Degradation of the environment caused by a human activity and climatic abnormalities associated with the global climate change occurring as an increase in temperature and CO_2 concentration and fluctuations in the size and distribution of rainfall are the main cause of yield reduction plants. Ecological and economic effects caused by soil compaction stress and drought are globally significant and confirmed by the fact that climatic anomalies occurring more frequently now, which may be related to the climate change and manifest as i.e. increase in the average temperature, CO_2 concentration and fluctuations in the size and distribution of rainfall. In many geographic regions freshwater resources as well as oil and gas resources have become a strategic element and has already became the cause of military conflicts. It is necessary to conduct intensive research to prevent the risk of a food crisis caused by the limitation of arable agricultural land, increase in production costs and prices and allocating part of the crop to biofuel production. It seems that the possibility of increasing crop yields by higher expenditure on fertilizers and plant protection have been exhausted, and progress can be achieved by “biological progress” by the introduction of varieties with increased resistance to stress. A perfect example is the "Green Revolution", which not only eliminated the famine in Asia but has done, that the traditionally regarded as poor (India, China) have become significant importers of wheat and rice.

Researchers and breeders refine crop plant genotypes for plant tolerance to environmental stresses both traditional methods of selection and genetic engineering. The current number of basic research in those issues is impressive and according to Web of Knowledge is over 2500. Despite the clearly defined aims in science and methodology, progress is too slow and assumptions of scientific lose in real environmental conditions. Drought tolerance in plants is a complex trait, and finding the appropriate phenotype is complicated by exposing the plants to simultaneously or sequentially appearing stress factors in natural conditions. For the purpose of the proposed project, perhaps the most important reason for the lack of success is the fact that the genotype itself is not the only factor determining the sensitivity and a biological progress requires a comprehensive response to what extent the potential of the plant stress tolerance to soil compaction and drought is determined by a genotype, and to what extent is subject to modifications in the context of genetic physiological and environmental interactions.

Currently, the breeding of plants resistant to different abiotic stresses applies physiological and molecular markers. Physiological markers assist the selection of plants having a matching character but it is a task work- and time-consuming, and requires many experiments, taking into account the different phases of plants growth and environmental conditions. In contrast, the molecular markers are more versatile because they do not become altered by environmental factors and the selection is independent of the development phase of the plant. Modern molecular biology techniques used in the preparation of new varieties with desirable traits are greater than the traditional methods in terms of ease of use and speed of obtaining the desired effects. However extensive use of molecular methods in breeding especially in obtaining genetically modified crops (GMO), but this creates a certain risk constraints natural biological biodiversity and why it is common to formation of gene banks to store seeds of species and varieties that could eliminated in the environment.

The subject of the proposed research is of great importance as it takes into account the little known mechanism of water transport in plants (vascular and non-vascular). Hydraulic conductivity (K) of roots, stems and leaves will be measured with a modern HPFM analyzer, which provides very accurate measurements of water flow. Due to its biology, maize is an interesting research object because, apart from important physiological traits, it is characterized by high genetic variability and is of significant economic importance.

Growth, development and productivity of plants depends on their genetic potential and the currently prevailing climate and soil environmental conditions. The environmental conditions are highly volatile. Unfavorable to plant the course of action of these factors are called abiotic stresses and they cause adverse effects which may even lead to plant death. Plants acclimation reaction to the grow in the excessively compacted soil and a reduced amount of water available for the plants includes physiological, morphological, anatomical and biochemical traits related to changes in the integrity of the biological membranes, the state of hydration of cells and tissues, enzyme regulation, osmotic content dyes, gas exchange leaves, fluorescence chlorophyll, the architecture of the root system. In natural environments frequently we have to deal with the situation of simultaneous occurrence of different stress (multistress effect) therefore a key objective of the research will be to determine changes in the rate of physiological processes in different genotypes of maize growing under different soil compaction and treated of soil drought stress. Research proposed in this project, intended to demonstrate and prove the effectiveness of physiological, biochemical and molecular traits, and their application for study of mechanisms of plants acclimatization at the level of induction/suppression of the respective genes and to identify potential molecular markers of tolerance.