Summary

The doctoral dissertation was composed of six peer-reviewed papers aimed to determine the role of fine roots and under-canopy litterfall of various forest tree species in the accumulation and development of soil organic matter in regenerated and reconstructed forest ecosystem scenarios.

The research was carried out on sites reconstructed in post-industrial areas, including combustion waste disposal sites, sandpit excavation, as well as regenerated post-fire sites. In the experiment influence of alder (black alder, gray alder, and green alder), Common birch, Scots pine, and European larch were tested.

In order to estimate the annual increment of fine root biomass, the accuracy and efficiency of sampling methods were assessed. The result concluded that using the core extraction method gives about three times higher annual biomass increments than the monolith method. Results concluded that the use of the core extraction method may accelerate fine roots increment and show the adaptation potential of trees and communities to highly degraded ecosystems.

The research allowed, as well, to determine the key soil properties influencing fine roots biomass increment, i.g. positively correlation with soil pH in the range from 3.5 to 4.1. Especially in the case of poor sandy soils, the biomass growth of alder fine roots was stimulated by nutrient deficiency. On the other hand, the higher availability of nutrients, e.g. magnesium (Mg), reduced the growth activity of fine roots. It was also found that the nitrogen (N) soil pool connected with annual fine roots biomass increment did not differ from the nitrogen pool connected with under-canopy litterfall, and the phosphorus (P) pool was even higher.

As a result of the research, it was also possible to determine the phytoremediation role of fine roots and the relationship between the content of heavy metals in soils and the biomass of fine roots. The index of bioaccumulation of trace elements fixed with fine roots was influenced by

soil properties, especially pH, texture, and soil organic matter content. The obtained results confirm the importance of fine roots in the process of soil organic matter formation and the accumulation of elements in the restored and reconstructed forest ecosystems. This is particularly important in the case of oligotrophic sandy soils, where the deficiency of nutrients can be balanced by an efficient circulation related to the production and rapid decomposition of organic matter, including the annual cycle of fine root growth.

Key words

fine roots, under-canopy litterfall, soil organic matter, ecosystem regeneration, ecosystem reconstruction