

Laudatio: Wilhelm Pfeffer Prize 2026

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In her Ph.D. thesis, Dr. Jaccoline Zegers investigated the response of zygnetophytes to osmotic stress. The age of genomics has identified the zygnetophytes as the group of algae most closely related to land plants. During their emergence 400-500 million years ago, the land plants had to cope with greater fluctuations in water availability and drier environments. Osmotic stress tolerance has mainly been studied in land plants and to a lesser extent in their relatives, leaving gaps in our understanding of plant terrestrialization. Studying the osmotic stress response in a sister lineage of land plants will thus extend our knowledge of the physiological requirements that made plant terrestrialization possible.

In her work, Dr. Zegers used a suite of methods from systems biology to study the acclimation to osmotic stress in *Mesotaenium endlicherianum* and other zygnetophytes, including transcriptomics, standard proteomics and phospho-proteomics, metabolomics, and DAP-Seq, a method to globally identify transcription factor binding sites. It is the first time that these methods were systematically applied to the zygnetophytes. Together with her colleagues, Dr. Zegers provided evidence that some proteins with established roles in land plants have conserved functions in the zygnetophytes. Proteins with a conserved function included XTH proteins, for example, which are enzymes involved in carbohydrate metabolism that likely participate in cell wall remodeling; EXL proteins, which support growth under stress conditions; or LEA proteins, which bind to other proteins and membranes to protect them against osmotic stress. Furthermore, several oligosaccharides were found to accumulate under osmotic stress, suggesting that they fulfil a protective function as well.

Dr. Zegers also investigated abscisic acid (ABA), a key phytohormone that regulates stress responses in land plants. While zygnetophytes appear to lack ABA, they possess the transcription factor ABF, which is hyperphosphorylated under osmotic stress. Building on these findings, Dr. Zegers developed an improved model for the evolutionary origins of ABA signaling. According to this model, early land plants incorporated the preexisting signaling components ABF and calcium-dependent protein kinases (CDPKs) into an ABA-mediated stress response.

In summary, Dr. Zegers' Ph.D. thesis contains a wealth of data on the acclimation of zygnetophytes to osmotic stress. Her work provides plant biologists with many new insights and interesting hypotheses on plant terrestrialization. Testing some of these hypotheses will require functional comparisons to other poorly studied groups of plants and methods to construct zygnetophyte mutants. Dr. Zegers' groundbreaking work serves both as a foundation and as an encouragement for further research.