Hornworts, a new window into early land plant evolution

The monophyletic group of hornworts is believed to represent the immediate sister group of all vascular land plants. However, this traditional view is still debated and cannot be satisfactorily resolved owing to the lack of detailed knowledge on the general biology and genomic features of hornworts. Until now, advancement in this field was primarily hindered by the lack of genomic resources for a hornwort model species. However, recent progress in the research overcomes this issue. We are working towards a high-quality genome draft of the model hornwort, *Anthoceros agrestis*, and some of its relatives. Our findings show *A. agrestis* has a remarkably small genome, with few recent paralogs, which makes it appropriate for genetic analysis. We also provide an overview of the *A. agrestis* gene space and a preliminary gene expression atlas which shed light on the regulation of morphological and developmental traits that are either shared with other embryophytes or unique to hornworts. Furthermore, we report our first achievements on the genetic transformation of *A. agrestis* using various techniques. Potential projects for students would be assisting in the annotation of the Genome, the phylogenetic analysis of traits to reinforce the evolutionary positions of hornworts or optimizing wet-lab experiments

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Unravelling the genetic basis of the Hornwort-Cyanobacteria Symbiosis

Plant-Microbe Symbiosis are an exceptional field of research. From the initiation and maintenance over the environmental implications towards the evolution of such associations, there are many aspects to study! In our research group, we are analyzing the molecular mechanisms of the hornwort-cyanobacteria symbiosis.

Plant symbiosis with nitrogen-fixing cyanobacteria is a unique form of mutualistic association. It has independently evolved in diverse, yet isolated lineages, from a few species of bryophytes, ferns, cycads, to a small genus of flowering plants. Compared to rhizobia, cyanobacteria are less dependent on the host, and therefore hold a promising translational potential toward installing nitrogen-fixing symbiosis onto crop plants.

However, very little is known about the genetic regulation in plant-cyanobacteria symbiosis. The major difficulty to study such symbiosis had been the lack of tractable genetic systems for the host plant species. Because of this, most of the research has solely focused on the model cyanobiont *Nostoc punctiforme*, and how the plant partners initiate and

maintain symbiosis still remains largely unknown. The recent groundwork by our group and project partners on the hornworts *Anthoceros agrestis*, has made hornworts a promising model system.
Students projects addressing this research could either be the phenotypic identification of plant hosts which have lost the ability to initiate a symbiosis by random mutagenesis or assisting in the analysis of the changes within the plant host genome upon initiation of the symbiosis.

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Hands-on lab work

If you don't want to spend your whole Master Thesis in our lab but would like to get some lab routine, we can provide you a great opportunity. A few hundred samples of peat moss are sitting on the bench waiting for their DNA to be extracted. This work will take less than a month and can be timed according to your lecture schedule. You will get a sense of what it means to work in a wet-lab and become a pro for DNA extractions, a skill which is needed in most research fields! If this sounds interesting to you, please let us know.

PS We might be able to reimburse you for your work. Just get in touch with us! ☺

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