Abstract

This Ph.D. thesis presents a comprehensive study of gene expression regulation within the male gametophyte development focusing on transcriptional, translational, and post-translational levels. The research introduces an online tool, GOLEM, designed for the visualization and analysis of motif distribution within the DNA of various plant species. Utilizing RNA-seq data, GOLEM enables the study of gene expression across different tissues and developmental stages, as well as a comparative analysis across the evolution of plant lineages. Through an integrated multi-omics approach, combining transcriptomic and proteomic data, the thesis enriches the understanding of gene expression dynamics in male gametophyte development, identifying significant trends and categorizing gene families based on their expression patterns. This multifaceted dataset provides a valuable resource for future functional genomics studies. Additionally, prospects and challenges of studying gene expression regulation in male gametophyte are discussed.

Furthermore, the thesis explores the regulatory potential of the nascent polypetide-associated complex (NAC) protein family in male gametophyte development, particularly their role in translation during pollen tube growth. Experiment results indicate that NACβ subunit knock-down causes defects in pollen tube growth, suggesting its essential function in translation. Moreover, the expression patterns of the NAC complex align with those of translation-related genes, implying its potential involvement in the translation machinery, an association previously noted in animal systems. The research posits that the NAC complex may be part of an extensive network of chaperones involved in protein folding and sorting in *Arabidopsis thaliana*. The research extends to examine the conservation of NAC function across different plant species, evidenced by successful functional complementation experiments between angiosperms and liverworts. Overall, the thesis contributes to a deeper understanding of the regulation governing gene expression in plant reproduction and highlights the critical role of the NAC protein family in plant development.