (effects not additive).
   - Well-watered plants were able to fully recover Pn at the end of the 6-day heat wave.

2) **Decoupling between photosynthesis and transpiration at leaf level during a heat wave**
   - The decoupling was observed only in watered plants, from 28 to 36°C approximately
   - At Tleaf > 36 °C both photosynthesis and transpiration decreased
   - Further analyses: stomatal conductance responses to temperature

Thank you!

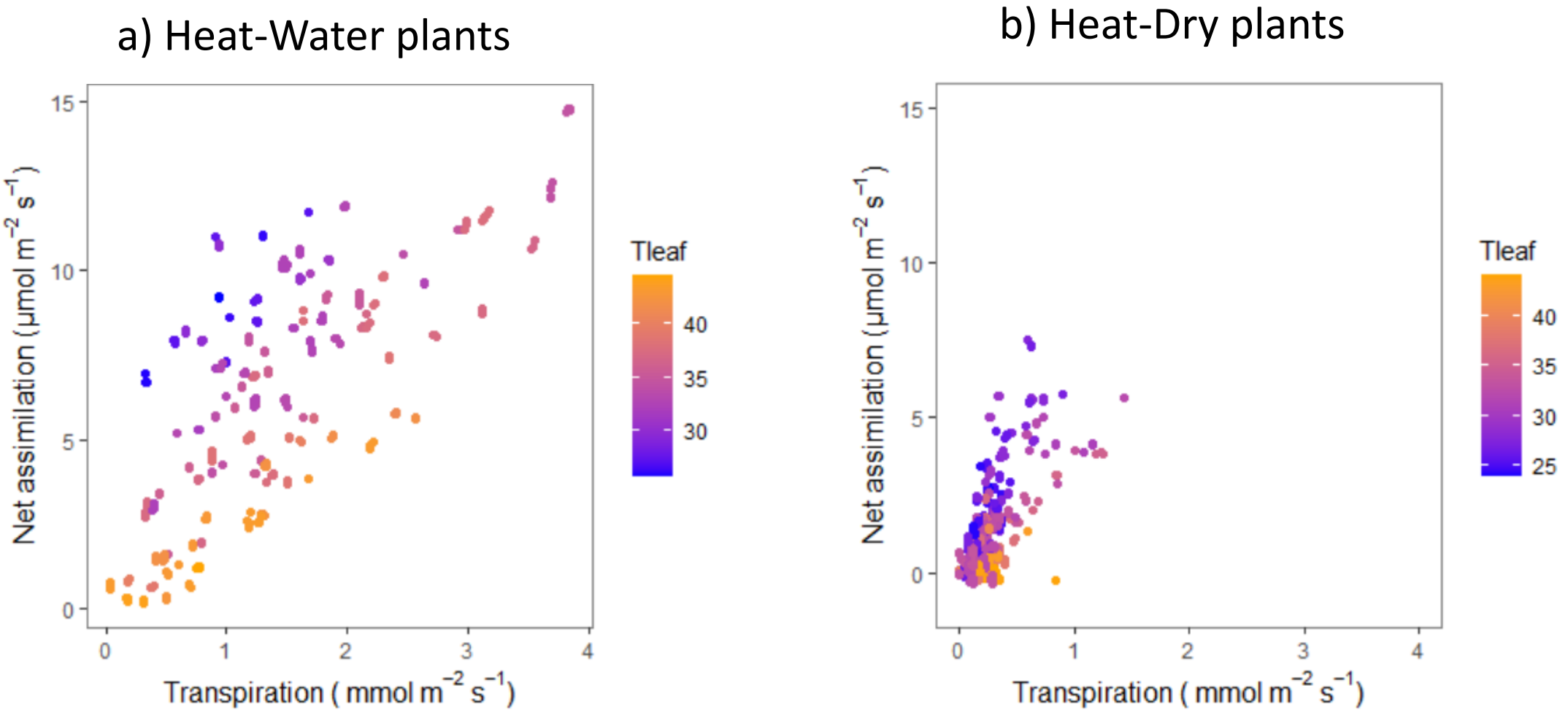
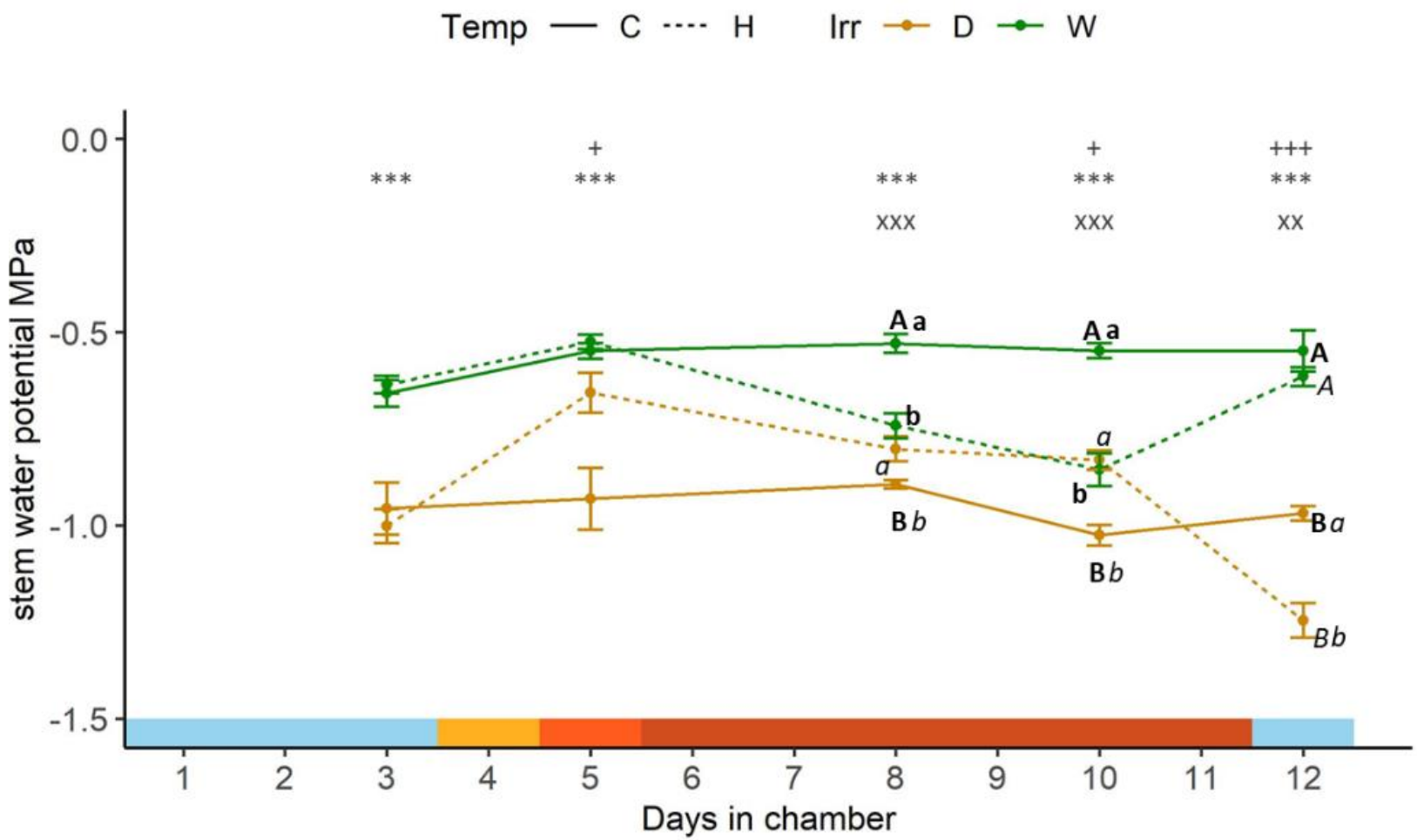


Fig. xxx: Relationship between leaf photosynthesis and transpiration in heat-water (a) and heat-dry plants (b). Colors represent leaf temperature.


Temp C H
Irr D W
stem water potential MPa
0.0
-0.5
-1.0
-1.5
***
+
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+
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A a
A a
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a
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8
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10
11
12
Days in chamber

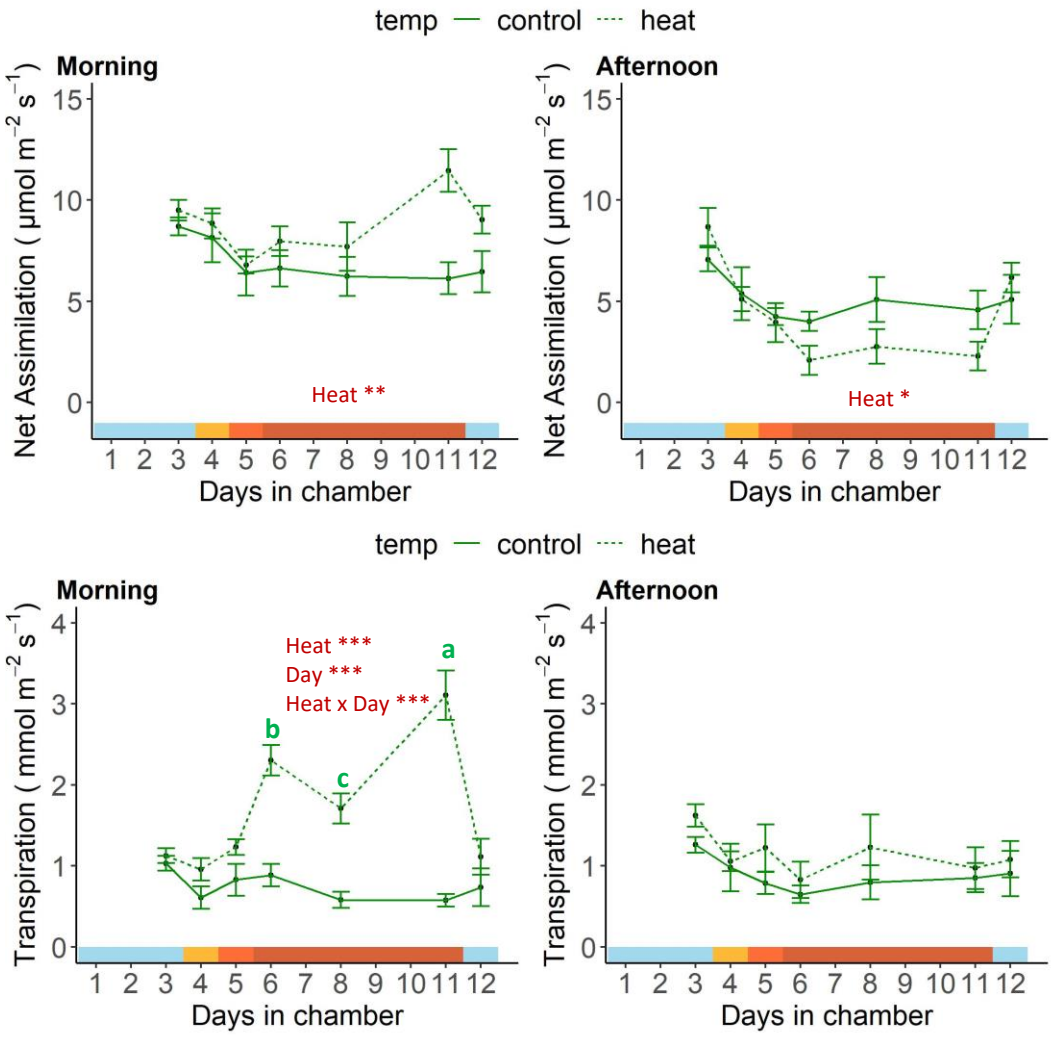

Fig. xxx: Leaf photosynthesis and transpiration in the morning and afternoon across the experiment in **WATER** plants (control and heat)

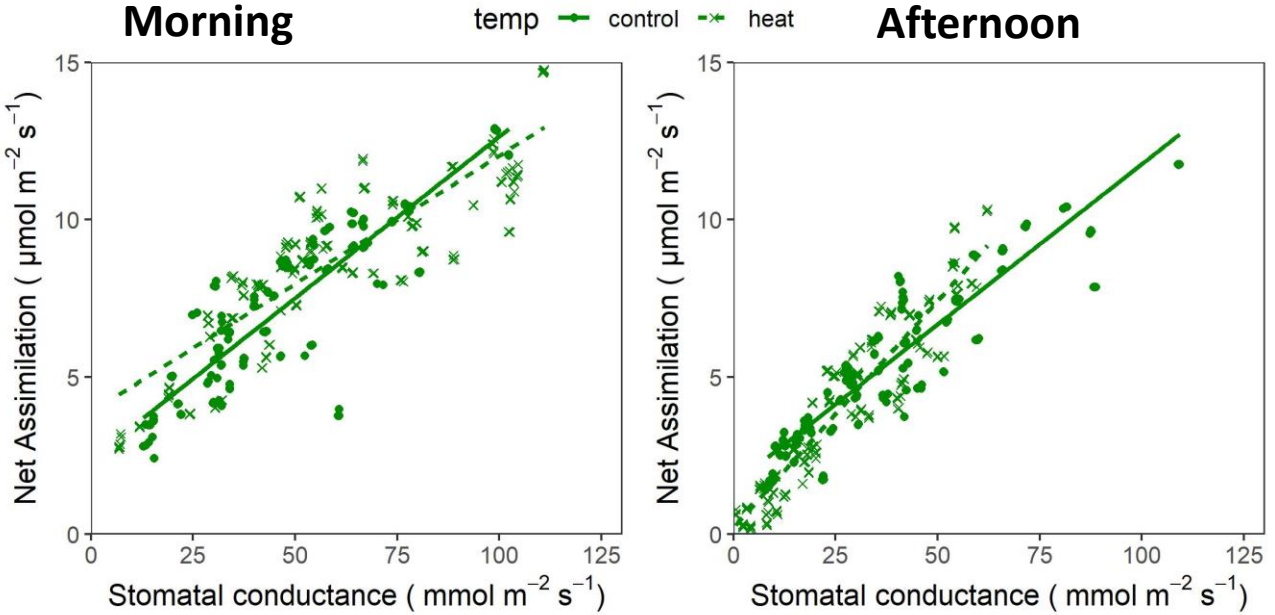

Fig. xxx: Relationship between leaf photosynthesis and stomatal conductance in **WATER** plants (control and heat)