Progressive climate changes are related to the unpredictable weather phenomena, which include, among others: extreme low temperatures at the beginning of the growing season ("cold spring") as well as high temperatures and prolonged drought in the summer, occurring frequently in recent years, in the moderate climate of Central Europe. Therefore, farmers are forced to search for new sources of resistance to abiotic stresses within varieties of crops. Due to reduced water requirement and versatile use (biogas, feed, consumption purposes), sorghum (*Sorghum bicolor* L.) seems to be an ideal candidate for the cultivation in the areas with a predisposition to drought. However, sorghum is considered to be more sensitive to low temperature stress compared to another economically important crop, maize (*Zea mays* L.).

Both closely-related species, maize and sorghum, originated from warm regions of the world are particularly exposed to the cold stress in Central Europe (including Poland) with moderate climate conditions.

Water relations in plant cells and their regulation by aquaporins - proteins involved in the transport of water and small molecules through cell membranes are often discussed in the literature in the context of plant adaptation to cold stress. The largest group of plant aquaporins, plasma membrane intrinsic proteins (PIPs) show relatively high activity in water conduction, which is important for water uptake and its further transport in the roots. PIPs have been studied in the context of their early response to cold stress in various plant species, however, the function of individual forms in this response is still unclear.

Hence, it seems to be important to undertake research focused on the search for mechanisms of sensitivity to cold associated with the involvement of aquaporins in the roots of the economically important crops. The aim of the project was formulated, in which the research hypothesis will be verified assuming that the cold response may be connected with the changes in the expression of genes related to aquaporins, as well as abundance and localization of these proteins in the root cells of tested plant species. In addition, the participation of cytoplasmic calcium ions - universal messenger in the signal transduction pathway about stress will be analysed in this reaction. Two maize varieties (Co255 and B73) and two sorghum varieties (Shan Qui Red and Tx3362), differentiated in terms of their sensitivity to cold will be used as an experimental material.

The research will be carried out on several levels using ultra-modern techniques, including comprehensive analysis of the transcriptome (RNA sequencing) and proteome (two-dimensional electrophoresis), immunolocalization of selected aquaporins using confocal microscopy, three-dimensional imaging of the ultrastructure of root cells using the SBF-SEM system (serial block face - scanning electron microscopy) and X-ray microanalysis for the detection of free calcium ions in the cytoplasm of the root cells.

We expect that the results from the proposed project will provide the valuable information on the cold-response of maize and sorghum, as well as they will be useful in the research on other thermophilic plant species. Also, the knowledge about the potential differentiation of the cold-sensitivity level will help farmers in the future to choose the appropriate seed material towards the selection of genotypes characterized by the ability to acclimatize to the low temperature. In addition, the results of the proposed research will contribute to the expansion of knowledge of the biology of the tested crop species.