Hypoxia is a consequence of changes in the environment in which plants live. Frequent rains, floods, a thick layer of snow, and periodic flooding of areas cause an oxygen deficit. This is due to impaired diffusion and poor solubility of oxygen in water, making it difficult for plants to access it. In the natural environment, hypoxic stress is one of the factors affecting the species composition of the ecosystem. However, on agricultural land it is the cause of economic damage and consequently social problems, mainly in underdeveloped countries. Unlike animals, which can escape from danger, plants, because of their sedentary lifestyle, cannot change the surrounding environment in which they are rooted. This has given rise to the development of complex adaptive and defensive systems. The cellular structures formed under unfavorable abiotic conditions called stress granules (SGs) are probably part of one such adaptive system.

Stress granules are membraneless cytoplasmic structures in size 0.1-0.2 µm. They are formed in the cytoplasm of cells exposed to abiotic stress, including heat, oxidative stress and UV radiation. The composition of stress granules varies depending on the stress inducing factor, which suggests their participation in adaptive mechanisms in response to stress conditions. Surviving the conditions of abiotic stress is related to the limitation of processes that require large amounts of energy in the cell. Protein synthesis is such a process. Therefore, under stress conditions, it is necessary to reduce the intensity of translation. This is primarily aimed at limiting energy consumption by synthesizing only proteins that are essential for the organism's survival. The mRNA molecules whose translation has been stopped are directed to the stress granules. One of the main questions regarding the function of SGs is whether these structures are a storage or degradation site for mRNAs. It has been shown that the cellular response to stressful conditions requires the presence of specific proteins. So far, the precise mechanisms regulating selective translation are unknown. It is known that despite the changes in SG composition under different stresses, both translational and non-translational mRNAs are present in cells. Selective accumulation of mRNA in SG may be a strategy that allows translation of only selected proteins in response to stress. Recent studies in animal models indicate that post-transcriptional chemical modifications of mRNA can affect mRNA cell localization. Initial research results showed that transcripts containing a modification of N6-methyloadenosine (m6A) accumulate in stress granules.

The aim of the project is to understand the function, composition of RNA and the processes accompanying the mechanisms of RNA transport to SG during hypoxia stress in plants. To achieve this, we intend to use molecular studies, stress granules isolation and sequencing of methylated mRNAs. Verification of the role of stress granules in posttranscriptional regulation of gene expression in plants during abiotic stress will be performed with the use of Lupine (Lupinus angustifolius). Narrow-leaf lupin is a crop that, due to its high protein and dietary fiber content and low fat and starch content, is gaining recognition as a potential food and animal feed ingredient

The research proposed in this part of the project is innovative. The role of m6A methylation in response to hypoxia stress in plants has not yet been investigated. In addition, none of the post-transcriptional regulation of gene expression studies to date has been carried out on a plant other than the model plant. These will be the first reports of new ways of responding to hypoxic stress in crops. The results obtained under the project, despite the fact that they relate to basic research, may in the future contribute to the production of plants with increased tolerance to hypoxia, which will reduce the loss of crops due to flooding.