The cells of a single organism, that contain the same genetic information, may be functionally and morphologically different. This diversity is due to the fact that specialized cells can "read" a various set of information encoded in the DNA. Those genes that are silenced in some cell in another cell can be activated. Thanks to the gene expression regulation, it is possible a.o. to specialize undifferentiated stem cells into specific types of differentiated cells. Therefore specialized cells are characterized by a specific expression pattern of strictly defined genes. Moreover they are able to constantly regulate gene expression to allow the proper functioning of the cell, despite the changing conditions of the external environment.

Larch microsporocytes are undifferentiated stem cells of microspores from which finally develops the pollen grain - male gametophyte. In this case, the time of meiotic division is the period in which undifferentiated cells are reprogrammed into specialized cells of the generative line. Our team discovered that during the diploten of the first meiotic division, there are significant changes in transcriptional activity. We distinguished periods of increased transcripts synthesis, after which a gradual silencing of transcriptional activity was observed. In addition, newly synthesized poly(A)RNA were not immediately exported to the cytoplasm. Some part of them is accumulated as a non fully spliced mRNA mainly in the nucleoplasm and Cajal bodies. As initially established, the cause of pre-mRNAs retention is probably related to the presence of unspliced intron sequences. It is possible that the observed phenomenon of nuclear retention is used for specific regulation of gene expression, which is important for the proper development and differentiation of generative cells.

In addition to the accumulation of pre-mRNAs, a large number of fully mature, ready-to-export mRNAs have been observed, which are also retained in the nucleoplasm. This fact suggests that the reason of mature mRNAs retention may be related to the inhibition of nucleocytosolic export. It should be mentioned that the lack of export has a significant impact on the final stage of gene expression, which is protein synthesis. It is possible, that in the studied model, specific export regulation is used as an additional tool for global post-transcriptional regulation of gene expression. The observed phenomenon of nuclear poly(A)RNA retention can be very important for the proper reprogramming of stem cells (microsporocytes) into specialized male gametophyte cells. The study of this process may also be significant for understanding the problem related to dysfunctions of sexual reproduction, which leads to frequent abortions of embryos in various species of larch. This problem significantly impedes the cultivation of larch in Asia, where it is an extremely important species both ecologically and economically.

The knowledge about the elements of machinery and mechanisms, which are related to the nucleocytosolic export in plant cells is still very poor. However, a similar mechanism of poly(A)RNA retention was observed in yeast cells exposed to heat stress conditions. In response to heat shock conditions, nucleocytosolic exports in yeast cells were inhibited, contributing to global poly(A)RNA retention in the nucleus. Understanding the specific regulation of export in stressed plant cells can be helpful for research focused on plant tolerance for abiotic stresses such as drought and salinity. For this reason, expanding the general knowledge about mRNA exports in plant cells is extremely important.

The aim of the planned research is to understand the mechanism of mature mRNAs retention, which can be related to the regulation of processes involved in nucleocytosolic export. This knowledge will allow to better understand the processes, which are important for the proper development and differentiation of generative cells. In addition, planned experiments will allow to expand the still poor knowledge about the mRNAs export in plant cells.