Elevated CO_2 alleviates **Heat stress** susceptibility in Wheat

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Introduction:

The main objective of the study was to investigate the effect of heat stress on photosynthetic performance and carbohydrate metabolism in two wheat cultivars of different origin, and to investigate whether elevated CO_2 is able to mitigate the effects of heat stress. We present data for the most susceptible wheat cultivar (of the two) subjected to three days of heat stress at tillering and anthesis.

Materials and methods:

The plants were grown in ambient (400 µl l^{-1}) and elevated (800 µl l^{-1}) CO_2 with a day/night temperature of 15/10° C. At the growth stages of tillering and anthesis, the plants were subjected to heat stress of 40° C for three continuous days. Photosynthetic parameters, maximum quantum efficiency of photosystem II (F_v/F_m) and leaf carbohydrate contents were analysed before and during the stress as well as after one day of recovery.

Fig. 1: The susceptible wheat cultivar grown in ambient CO_2 (A) and elevated CO_2 (B) after exposure to heat stress at three developmental stages (tillering, booting and anthesis) and photographed at the grain filling stage.

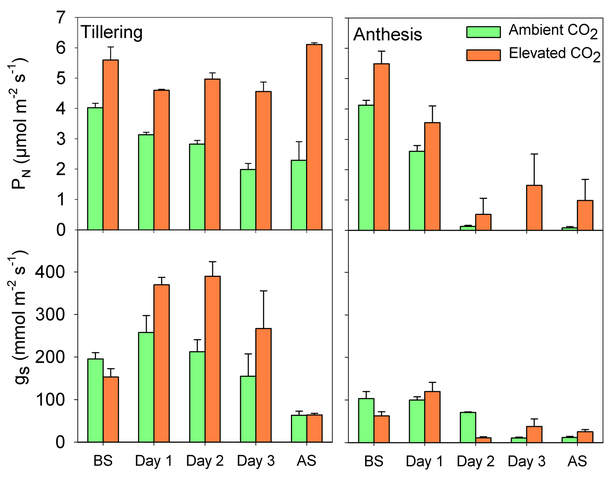

Fig. 2: Net photosynthesis (P_N) and stomatal conductance (g_s) before heat stress (BS), during three days of heat stres (days 1-3) and after heat stress (AS) at tillering and anthesis.

Results:

- Heat stress reduces P_N and F_v/F_m, but increase the accumulation of leaf sucrose
- Plants grown in elevated CO_2 maintain a higher g_s, P_N and F_v/F_m
- Plants grown in elevated CO_2 accumulate fructose and glucose during heat stress
- Plants were more susceptible to heat stress at anthesis than at tillering

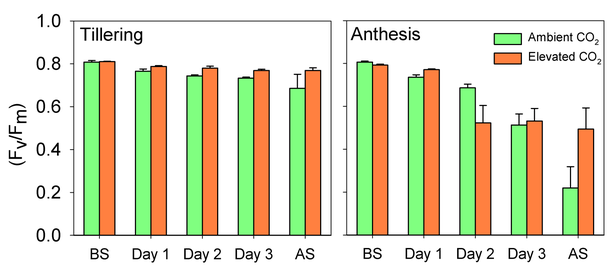

Fig. 3: Maximum quantum effeciency of PSII (F_v/F_m) before heat stress (BS), during three days of heat stres (days 1-3) and after heat stress (AS) at tillering and anthesis

Conclusion:

- Heat stress tolerance in wheat is related to the phenological stage, and can be alleviated by elevated CO_2, partly due to a higher temperature optimum for photosynthesis and better stomata regulation.
- Leaf sucrose accumulation is aligned with maintenance of photosynthesis and possibly caused by limited carbohydrate partitioning to other plant parts.
- Leaf hexose accumulation can lead to osmotic adjustment and explain better heat stress tolerance at tillering.

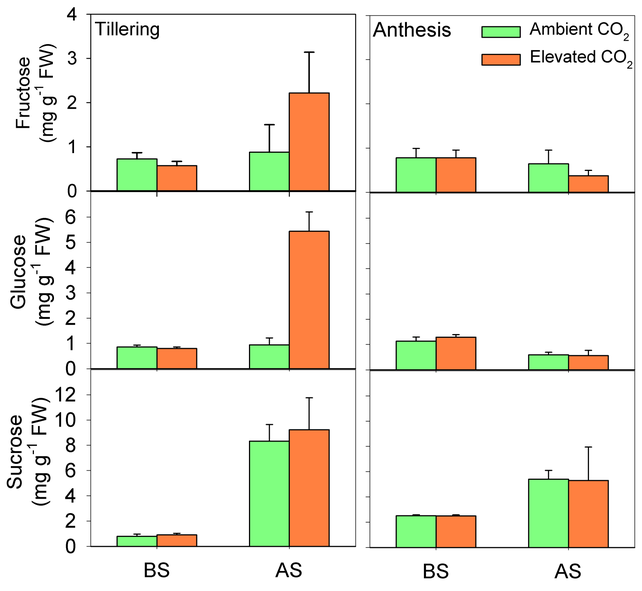

Fig. 4: Leaf sugar concentrations before heat stress (BS) and after heat stress at tillering and anthesis

References:

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