DESCRIPTION FOR THE GENERAL PUBLIC

Phloem is a specialized plant tissue that is a component of the conductive tissues in vascular plants. Specifically, the main function of phloem is the transport of organic compounds (assimilates), produced during photosynthesis, from leaves to other plant organs. However, it is a heterogeneous tissue, in which, in addition to conductive elements (sieve tubes) and accompanying cells, we can also distinguish parenchyma and dead fiber cells. Proper transport, i.e. the flow of assimilates within the sieve tubes of the phloem, is im possible without the development of specially adapted cells**.** The most important element in the construction of the sieve tubes is the presence of several pores in the transverse walls, which are called sieve plates. Cytoplasmic bands penetrate through the pores, which allows the transport of assimilates between individual members of the sieve tube. Sieve elements are also poor in organelles, and in their mature form, they lack the nuclei. During the process of phloemogenesis, i.e. the differentiation of sieve tube elements from meristematic tissue, cellular structures disappear.

However, the mechanism responsible for the selective degradation of cytoplasmic structures during the development of phloem conductive elements during phloemogenesis is not known. In this project, we assume that selective autophagy is the mechanism regulating the process of differentiation of sieve elements from meristematic tissue. Autophagy, or 'self-eating', is a biological catabolic process involving the controlled degradation of molecules, cytoplasmic fragments and cellular organelles. Autophagy also ensures the selective elimination of unnecessary compounds or damaged parts of cells without the need to kill them. In plant cells, autophagy occurs as part of the plant's development program but also occurs in response to numerous exogenous factors and environmental stresses. There are different types of autophagy which occur at the cellular level, including microautophagy and macroautophagy. During the first of these processes, small portions of the cytoplasm are digested in the vesicles (autophagic bodies) located within vacuoles. The second type of autophagy initiates in the cytoplasm, where unnecessary cellular components are incorporated into the autophagosome (double-membrane structure) located in cytoplasm. Within the interior of the autophagosome, or after the transportation of cargo to vacuoles, the material degrades due to the action of hydrolytic enzymes. Both processes are suggested to occur simultaneously or successively in the cell and they are also involved in the degradation of cellular material during phloemogenesis. Therefore, the main goal of the project is the analysis of the sieve element differentiation process; as well as the selection and comparative analysis of potential cytological and molecular autophagy markers involved in that process in roots. We will use a multi-faceted knowledge approach combining anatomical, cytological, chemical, molecular and culture methods. All research will be conducted on plant material obtained from the roots of the black cottonwood/California poplar (*Populus trichocarpa*) and Arabidopsis (*Arabidopsis thaliana*). Poplar is a woody plant species which is also model plant, characterized by the presence of thick pioneer roots, which provides researchers an excellent opportunity to observe developing phloem. In the case of Arabidopsis, this project will utilize plant lines that have mutations within genes encoding proteins that are functionally related to autophagy (*atg5* and *atg9*). Using mutants with an impaired autophagy pathway, it will be important to determine whether this also has implications for phloem formation and function.

The aim of the project is to fill the gaps in existing knowledge regarding the mechanisms controlling phloemogenesis in plants based on the hypothesis that a unique, genetically programmed pathway of sieve elements differentiation exists and can engage mechanisms similar to programmed cell death (PCD) during wood development; which, however, will not end in the death of the sieve cell. Additionally, a mechanism regulating the degradation process of cytoplasmic structures in phloem conductive cells remains to be discovered; and it will be particularly interesting to identify the signal that determines the sudden cessation of degradation processes at the time of sieve element maturation. This project has a potential to clarify to what extent the process of phloemogenesis is genetically regulated (similarly to genetically programmed cell death) and how it correlates with the accompanying cells supporting the survival of the sieve elements with such a poor set of cell organelles. In the past, this research area has not garnered significant attention as evidenced by the very limited amount of information pertaining to this subject within published literature.