Title: Elucidating the role and mechanism of regulatory network of genes encoding dioxygenases in terms of plant adaptation to land conditions.

In a constantly warming climate, understanding the mechanisms of plant responses to adverse environmental conditions is extremely important. Prolonged periods of drought or high temperatures exposures resulting from climate change inhibits the growth and development of plants and as a result decrease the yield contributing to high economic losses. In order to minimize yield losses, it is therefore necessary to know more about the molecular defence mechanisms that allow plants to grow and develop in unfavourable environmental conditions. Finding the answer to the question what makes some plant species to cope better under stressful conditions leads us to research on the regulation of protein biosynthesis, which may play an important role in plant resistance to stress. Land plants that are the subject of the planned research derive from aquatic plants. It can be assumed that the adaptation of plants to terrestrial conditions occurred as a result of specific selection pressures. **Because land plants, unlike aquatic plants, are exposed to drought stress, elevated temperatures and harmful UV-B radiation, studies on the regulation of the expression of genes encoding dioxygenases and occurring in all land plants genomes appear to be particularly important.**

As a result of the research previously carried out in our team on the model plant *Arabidopisis thaliana L*. (thale cress), we have selected a number of genes encoding proteins that act as dioxygenases. Two dioxygenases, which biological functions has not been described yet, are particularly interesting due to the fact that they occur in the genomes of all land plants.

The main features of the genes encoding them are: 1) the presence of variants conditioning different protein structure and 2) regulation of their biosynthesis through natural antisense RNA sequences present in the genome. Based on the literature review, we conclude that the proteins encoded by these genes may play an important role in plant resistance to adverse environmental factors occurring on land, and as a result of their function may minimize adverse effects on plant growth and development. **In the proposed doctoral project, we would like to answer the question about the mechanism and role of regulation of genes encoding dioxygenases in the adaptation of plants to growth and development in land-based conditions.** The research will be conducted on the *A. thaliana* model plant, and at the last stage of the project we will include crop plants such as tomato (*Solanum lycopersicum L*.) or potato (*Solanum tuberosum L*.).

During the proposed research, we will characterize the impact of the selected environmental stresses (drought, UV radiation, infection with bacterial plant pathogens) on *A. thaliana* plants (Col-0 accession) and its mutants in the genes encoding the tested dioxygenases. The mutants necessary for preforming this studies will be constructed by the PhD student. All plants will be grown in soil, hydroponics and *in vitro* cultures in the presence of the stress factors, and their phenotypic characteristics will be compared between lines. Plant material will be collected and biochemical analyses will be performed determining the content of chlorophyll, flavonoids, anthocyanins and antioxidant activity. The biosynthesis of the studied dioxygenases will be determinate in real time. Gene expression regulation mechanisms will be investigated by using the RNA sequencing technique.

Understanding plant regulatory mechanisms designated for responding to abiotic and biotic stresses should provide us with the control tools for handling the effects of plant growth under adverse environmental conditions and, by these means, might lead to reduction of the associated economic losses.