

The exceptional summer of 2003 as a test scenario for the root competition between adult beech and spruce forest trees

P. Nikolova, K.-H. Häberle, H. Blaschke, R. Matyssek

Ökophysiologie der Pflanzen, Technische Universität München, 85350 Freising, Germany

The summer of 2003 was characterised by above-average insolation, distinctly enhanced daily mean temperatures and exceptional drought conditions. These extremes regarding Central-European summer conditions were setting the stage for examining the below-ground competition between 60-year-old beech and spruce trees in a mixed forest near Freising. Competitiveness for gathering soil resources was viewed in terms of the structural investment into roots that is required to ensure efficient sequestration and exploitation of belowground space. Thus, the availability of water became a crucial factor in the exacerbating competition between the forest trees during the assimilation period of 2003. It was hypothesized that the two tree species contrast in their structural and functional investment/return strategies with respect of competitiveness for water.

Root responses observed in 2003 were compared with those of 2002. Emphasis was on the standing biomass, growth increment as well as the respiration of fine roots, the water transport in coarse roots and the proportion of autotrophic in total soil respiration. In 2003, the signature of $\delta^{13}\text{C}$ in the biomass of newly formed fine roots reflected enhanced WUE in both competitors, although the rate of fine root recovery was reduced by 80% for spruce as growing in monoculture. In addition, premature dormancy of the fine roots appeared to exhibit stress avoidance in response to drought. In contrast, beech displayed less constraint on the structural and physiological performance of the root system and appeared to reflect drought tolerance. Root architecture was related to the distribution patterns of precipitation and soil properties in the stand towards mechanistic interpretations of the species-specific strategies in competitiveness under the harsh summer conditions of 2003.

It is concluded that the greater structural and physiological plasticity of the root system of beech in tolerating drought periods substantially contributes to the documented high competitiveness and dominance relative to spruce at many forest sites of Central Europe.