Under controlled conditions of in vitro culture plant cells demonstrate the unlimited ability to divide and reproduce the entire plant organism. Somatic embryogenesis (SE) is a special example of the regeneration. During the process, somatic embryos are formed from plant cells that are not normally involved in the development of embryos, i.e. ordinary plant tissue. Because of high efficiency of SE, this phenomenon is widely used for the multiplication of many economically important species. In addition, the development of both the somatic and zygotic embryos is highly similar. Consequently, SE provides a useful model to study embryology in plants. So far, the factors and conditions that induce this regeneration pathway as well as the development of the somatic embryos have been recognized and described. A number of genes and proteins have been identified as the markers of SE. However, the issue raised in 2005 in Science "How does a single cell become a complete plant?", remains unresolved. System of SE in tropical fern *Cyathea delgadii*, which we described in 2015, is suitable for research seeking the answer to this question. Its uniqueness is primarily based on unicellular, epidermal origin of somatic embryos and the SE induction without plant growth regulators in the medium. High efficiency and repeatability is also its advantage.

Within a complex multicellular plant organism, cell-to-cell communication either occurs through the system of cytoplasmic membranes (symplast) or cell walls (apoplast). Such communication allows for precise exchange of information between cells. In this way it controls the processes of plant growth and development. It is assumed that in in vitro tissue culture the initiation of SE from a single somatic cell is preceded by the loss of its communication with neighboring cells. Following this, we aim to find the answer to the question whether there is a correlation between changes in cell-to-cell communication and cell differentiation in the process of SE.

In our experiment the plantlets (young sporophytes) of *C. delgadii*, maintained under controlled conditions of in vitro culture, will be used as a source of plant material. The fragments of petioles (explants) measuring 2.5 mm in length, whose individual epidermal cells differentiates in somatic embryos within 10 days of culture, will be taken for examination. Explants that are incapable for SE and those in which the embryos show multicellular origin will be included in these experiments as a control. Moreover, the osmotic agents that increase the effectiveness of SE and change the path of embryo origin from multicellular to unicellular will be analyzed. To investigate the communication between cells various fluorescent dyes that can move between cells as well as antibodies reacting with components building cell walls will also be applied. Changes in intercellular communication will be visualized using a variety of microscopy techniques: light, transmission and scanning electron, and confocal.

The final result of the study will be to deepen the knowledge about mechanisms regulating communication between plant cells by symplast and apoplast during the SE induction and an embryo formation. Thus, it will bring contribution to answering one of the most bothering question of contemporary researchers of experimental plant biology. In practice, in-depth knowledge of SE induction mechanisms may pave the way for the intensification of regenerative systems of other plants based on this way of regeneration