Role of HFR1 and ROS in light-dependent germination of *Arabidopsis* seeds

Production of seeds (organs made of an embryo surrounded by a layer of endosperm and testa) by plants is one of the most important evolutionary adaptations of these organisms. Germination and dormancy alleviation are among the most important processes occurring in seeds. The first term is defined as a set of complex reactions on the physical, biochemical and metabolic level, which leads to the activation of metabolism of an embryo and induction of elongation growth of its cells. The second term relates to particular species trait, conditioned by the intrinsic properties of the seed, which is characterized by an inability of seed to germinate even under favorable environmental conditions. Among most important internal factors regulating dormancy alleviation and germination are plant phytohormones (i.e. gibberellins - GA, abscisic acid - ABA) and other regulators of plants' growth and development (i.e. Reactive Oxygen Species - ROS). For many years ROS were considered to be molecules with deleterious effects, usually contributing to the destruction of cellular structures, aging and death. However, the recent discoveries have demonstrated that ROS may play a number of positive functions. It has been shown that ROS are involved in the induction of defense against pathogens and regulation of germination. What is more, also the experiments conducted by Dr. Krystyna Oracz (leader of *SeedExplorerGroup*, www.seedexplorer.eu) indicated that one of the mechanisms of dormancy alleviation is associated with an increase in ROS level and oxidation of specific proteins.

Besides the internal stimuli, such as hormones and ROS, the processes occurring in seeds are also influenced by environmental factors such as temperature and light. The perception of light signal is performed mainly by the photoreceptors from the phytochrome family (PHY). It has been shown that germination of seeds of thale cress (*Arabidopsis thaliana*) is stimulated by red light perceived mainly by PHYB. Phytochromes under the influence of the absorbed light stimulus are activated, which starts a cascade of protein-protein interactions, involving various types of enzymes, regulatory proteins and transcription factors, and consequently leading to changes in the profile of genes expression in seeds. One of the proteins regulating plants photomorphogenesis under far red light is HFR1 (Long Hypocotyl In Far-Red). It is a protein that is responsible for inhibition of hypocotyl growth under conditions of far red light exposure. Recent studies have also shown that HFR1 can play an important role in the regulation of seed germination by indirect regulation of the expression of genes involved in GA and ABA metabolism. It has also been postulated that the light signal can induce changes in the metabolism and/or signal transduction of ROS within seeds. However, still very little is known about the specific proteins and regulatory factors within the network of interactions between the light signal transduction pathways and ROS in the regulation of seed germination.

In recent studies conducted in the research group *SeedExplorerGroup*, it has been shown that the expression of *HFR1* in germinating seeds of *A. thaliana* is stimulated by light and depends on the depth of dormancy. The proposed project PRELUDIUM 12 is the continuation of this experiments and aim to elucidate the possible interactions between the light signal transduction and ROS, during the regulation of seed germination of that species. The effort will be taken to characterize the mechanism of action of HFR1 during germination of *A. thaliana* seeds, with particular emphasis on the role of ROS in this process. In an attempt to answer the questions regarding the function of ROS in HFR1 controlled light-dependent seed germination, several experiments will be performed using various test methods, such as for example: germination tests, quantitative Real Time PCR analysis of gene expression, measurements of the enzymatic activities, microscopic observations etc. Obtained results will provide new, valuable information on the complex network of interactions between signals induced by external stimuli (light) and internal (ROS) and highlight their importance in the processes occurring in seeds. Detailed knowledge of this kind of signaling network will have a significant contribution to the development of research in the field of signal transduction and cellular biology of seeds.