The study of plants for agricultural purposes consists in the evaluation of their phenotype, i.e. the properties characterizing their productivity, quality and resistance to stress, and describing processes at the molecular level related to gene expression, protein functions and production of metabolites. Modern measurement methods provide large amounts of data, but the amount and quality of information in these data depends on the proper planning of experiments, including the proper determination of the moments of sampling for analyzes. In the project, we will tackle the challenge of optimizing the biological sampling plans to quantify molecular-level traits. We will develop new statistical procedures for the integration of phenotypic, transcriptomic and environmental data in the form of time series, which will allow normalization of estimated genetic effects with respect to differences in plant development (developmental heterochrony). We will also develop new algorithms for recognition of develpomental stages of plants by image analysis. We will prove the concept by performing an experiment in which the reaction of barley plants to water scarcity will be investigated. The project will provide basic results in the field of data analysis methods of time series and image analysis in plant studies. It will also expand knowledge about the stress associated with drought in barley with results of high basic and application importance. The project will be carried out in cooperation between IPK (Gatersleben, Germany), a scientific unit with extensive experience in the field of plant physiology research and having unique research equipment for plant phenotyping, and a team from IPG PAS in Poznań with knowledge and experience in the field of statistics and bioinformatics.