Description for the general public

Due to the sedentary lifestyle, plants are exposed to many unfavorable environmental conditions limiting their growth and development. The water deficit is one of the major stress factors with a high impact on plants' productivity. The objective of the project is to recognize the key components of plant leaf metabolism associated with the tolerance to water deficit and the capacity to regenerate after stress cessation in forage grasses. The grasses from *Lolium* (ryegrass) and *Festuca* (fescue) genera will be the plant materials proposed to be used in this proposal, which are crucial for grassland production in the temperate regions. *Lolium multiflorum* (Italian ryegrass) is a grass species not only with a high forage quality and productivity but also with a low level of tolerance to abiotic environmental stresses, including water deficit. *Festuca arundinacea* (tall fescue) has the capacity to avoid soil water deficit due to its deep and well-developed root system and/or to tolerate water deficit mainly as a consequence of modification of its leaf metabolism. In turn, other *Festuca* species such as *F. glaucescens* (often recognized as tetraploid botanical variety of tall fescue) exhibits a survival strategy by becoming quiescent under severe water deficit conditions, which enables it to survive and to resume the growth following irrigation. *Lolium multiflorum* and *F. arundinacea* can be crossed with each other and this gives the opportunity to transfer the beneficial traits from one species to another during the process of crossing. The introgression forms of *L. multiflorum*/*F. arundinacea* are unique research materials for the studies to recognize the molecular basis of water deficit tolerance in forage grasses. The application of such a plant material in the research enables us to dissect the complex trait, such as water deficit tolerance, into its particular components, each one expressed differently in particular introgression forms. The following grass genotypes distinct in their levels of stress tolerance and/or regeneration capacity after stress cessation within three plant groups will be used as the plant materials in this proposal: (*i*) genotypes of *F. arundinacea*, (*ii*) genotypes of *F. glaucescens,* and (*iii*) introgression forms of *L. multiflorum*/*F. arundinacea*. The aim of the study will be to analyze **(1)** photosynthetic apparatus activity; **(2)** accumulation of reactive oxygen species (superoxide anion, hydrogen peroxide, and hydroxyl radical), nitric oxide and abscisic acid; **(3)** potential of cellular antioxidant system (catalase, ascorbate peroxidase, glutathione peroxidase, glutathione reductase, and superoxide dismutase); and **(4)** analysis of biological membranes' integrity. The relationships between all these components have not been recognized for the forage grasses to date. All the analyses will be conducted in the control conditions (full irrigation conditions), at the selected time-points of water deficit treatment and during plant recovery (under re-hydration conditions).

We assume that the research performed with respect to the proposal aims, together with our previous scientific achievements associated with the tolerance of water deficit and the regeneration capacity after stress cessation, helps to create a comprehensive model of grass reaction to water deficit conditions. We also believe that this project will be important not only for the group of *Lolium-Festuca* grasses but also it could be a good reference for the research on the other plant species. This project's achievements will also be important for the understanding of mechanisms involved in the tolerance to water deficit in plants. Furthermore, the *L. multiflorum/F. arundinacea* introgression forms analyzed here could also be excellent initial plant materials to develop new *Festulolium* cultivars improved with respect to water deficit tolerance.