The problem of global drought-induced stress and mortality of forest tree species due to increasing temperatures is currently alarmingly large and unprecedented. Due to the rapidly changing climate, Scots pine (*Pinus sylvestris* L.) - one of the most important species of forest trees on Earth - may lose up to 60% of its current range in Europe within a few decades. **A breakthrough would be the large-scale use of a biochemical indicator of drought-resistant, high-quality seeds.** The adaptation of plants to survival in a specific environment is shaped by external factors affecting parental trees and the seeds during their development. Local populations of tree species are adapted to the given environmental conditions. However, nowadays trees adapt much more slowly than climate change occurs. Therefore, there is a need to identify populations characterized by high seed viability, which would give rise to more resistant forests under new conditions. **Minimization of the risk of tree stand stability loss by identification of populations characterized by higher seed viability may be crucial for the continuity of forest ecosystems as well as managed forests aimed at wood production.**

Proline and enzymes involved in its metabolism are promising candidates for such an indicators. The accumulation of proline is a mechanism triggered by plants to counteract the consequences of drought. Low precipitation and high temperatures cause plants to experience stress, which causes an excessive accumulation of toxic molecules of reactive oxygen species (ROS) in plant cells. ROS damage cell lipid membranes and disrupt cell functions, thus reducing seed viability. Proline is an amino acid that removes excess ROS, limiting the disturbances they cause and stabilizing the structure of cell membranes and related proteins. In addition, it reduces water loss, which is important in the face of drought. Our preliminary research has shown that the proline content in seeds changes during their development depending on the moisture and thermal conditions and that the proline concentration in woody plant seedlings changes with the duration of drought stress. **We intend to assess whether differences in the biochemical response to drought between seeds that mature in regions with different local climatic conditions can be adaptive changes and which of them can serve as markers of seed viability**. For this purpose, seeds obtained from nine stands in Poland located within three regions characterized by different thermal and precipitation conditions will be used. We will perform genetic analyses that will help to select the most genetically uniform populations at neutral markers. This comparative approach may bring us closer to understanding the role of proline in the complex mechanism of acquiring the ability of tree offspring to survive under new conditions caused by climate change. Then, we will test the variability of the selected populations with the use of planned biochemical methods. The differences observed at the biochemical level between the selected populations growing in different climate regions will probably constitute adaptive differences. Not only the viability and vigor of seeds from individual climatic regions will be determined, as evidenced by germination capacity, the level oxidative degradation of lipids proline levels. We will also measure the activity of enzymes involved in proline metabolism, such as delta-1-pyrrolyl-5-carboxylate reductase (P5CR), which is responsible for proline biosynthesis, and proline dehydrogenase (ProDH), which is involved in proline catabolism, and expression levels of genes encoding these enzymes. It is assumed that seeds characterized by higher viability show a higher level of expression of gene encoding an enzyme responsible for proline catabolism and seed viability decreases with a decrease in the mean annual precipitation total.

Indication of a fast and unambiguous marker of seed viability may be crucial for protecting the seed resources of forest-forming tree species. This research can close the gap caused by missing studies on the basic molecular mechanisms of tree seed ability to withstand unfavorable environmental conditions in the face of climate change. In the case of long-lived organisms of trees, unlike herbaceous, it is still not completely understood how climate change affects the basic molecular mechanisms related with seed viability, and thus the ranges of species. The adaptation of tree species to the consequences of climate change is one of the most important challenges facing modern forestry. **Minimizing the risk of tree stand stability loss by identifying populations characterized by higher adaptability and using their offspring for reforestation may be crucial for reducing economic losses in managed forests and for the continuity of forest ecosystems.** It would enrich knowledge on adaptive potential of Scots pine, which is one of the most important species of managed forests in Europe. Seeds from populations identified as more resistant to drought can be used as part of assisted migration, i.e., placing in a given area individuals better adapted to the forecasted climate changes.