

Factors affecting fine root and rhizome contribution to soil carbon sequestration in Norway spruce stands

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The aim of the study was to analyze the factors affecting the turnover rate (TRate) of <2mm fine roots (FR) and understorey rhizomes, both <2 mm in diameter, of spruces, deciduous trees, shrubs and herbs, and to estimate the respective carbon (C) inputs into forest soils. FR and rhizome bio- and necromasses were measured in ingrowth cores after 3 years after inserting; 4 times a year in a pole (28yr) and a mature (84yr) Norway spruce stand; and once in soil cores. Stand density was 2315 and 698 stems ha⁻¹, and basal area 15.5 and 29.0 m²ha⁻¹ in pole and in mature stands, respectively. The annual FR and rhizome production in the ingrowth cores was calculated according to Fairley and Alexander (1985); TRate was calculated dividing the annual production by the mean biomass. FR (and rhizome) turnover was calculated multiplying the TRate from ingrowth cores by the respective mean FR (and rhizome) biomasses from soil cores. In the pole stand, tree FR comprised 97.4% (11.8 t ha⁻²) of the fine belowground plant biomass in soil cores and 99.2% (13.3 t ha⁻²) in ingrowth cores; the rest was shrubs and herbs. In the mature stand, tree FR biomass formed 92.4% (9.4 t ha⁻²) in soil cores; and shrubs and herbs 6.5%, and 0.8%, respectively; in ingrowth cores tree FR formed 94.7% (6.8 t ha⁻²). In the pole stand, the turnover of tree FR was 6.9t ha⁻² year⁻¹ (97.5% of the whole FR and rhizome turnover) and in the mature stand 7.1t ha⁻² year⁻¹ (80.7%).

In the mature stand the turnover rate was: 0.68; 1.58; 2.12 and 2.72 year⁻¹, for spruces, deciduous trees, shrubs and herbs, respectively. The main factors affecting fine root and rhizome contribution to soil C were plant species composition, environmental conditions and stand age.