

Effects of Day and Night Temperature on Rice Photosynthesis

Kristian Johnson, Sabine Stuerz, Marc Schmierer, Folkard Asch

Introduction

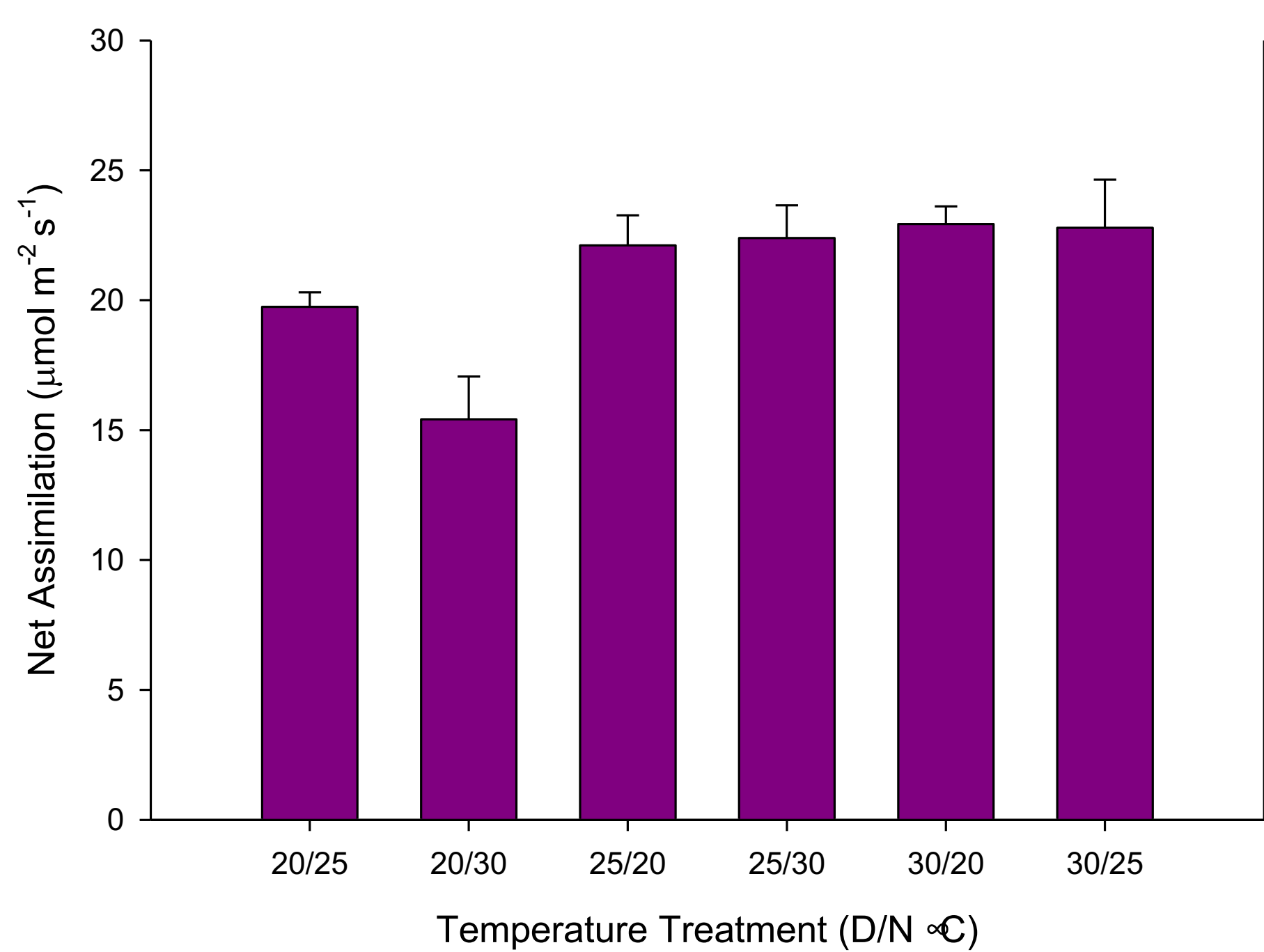
Daily minimum night temperatures have increased faster than daily maximum temperatures. In rice (*Oryza sativa*), higher night temperatures have been shown to increase respiration, without increasing biomass accumulation, but decrease spikelet fertility and yield. How rice acclimates its sink-source relationships to moderate shifts in night temperature is not entirely clear, but is fundamental to understanding the potential impacts of a changing climate on a staple half the world depends on.



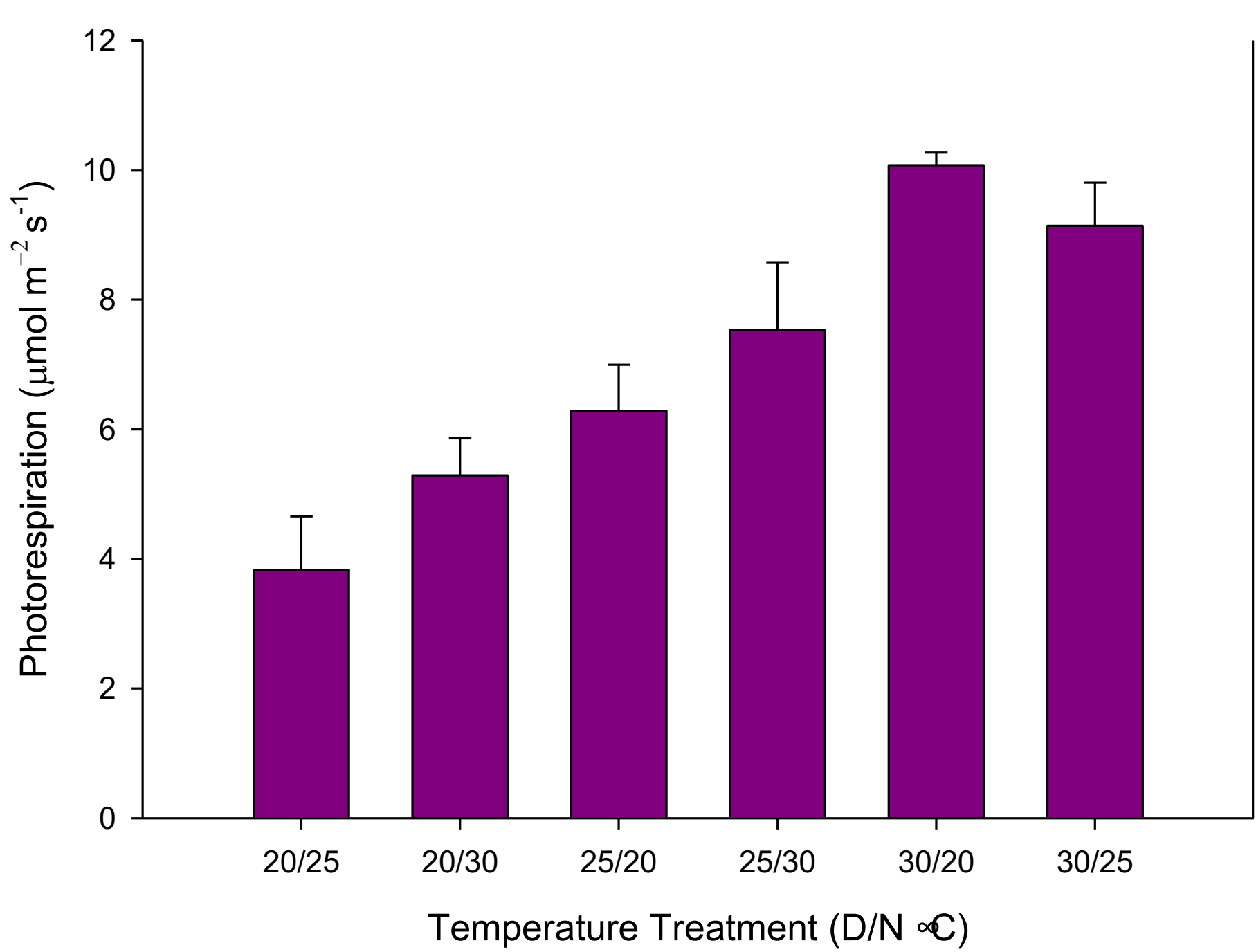
Conclusions and Outlook

- Higher night temperatures:
 - Shift sucrose export and utilisation to the night-time
 - Increase photosynthetic efficiency by reducing photorespiration
 - Increases photosynthetic tolerance at higher temperatures
- Further refinement of the curve-fitting algorithm for determining mesophyll conductance and photorespiration

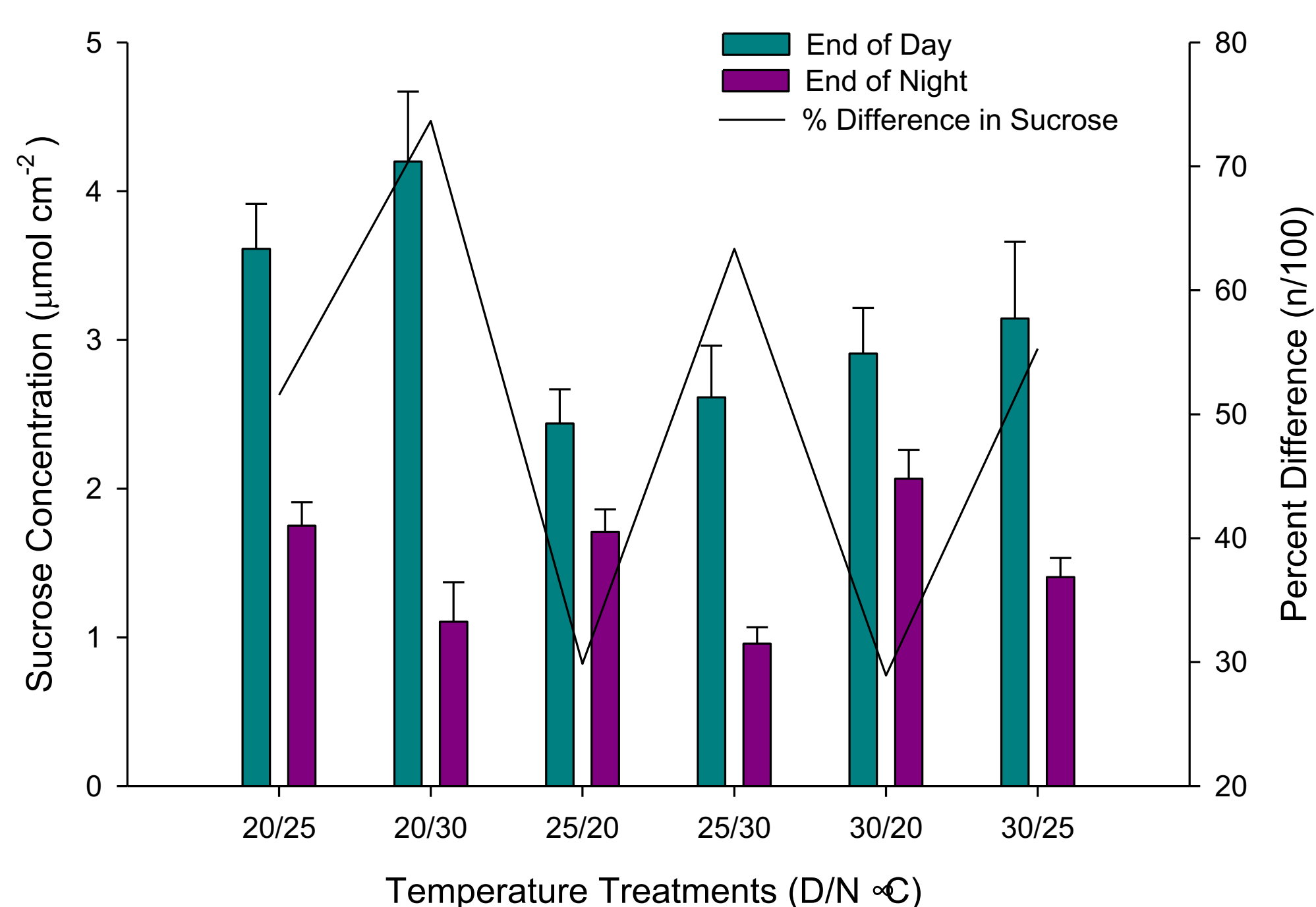
Results and Discussion



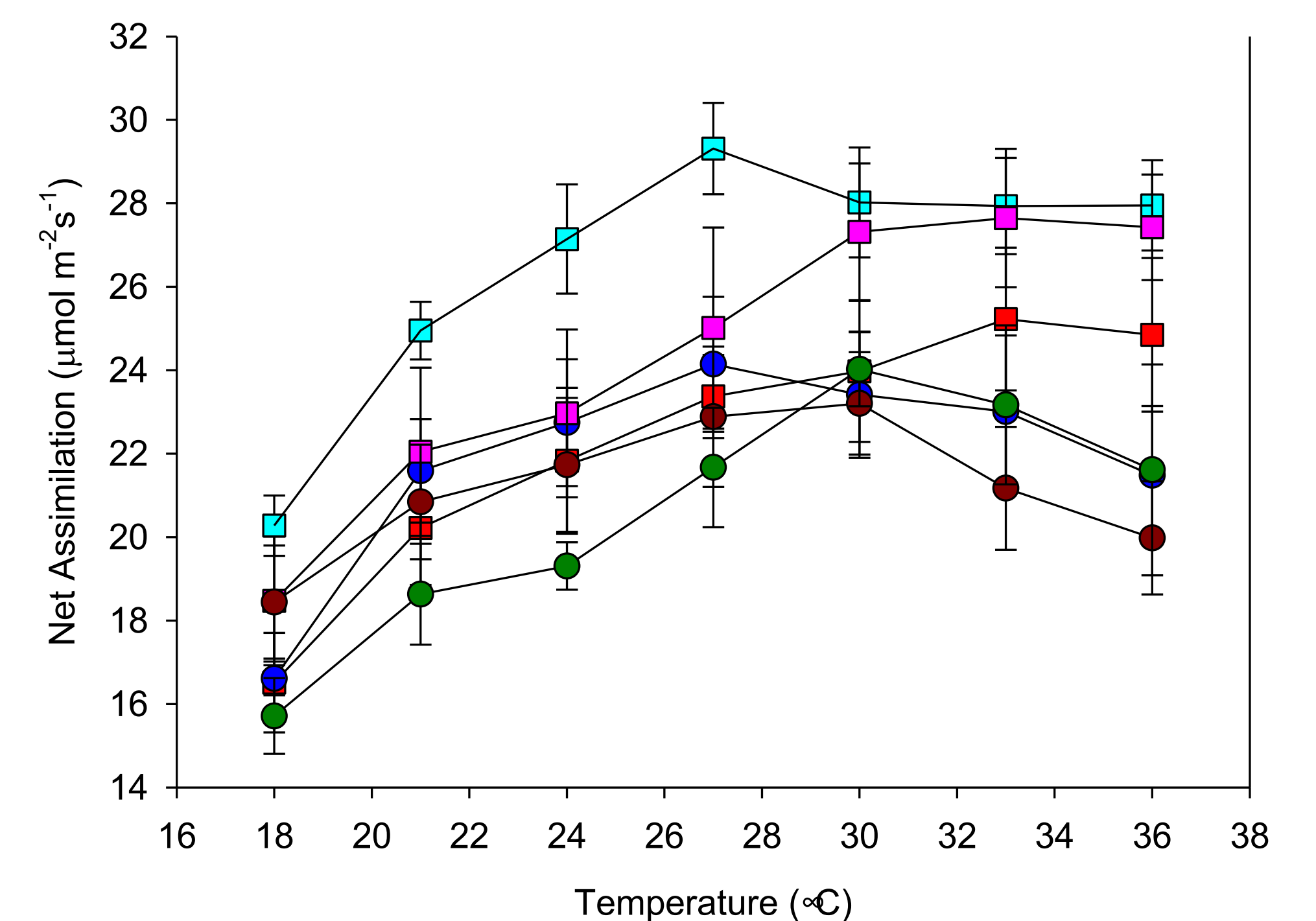
- Assimilation rates were lower at low day temperature.
- ❖ Higher temperature likely leads to increased assimilation rate due to an increase in enzyme activity.



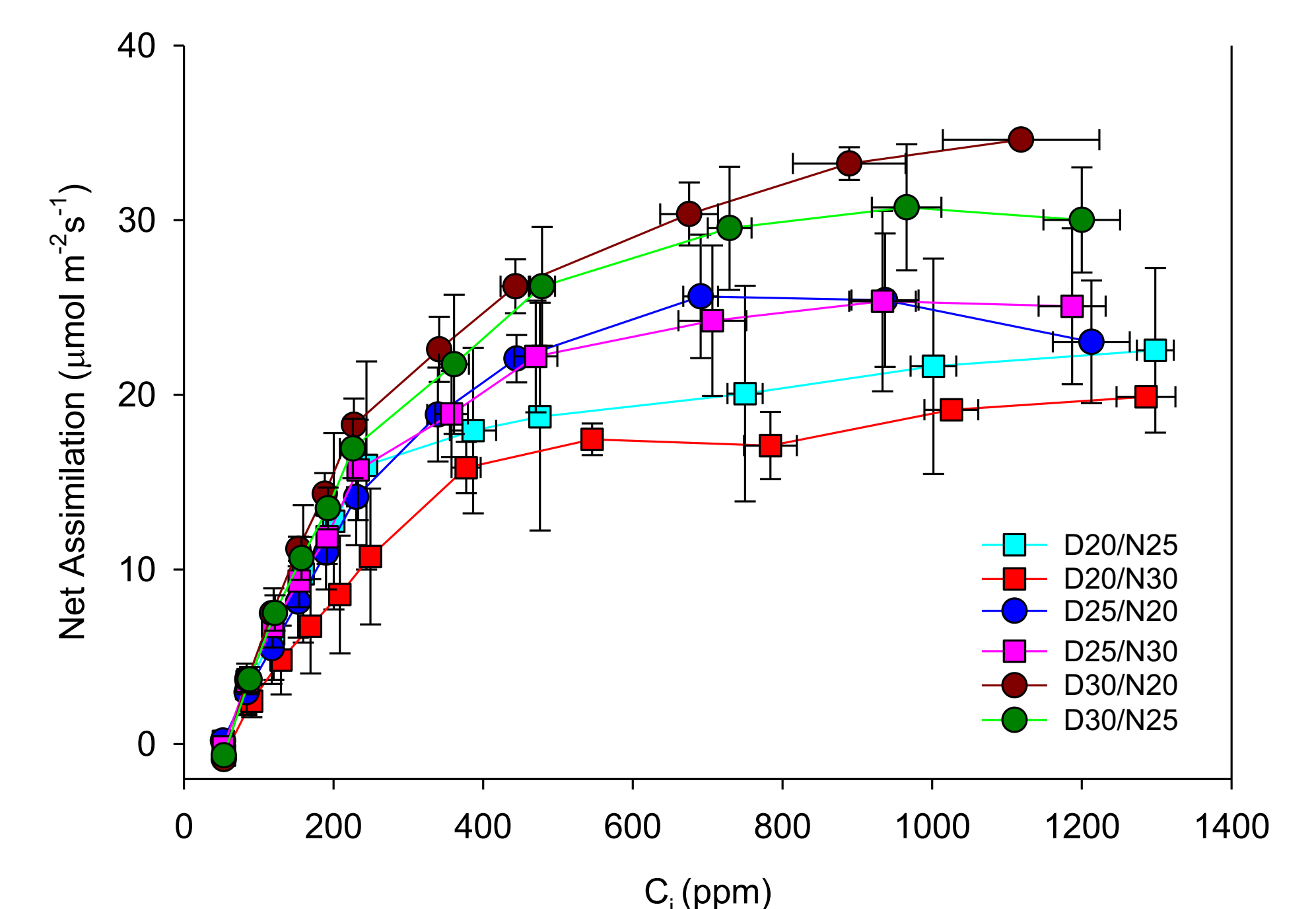
- Photorespiration was highest at higher day temperatures.
- However, it was lowest at higher night temperatures.
- ❖ Night temperature positively influences photosynthetic efficiency.



- Higher night temperatures led to higher sucrose levels at 'end of day'
- The difference between sucrose levels was greatest at higher night temperatures.
- ❖ The larger differences in sucrose indicate a shift towards growth during the night in higher temperature nights.



- Assimilation decreased above 30°C in plants grown at higher day than night temperatures.
- ❖ Higher night temperatures increase photosynthetic tolerance to higher temperatures.



- Assimilation rates across C_i levels were highest during higher day temperatures.
- ❖ Assimilation rate is predominantly driven by enzymatic efficiency, which increases with temperature.

Materials and Methods

5-week-old IR64 rice plants in hydroponic solution were exposed to 6 different temperature treatments for two weeks in a growth chamber. After 7 days of acclimation, photosynthetic parameters were measured, A-C_i curves, and assimilation, as well as temperature curves at 3°C steps. Photorespiration was measured as the difference between 0 and 21% O₂ at CO₂ 300 (ppm). Leaf samples for carbohydrate and chlorophyll were taken at end of day, end of night, as well as a leaf shaded for 48 hrs.

