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*Published in:*
Procedia Environmental Sciences

*DOI:*
10.1016/j.proenv.2015.07.239

*Publication date:*
2015

*Document Version*
Final published version

Available online at www.sciencedirect.com
ScienceDirect
Procedia Environmental Sciences 29 (2015) 160 – 161
Procedia Environmental Sciences

Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)

# A 10-days heatwave around flowering superimposed on climate change conditions significantly affects production of 22 barley accessions

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**Abstract**

Extreme climate events as heatwaves, floods and storms cause acute changes in season variability influencing primary production and are very likely to increase in magnitude and/or frequency (IPCC, AR5, WGI)[1,2].
In the present study 22 primarily Nordic barley accessions were grown in four basic climate treatments of 1) 19/12°C (day/night) and 400 ppm carbon dioxide concentration [$CO_2$] mimicking ambient South Scandinavian summer conditions, 2) elevated temperature (+5°C day/night), 3) elevated [$CO_2$] at 700 ppm and 4) the combination of elevated temperature and [$CO_2$]. Temperature and [$CO_2$] were at levels representing a worst case scenario (~RCP8.5, IPCC) at the end of the 21$^{st}$ century. A 10 day-heatwave of 33/22°C (day/night) was superimposed around the time of flowering on the basic climate treatments.
The superimposed heatwave decreased overall grain yield in all combinations, however, vast variation in response was identified among accessions. In the two-factor treatment the decrease in grain yield varied from 2-80%. The heatwave caused the strongest overall effect in the treatment of elevated [$CO_2$] decreasing grain yield by 48% and the least effect (35%) was observed under elevated temperature suggesting elevated temperature to have a priming effect. In all heatwave treatments allocation of biomass was changed, increasing aboveground vegetative biomass and decreasing grain yield as previously reported[3].
The treatment with the combination of elevated temperature, [$CO_2$] and the superimposed heatwave may best represent a future climate scenario since more than one climate factor most likely will change at a time. From the basic ambient treatment to the two-factor treatment including heatwave, grain yield decreased 52%.
Our study emphasizes the need for assessing the effects of extreme events under climate change conditions on numerous accessions in order to select appropriate genotypes for breeding future cultivars that can secure the primary production.


Peer-review under responsibility of the organizing committee of the Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)


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doi:10.1016/j.proenv.2015.07.239

*Keywords:* biomass allocation, climate change, extreme events; genotype differences; heat exposure; production stability; temperature priming

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