

Climate Change Effects on Plant Health

Foliar diseases are a major problem in organic (and conventional) barley fields. The aim of this PhD project is to describe, how predicted changes in our future climate may affect growth of spring barley and its interaction with pathogenic microorganisms, so it is possible to meet any predicted harmful effects in time, e.g. by selection of appropriate genotypes, new methods of practical disease management or plant breeding. Up till now there is no data available on the host-plant interactions of European crops in a new climate, where more environmental factors are changed simultaneously.

Description of project:

During the project the effects of the important climate factors, CO₂, ozone, temperature and drought (in combination and alone) on plant growth and disease resistance will be analyzed. Different spring barley cultivars/lines (*Hordeum vulgare*) with different levels and types of resistance against foliar diseases, e.g. powdery mildew (*Blumeria hordei* f.sp. *hordei*), leaf rust (*Puccinia hordei*), leaf spot (*Drechslera teres*) and *Ramularia collo-cygni* (a new potentially serious disease) will be tested in different climate change scenarios and compared to effects under ambient conditions. The diseases include both biotrophic and necrotrophic fungi that may act differently to the predicted future climate changes.

The Ph.D. student will evaluate plant susceptibility/resistance by standard infection assays. If changes in resistance are observed among the different climate treatments, histological examinations will be used to identify the cellular basis of this. It will also be possible to analyse transcription of different resistance related genes using microarrays and quantitative PCR. Changed climate may not only affect disease resistance directly, but also indirectly through change host-plant physiology. Therefore, plant physiology factors will be measured during the experiments (e.g. relative chlorophyll content, stomata conductance, level of leaf stress necrosis, leaf net-photosynthesis and transpiration). Vegetative biomass, and seed yield will be used as a measure for growth rate of the infected barley plants. The infection assays and measurement of production parameters will allow the Ph.D. to estimate the direct effects of climatic factors on yield in spring barley cultivars/lines in our future climate, and thus recommend plant material for the organic cultivation. Stress resistant plant material needs to be identified to safeguard good and stable organic barley production in a changing and variable climate. The project will also yield entirely new insights into the effects of climate change on host-plant physiology and disease resistance mechanisms.

The experiments will mainly take place at the advanced phytotron (RERAF) for climate manipulations at Risø DTU, Roskilde. The experiments are coordinated with an ongoing climate change project that aims to analyze long time effects of multifactor climate changes to plant production (yield), adaptation, and plant competition (see <http://ing.dk/artikel/85198> or www.videnskab.dk for a popular description of this project). The Ph.D. will also spent time (1-1½ year) at KU Life, where the analysis of most of the data will take place. The project is collaboration between Risø DTU, the Ecosystems Programme, the Faculty of Life Sciences, KU, Department of Agricultural Sciences and Department of Plant Biology and the breeding companies Sejet Plant Breeding and Nordic Seed A/S. The combination of the international Research School for Organic Farming and Food Systems, SOAR, and the different expertises from Risø DTU, KU-Life and plant breeding companies is believed to create a fruitful cross disciplinary environment for the Ph.D. education and project.