Spectroscopic methods for rapid phenotyping of trees reflecting their ecological resilience

DENDRO-SPEC

The overall objective of the DENDRO-SPEC project is to generate new knowledge allowing better understanding the effect of genetic variation in tree populations combined with stand conditions, silvicultural practices and local microclimate on mechanisms of xylogenesis and, consequently, characteristics of generated wood. For that reason, an innovative measurement protocol and original hardware set-up optimal for routine assessment of the wide range of wood properties will be developed. The prototype scanning system will integrate state-of-the-art near infrared spectroscopic technologies with cutting-edge data mining solutions. It will allow mapping a wide range of wood characteristics, considering the natural variability at the scale of a single tree as well as forest plot or even overall population.

The genetic adaptation, shaped by evolutionary forces as natural selection, genetic drift, migration, type of mating and recombination, can be much better investigated and explored assuming a systematic approach as proposed for the DENDRO-SPEC project. Research will be conducted on a unique sample set of Scots pine wood available as a result of the proceeding fifty-year in-field project experiment. The progeny of the populations proposed within the frame of the DENDRO-SPEC project is very particular and with high potential for scientific breakthrough. Selected trees are growing in identical soil and climatic conditions, preserving the diversity interpreted as influenced only by genetic factors, different for each studied population, while the phenotypic plasticity (capacity of an organism to change its phenotype in response to a change in environment) is under control.

The DENDRO-SPEC project activities include a systematic characterization of a whole range of material properties that can be precisely traced to specific trees, and therefore, linked to a fully described portfolio of genetic structure of analysed provenances, silviculture and climate references. DENDRO-SPEC project proposes comprehensive, multi-level and multi-sensor characterization of a whole range of quality features by several innovative methods. The project will employ cutting-edge non-destructive spectroscopic techniques combined with advanced data mining for systematic and extensive characterization and evaluation of wood. It is expected that proposed spectroscopic techniques implemented as high-throughput phenotyping measurement tools may become a commonly accepted alternative to the labour intensive and costly genetic methods. The DENDRO-SPEC project will provide new knowledge, methods and tools that have high potential for further optimizing the management and sustainable use of forest resources in the context of climate change.

The DENDRO-SPEC project will generate a knowledge and understanding of the adaptive potential of a tree population and establish a foundation for future fundamental and applied research in the field. The project will provide new knowledge and tools for reliable assessment of several wood quality indicators particularly relevant in the context of ongoing research related to provenance studies of basic forest tree species and will generate new know-how regarding complex mechanisms of tree formation and xylogenesis.

It is expected that DENDRO-SPEC methodology will demonstrate its highest suitability toward fast, non-destructive and complete characterization of wood. The middle/long term impact of the DENDRO-SPEC project will include input for optimization of the future forest stand compositions by means of planting trees capable of elevated CO_2 sequestration, still guarantying expected technical characteristics of timber. This is extremely relevant in the context of recent climate change and necessary mitigation actions. The new know-how delivered will assist strategic decisions and planning of optimized selection of trees growing in different locations by maintaining and/or restoring forest ecosystems depending on the genetic potential and physiological responses of diverse populations. Consequently, the DENDRO-SPEC project will develop new methodology that might be later implemented for fast and accurate estimation of wood quality that responds to continuously evolving demands for forest products and services.