Verleihung des Wilhelm-Pfeffer-Preises

Laudatio auf Dr. Rabea Meyberg

In her Ph.D. thesis, Dr. Rabea Meyberg investigated the sexual reproduction and fertility of the moss *Physcomitrium patens* (former *Physcomitrella patens*). In a process called terrestrialisation, plants conquered land some 400-500 million years ago. This major achievement in plant evolution profoundly influenced our planet's atmosphere and biogeochemical cycles. Due to the similarities of bryophytes with the first land plants, the moss *Physcomitrium* is an important model organism to understand plant evolution and the breadth of life strategies used by plants on land. In contrast to the highly reduced gametophytic phase in angiosperms, the life cycle of mosses and other bryophytes is dominated by the gametophyte stage, which is easily accessible in *Physcomitrium*. The small size and haploidy of the gametophyte stage also facilitate the isolation and characterisation of mutants.

Physcomitrium patens emerged as a model organism in the 1960s and 70s. One ecotype called Gransden was collected in 1962 and used as the main laboratory strain for almost 40 years. However, prolonged vegetative propagation in the lab over several decades probably led to the accumulation of mutations and epigenetic modifications that strongly diminished fertility. As a consequence, the scope of many publications has been limited to the vegetative stage of *Physcomitrium*, and studies of sexual reproduction and the alternation of generations have been neglected. Dr. Meyberg's work is a big step to overcome these limitations.

In her Ph.D. thesis, Dr. Meyberg used a broad set of methods to systematically compare the poorly fertile Gransden ecotype with a more recently isolated ecotype called *Reute* (collected in 2006). In contrast to angiosperms and most gymnosperms, the male gametes (called *spermatozoids*) are motile in mosses, and Dr. Meyberg demonstrated that spermatozoid motility is virtually abolished in the Gransden ecotype. Electron microscopy unveiled a striking coiled phenotype of the flagella of Gransden spermatozoids, and the central pair of axoneme microtubules appears to be compromised. Using a global comparison of DNA methylation patterns and mRNA levels between the Gransden and Reute ecotypes, the awardee further identified a set of candidate genes associated with male infertility in *Physcomitrium*. These candidate genes include several homeobox genes, for example, *MADS3*, which was not characterised previously. For another candidate gene, *CCDC39*, Dr. Meyberg constructed a knock-out mutant and indeed found a loss of fertility in this mutant. Furthermore, spermatozoids of this mutant have a completely disrupted axoneme structure. While *CCDC39* may not be the master regulator responsible for the poor fertility of the Gransden ecotype, there are striking phenotypic similarities between the *ccdc39* mutant and Gransden.

In summary, Dr. Meyberg's comprehensive analysis demonstrated that defects of the male gametes are responsible for the low fertility of the Gransden ecotype. Her clearly written thesis thus provides an answer to a question that has puzzled *Physcomitrium* researchers for many years. Furthermore, Dr. Meyberg's work provides a basis for further investigations of sexual reproduction and the alternation of generations in mosses, and it suggests that *Physcomitrium* may represent an interesting model to study flagella-related diseases and reproductive defects in humans.

Botanik-Tagung, *International Conference of the German Society for Plant Sciences*, Bonn, 30. August 2022

Prof. Dr. Severin Sasso, im August 2022
https://www.lw.uni-leipzig.de/institut-fuer-biologie/abteilungen/pflanzenphysiologie