

#10 Project Title: Phenology and genetics of adaptation in wild grass species

Project Supervisors:

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Project background and goals

Species of the grass family Poaceae dominate many plant communities worldwide and are important for ecosystem stability and services. Poaceae species are adapted to many different eco-geographic areas including stress prone environments and therefore represent an interesting plant family to explore the genetics of adaptation to diverse and changing environments. Here, we propose to exploit the genetic and phenotypic variation within and between diverse species of the grass genus *Hordeum*, including the economically important crop barley (*H. vulgare vulgare*) to identify the traits and underlying genetic determinants that control plant performance and adaptation to abiotic stresses. The *Hordeum* species are distributed in arid, stress-prone and temperate environments of South America and Eurasia including Germany and have been characterised as ruderal, stress-tolerant and competitive species. In addition, domestication of wild barley (*Hordeum v. spontaneum*) has led to drastic intra-species changes in the ecology, including changes in growth patterns and stress tolerance, in cultivated barley.



A preliminary analysis of a large number of different shoot traits scored in common garden experiments in wild *Hordeum* species and wild and cultivated barley has revealed variation in growth habit (annual, perennial) and in shoot and leaf development between and within different species. Variation in leaf traits and growth habit have been linked to different ecological strategies, slow-growing and stress tolerant versus fast growing and stress susceptible. However, the extent to which life history strategies (annual perennial), growth patterns and leaf form determine stress adaptation is still under debate and the underlying genetic variation and impact on adaptation is also not well understood.

This study will determine intra- and inter-specific genetic variation and plasticity in shoot development, morphology and physiology (carbon assimilation), using natural and experimental populations of wild and cultivated barley and diverse *Hordeum* species grown under stress. We will a) quantify natural variation in development, morphology and physiology of the shoot b) determine the genetic and genotype*environment variation for these traits and c) identify genomic loci and candidate genes contributing to differences in plant performance based on the analysis whole genome sequencing data. In addition, we will analyse the distribution and abundance of local *Hordeum* populations in natural reserves with contrasting ecological constraints such as the nutrient rich "Urdenbacher Kämpe" (Düsseldorf), and the dry and nutrient poor Muschelkalkkuppen (Zülpicher Börde). The overall goals of this proposal are to unravel the genes and genetic variants relevant for plant performance in stress-prone natural habitats characterised by complex and fluctuating environmental conditions and assess their adaptive value and fitness consequences.

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Please, submit a motivation letter, CV, transcripts and certificates, and references, or the names of possible referees as a single PDF document to maria.korff.schmising@hhu.de.