

Role of roots of selected trees species in soil organic matter stabilization and in shaping microbial activity of forest soils

Interest in research on the carbon cycle in forest ecosystems is increasing due to the emerging climate change issues. Soil is known to be one of the largest carbon reservoirs on the Earth. Soil C stock is influenced by several environmental factors such as topography, climate, bedrock, and vegetation. Forest soils are characterized by a high accumulation of organic carbon in the surface horizon because of the supply of organic debris from the aboveground plant parts and root systems. Roots are a key component of the underground system; they are the primary source of soil organic matter (SOM) and influence microbial activity. Root secretions have a significant impact on soil organic matter dynamics and plant–soil interactions in forest ecosystems. Understanding the influence of stand species composition on the transformation of soil organic matter is important in evaluating soil as a site of stabilization and carbon source. The study will consider the role of root exudates in supplying carbon substrates as an energy source for microorganisms. Soils on which six tree species grow, i.e., Scots pine, oak, beech, ash, hornbeam, and larch, which play an important forest-forming role in temperate forests, will be included in the study.

In our research, we will determine the relationship between root biomass and their exudates and soil organic matter fractions as well as the abundance of bacteria and fungi in forest soils. We will carry out a detailed root analysis (root biomass including fine roots; root growth; root decomposition rate; root exudates). Soil organic matter fractionation will be performed in soil samples and basic properties will be determined, i.e. pH, acidity, C and N content, micro and macro element content. In addition, enzymatic activity as well as number and diversity of bacteria and fungi will be determined in soil samples using NGS method. The research will explain the influence of root biomass of major temperate forest species and their secretions on the quantity and quality of soil organic matter and on the abundance and diversity of microorganisms involved in its transformation. The research will complement knowledge on forest ecosystem ecology, biogeochemistry, and soil microbiology. Knowledge of the factors affecting soil organic carbon accumulation and the relationship between these processes and tree root systems is crucial for understanding the carbon cycle in forest ecosystems.