Variable O3 episodes' influence on yield and physiology in old and new wheat varieties under a climate change regime with elevated temperature and CO2 levels

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Variable O_3 episodes' influence on yield and physiology in old and new wheat varieties under a climate change regime with elevated temperature and CO2 levels.

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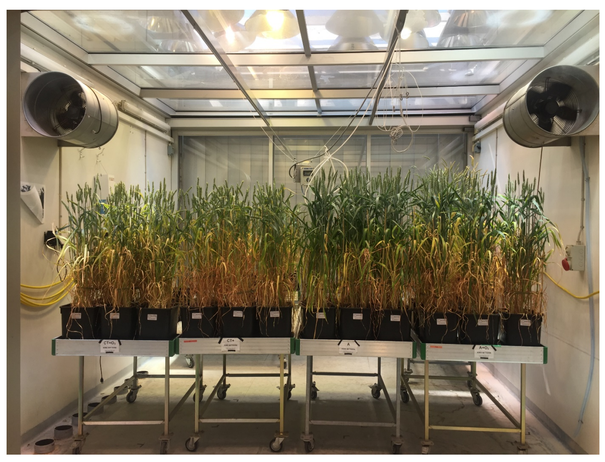
Background

The impact of O_3 on crop yield is a concern at present climatic conditions and effects of climate change will aggravate this impact (Ainsworth, 2017; Tian et al., 2016). Responses to changes in climatic factors are results of interactions and within plant regulation following the changes in one or more of these factors but also depends on genetic predispositions (Albert et al., 2011; Clausen et al., 2011; Ingvordsen et al., 2015; Shaw et al., 2002).

RERAF Facility

The plant growth facility, RERAF, includes six 75 m^3 airtight chambers providing precision control of various climatic factors and air pollutants to mimic the impact of potential future climates and pollutant levels on plant growth.



Materials and methods

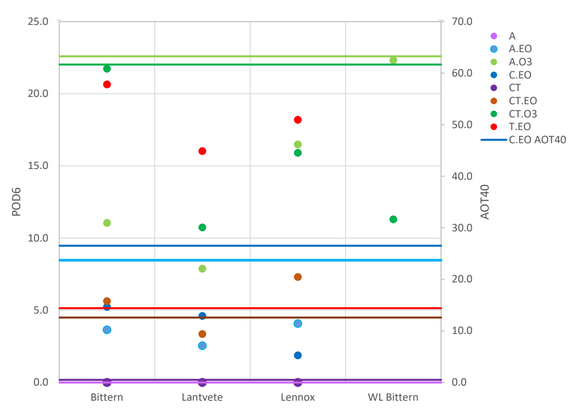
Of three spring wheat varieties five pots with 12 seeds were grown under conditions shown in Table X; two modern varieties: *Lennox* and *KWS Bittern*, and a landrace variety, *Lantvete*.

Pots were watered based on chamber temperature; pots at ambient started at 5200 g and ended at 7000 g over their growth cycle, while pots in warmer conditions received 200 g more water throughout the cycle. Water limited *KWS Bitterns* in treatments A.O3 and CT.O3 were at all times watered to a total weight of 5400 g and 5600 g respectively.

The climate **treatments** were combinations of two levels of temperature and CO2 and three O_3 regimes.

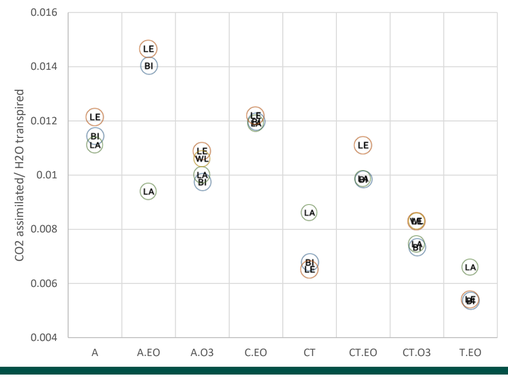
19/12 °C	17/24 °C
400 ppm	700 ppm
No O3	80-100 ppb

Treatment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A																
A.E0																
A.O3																
C.EO																
CT																
CT.E0																
CT.O3																
T.EO																

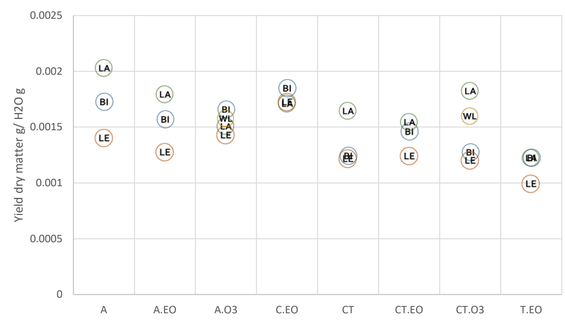


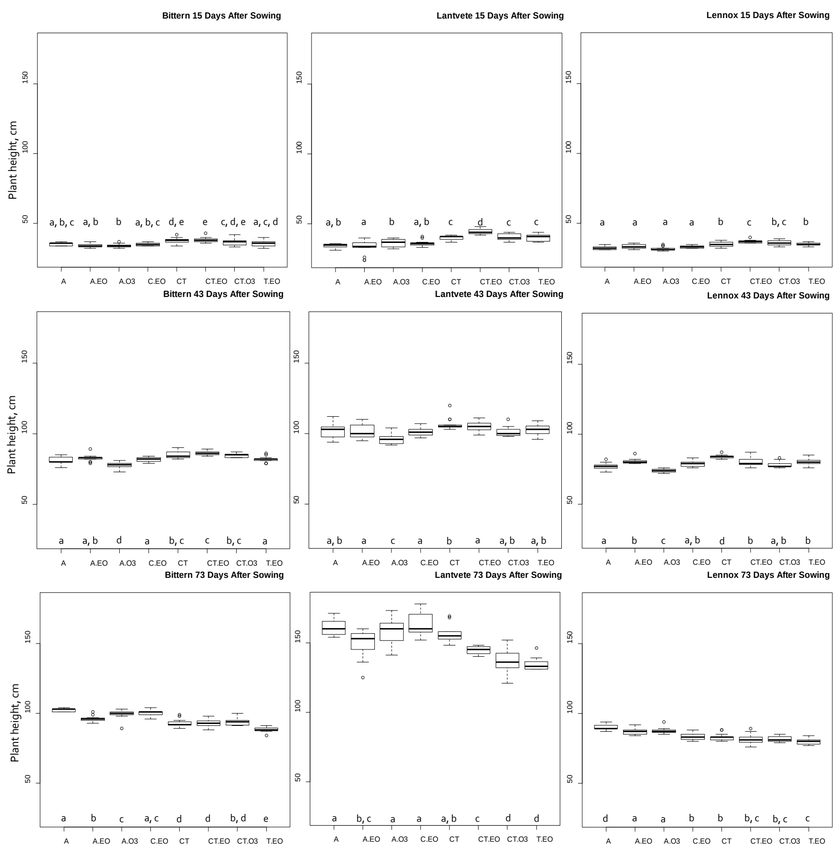
O_3 exposure and uptake expressed as 'AOT40s' for treatments (lines) and 'POD6s' for varieties in treatments based on measured conductances, plant development, and O_3 concentrations. The treatment-induced need for stomatal opening is clearly reflected in uptake as well as in variety differences.

Water Use Efficiency at day 56 or 58 after sowing. The varieties display differences in the treatments, that may be anticipated from the temperature settings: warmer treatment leads to lower WUE. The addition of ozone disturbs the varieties differently depending on the climate treatment.



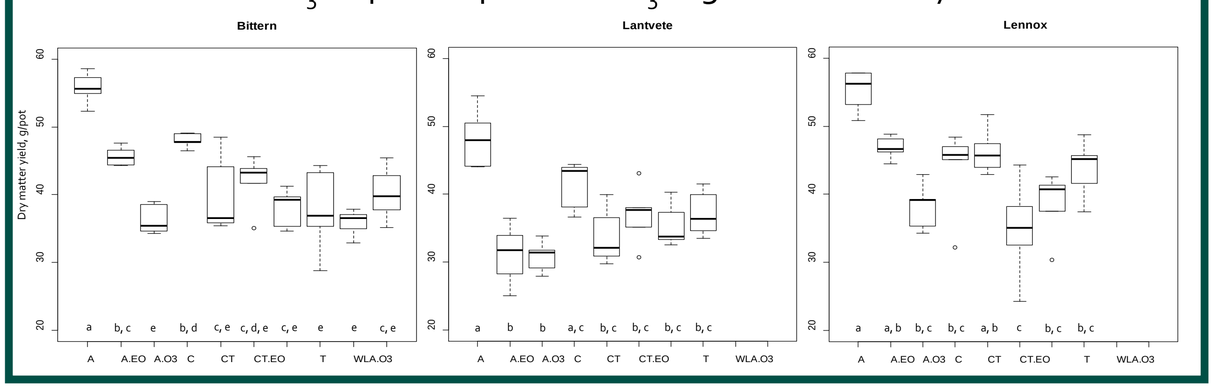
Dry matter yield / water consumption (right): the ratio of dry matter in the pots (g) to water consumed in the pots as evapotranspiration (g). In several of the treatments varieties show no differences, although the landrace variety seem to outperform the modern varieties in those where a difference is seen.





Plant height was favored by warm treatments for all varieties in the early stages, but later in the growth period, plant height was affected by variety as well as treatment, and varieties showed different responses to the O_3 treatments.

Yield: All varieties yielded best in the ambient (A) treatments. O_3 exposure impacted differently depending on variety and O_3 regime. In A-treatments, O_3-exposure resulted in yield reduction in modern as well as landrace varieties. In the warmer CT-treatments yields are reduced by the climate treatment and O_3-impact depends on O_3-regime and variety.



Summary: Spring wheat variety and O_3-regime interact with the climate treatments to determine yield under ambient and warmer climates; modern varieties display strong reduction of yield under ambient conditions where the landrace variety yield is equally reduced under episodic as well as chronic O_3-exposure. At the warmer treatments O_3-impact is less distinctly exhibited by variety and O_3-regime.

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