Maize is one of the most important crops in the World. It is the main source of food and feedstuff in some regions of the world. Maize is also used for the production of biofuels. In Poland, maize production increases. In 2013, the maize cultivation area, including silage and grain production, was higher than 1 million hectars, and grain production reached 4 million tons (Prof. T. Michalski, Farmer.pl). Poland is also an important exporter of maize. One should note that current maize cultivation in Poland is the effect of intensive breeding programs. Breeders have produced high-yielding varieties well adapted to the local climate conditions. The moderate climate in Poland is rather unpredictable, although the seasonal pattern of temperature changes is rather steady. In April, the average air temperature increases, but in May spells of low temperature may occur. The risk of such events is c.a. 34%. Summer temperatures are rather favorable for plant growth and autumn temperatures are mild.

Thus, the main constrains for growing sub-tropical crops such as maize are cold spring conditions. The optimal temperature for its growth is much above 20^{o}C. At temperatures 10-15^{o}C, growth is retarded, while temperatures below 5^{o}C may lead to tissue injuries or even plant death. This is particularly of concern for materials that originate from the main regions of maize cultivation: US Mid-south and South-East Asia. However, the maize phenotype is flexible and the crop has adapted to different climates, including temperate climate. In that context, the geographical localization of Poland is of particular importance. About 20 years ago, Poland was the north limit of maize cultivation. Today, thanks to the advancements in maize breeding programs, the maize cultivation zone has moved much to the north and maize cultivation for grain (not only silage) is now possible all along Polish territory.

The basis for maize breeding is the production of inbred lines. Breeders interbred them in order to obtain hybrids and the best hybrids are selected to become market varieties. Recently, one of breeding programs has led to the production of inbred lines being able to survive cold spells with minimum temperatures near ground around 0^{o}C. Our group has extensively studied few tolerant inbred lines. Our studies allowed us to identify physiological mechanism that potentially determines the cold tolerant phenotype of these lines. New project is aimed on discovery of genes responsible for the mechanism of maize cold tolerance. We are going to use modern genomic approach – Genome-Wide Association Study (GWAS). Such approach allows for seeking the genome loci most strongly associated with the given physiological trait. To this end we are going to use ca. 450 inbred lines (including 8 from Polish breeding programs). Tested inbred lines representing should represent wide spectrum of maize genomic diversity and at the same time their genotypes should be easily accessible from public databases, as well as kernels from public Gene Banks. To verify the role of identified genes, their expression will be tested in cold-tolerant and cold-sensitive genes. If successful, we will advance our understanding of maize cold-tolerance. If the genetic-phenotypic correlations are established, we may have in our hands a set of genetic markers to assist the maize breeding programs for cold tolerance. The results of this project could be of importance for the other regions of temperate climate: East and Central Europe, Canada, North China, Chile and Argentina.