**Summary**

The effect of climate change is the increasing occurrence of disturbances in the form of weather anomalies, which affect the forest ecosystem and soil environment. In conducted research, increasing attention is being paid to the impact of thermal and moisture conditions on the stability of forest stands and the formation of soil properties, especially on the cycling of carbon, nitrogen and phosphorus. Soil is one of the largest carbon reservoirs on Earth, and its reserves are influenced by such environmental factors as climate, bedrock and vegetation. Forest soils are characterized by a high accumulation of organic carbon in the surface horizons as a result of the influence of vegetation through the aboveground biomass provided, root systems and their secretions. The purpose of the present study was to determine the role of the root system of selected forest tree species in shaping soil properties, especially stabilization of soil organic matter and shaping microbial activity of soils. The effects of simulated drought and excessive nitrogen deposition on the secretions and morphological characteristics of the root system of selected deciduous and coniferous species were investigated. Four field experiments were conducted, resulting in confirmation of the influence of the root system on the physicochemical and biological properties of the forest soil. The root systems of trees and their secretions had a significant impact on shaping the quantity and quality of soil organic matter expressed by fractional composition. The results showed a close relationship between the morphology of the root system and the enzymatic activity and amount of bacteria and fungi. A difference in the composition of bacteria and fungi was shown for coniferous species such as pine and larch. Soil in ash stands had a high diversity of microorganisms compared to other species. The study showed that a higher nitrogen rate increased the amount of carbon released with the secretions of fine roots and the overall root morphology. Excessive nitrogen deposition had a significant effect on the overall nutritional status of beech seedlings. An experiment with simulated drought showed that moisture limitation influenced greater root growth compared to the control variant. Drought affected the amount of carbon secreted with root exudates, which had a direct effect on the change in enzymatic activity. In conclusion, the conducted research indicates a very important role of root systems and their secretions in shaping the properties of forest soils. The results obtained can be practically used in planning the species composition of the forest stand, which can consequently translate into improved stability of forest ecosystems.

**Keywords**: Enzyme activity, root morphological characteristics, soil organic matter, soil microorganisms, properties of forest soils, root exudates