

The object of this project is to explore a novel technique for modulating the activity of plant genes through the use of short oligonucleotide sequences. It is a method based on the induction of epigenetic changes. Epigenetic processes allow heritable changes in phenotype without the need to alter the genome sequence. Changes at the level of the epigenome can lead to modulation of gene expression through mechanisms related to non-coding RNA molecules, DNA methylation (5-methylcytosine, N6-methyladenine) and modifications of histones. Despite the enormous potential of genetic transformation of plants from the perspective of agricultural science, nutrition and medicine, public opposition to genetically modified organisms (GMOs) prevents the practical use of transgenic plants. Therefore, methods of modifying the phenotype of organisms that allow the use of their natural genetic repertoire are being sought. Treatment of plants with short oligodeoxynucleotides (OLIGO / ODN), also known as OLIGO technology, is an innovative method used for the targeted induction of epigenetic changes in plants. The method consists in introducing into the cells short oligodeoxynucleotides homologous to the corresponding regions of the gene under study (coding for this gene and regulating its activity (non-coding)). A major advantage of this method is the reduction of pleiotropic effects, which are a common problem in the creation of genetically modified organisms. It is also worth noting that the plants obtained by treatment with OLIGO are by law not genetically modified and therefore not subject to GMO regulations. The mechanism of action of OLIGO is not yet fully understood. Based on previous studies, we can assume that it is probably based on RNA-dependent DNA methylation. A thorough understanding of this mechanism (and its regulation) at the level of the genome (DNA), transcripts (mRNA) and protein expression is the subject of this project. The development of an algorithm to predict the activity of a particular oligo will facilitate the use of this technology in the future in science and possibly in agriculture (production of new, not GM, varieties). The project will also develop a method to regulate the expression of multiple homologous protein isoforms, which is a difficult task using standard transgenesis methods. It is also important that the research is conducted on a crop grown in Poland - potato (which guarantees direct implementation and tests the possibility of applying the new technology not only in the laboratory but also in conditions close to the field). The results of this project will undoubtedly have a significant impact on the development of modern - based on the achievements of science - agriculture.