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Mean age of carbon in fine roots from temperate forests and grasslands with different management

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Fine roots are the most dynamic portion of a plant's root system and a major source of soil organic matter. By altering plant species diversity and composition, soil conditions and nutrient availability, and consequently belowground allocations and dynamics of root carbon (C) inputs, land-use and management changes may influence organic C storage in terrestrial ecosystems. In three German regions we measured fine root radiocarbon (14C) content to estimate the mean time since C in root tissues was fixed from the atmosphere in 54 grassland and forest plots with different management and soil conditions. The mean age of C in fine roots in forest environments averaged 11.3±1.8 years (mean ± SE, n=27) and was significantly older and more variable compared to grassland environments (1.7±0.4 years, n=27). We further found that management affects the mean age of fine root C in temperate grasslands mediated by changes in plant species diversity and composition. Fine root mean C age is positively correlated to plant diversity (r=0.65) and to the number of perennial species (r=0.77). In temperate grasslands the mean age of fine root C is also influenced by the study region mainly due to differences in soil characteristics and climate, with averages of 0.7±0.1 years (n=9) on mostly organic sandy soils and of 1.8±0.3 years (n=9) and 2.6±0.3 (n=9) in more silty and clayey soils respectively. Our results indicate an internal redistribution of C in perennial species and suggest linkages between fine root C age and management in grasslands. These findings improve our ability to predict and model belowground C fluxes across broader spatial scales.