International Symposium “Root Research and Applications”
RootRAP, 2–4 September 2009, Boku – Vienna, Austria

Long-root growth dynamics, bio- and necromass, turnover rate, NPP and its proportion of fine root production in a fertile Norway spruce forest

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Long roots (LR) are functionally significant for the spreading and stability of the fine root system and for nutrient transport within the plant. Woody roots of diameter <2 mm develop from fast-growing or slow-growing long-roots with a primary structure and conical root apex (Salyayev, 1959), which occupy free soil volume quickly and create the option to form more ectomycorrhizal short roots on them later. The LR growth dynamics, bio- and necromass, turnover rate, net primary production (LRNPP) and its proportion of fine root production (FRNPP) was measured in a fertile Norway spruce (Picea abies) forest. Soil and ingrowth core and soil monolith (50x50x20 cm3) method was used for estimation of in 1996-1999 and 2008, respectively. The yearly average increment of fast-growing LR in study area was 295 ± 53 mm in 1982 (40 yr-old), 224 ± 79 in 1994 and 115 ±19 mm in 2008, and their growth was seasonally most rapid from mid-June until mid-July. In the first half of the growth period the growth of LR depended mainly on soil temperature, and in the second half, on the soil moisture content.

LR occupied the root-free soil volume in ingrowth cores first. The mean LR biomass was 55.8 (12.7 % of total fine root biomass), 25.6 (4.9 %) and 7.3 kg ha-1 (1%) in the first, second and third year ingrowth cores, respectively; 6.4 kg ha-1 (0.5 %) in soil cores and 5.7 kg ha-1 in soil monoliths. The LRNPP was 7.8 and 9.4 kg ha-1 year-1 estimated by ingrowth cores (third year after inserting) and soil monoliths, respectively. Turnover rate of LR was 1.1 year-1 for third-year ingrowth cores and 1.7 year-1 for soil monoliths. Hence LR dynamics is affected by their age, status (fast- or slow-growing) and limiting environmental conditions.