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Determinants of soil organic carbon pools in oak stands in northeastern Austria

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Recently deciduous forests in northeastern Austria received increased attention as potential sources of biomass for energetic utilisation. There are still substantial deficits in the knowledge on carbon pools, -sequestration and -dynamics at these forest sites. The aim of our study was therefore to identify the main determinants which control soil organic carbon (SOC) pools in differently managed Quercus petraea dominated stands. We used the chronosequence approach to test the influence of stand age and management on the SOC pool. Soil samples were systematically collected from 14 plots by means of a 70mm hand auger to a depth of max. 60cm and separated into five geometric horizons. Narrow O-layers and signs of active bioturbation on most sites suggest rapid carbon mineralisation. Carbon pools of the aboveground biomass, the O horizon as well as fine and coarse roots and decay were determined. Soils in our study are cambisols derived from fossil alluvial deposits and loess and calcic chernozems derived from loess. Total soil carbon was determined by means of dry combustion and subtraction of soil inorganic carbon (SIC, by means of the Scheibler-method) if present. Mean SOC contents ranged from 5.3 kg.m-2 to10.4 kg.m-2 in the entire study area. The highest contents were found in calcic chernozem sites (7.2-10.4 kg.m-2) followed by loamy cambisol (6.1-6.8 kg.m-2) and sandy cambisol sites (5.3-6.9 kg.m-2). Among three chronosequence sets, we found strong positive correlations with total nitrogen (Pearson correlation coefficients of +0.91 to +0.93, $p<0.01$) and medium strong positive correlations with fine root content (+0.27 to +0.42, $p<0.01$). In both cases, stronger correlations were observed at cambisol sites. Further medium correlations were found between SOC and decay (+0.23 to +0.42, $p<0.01$), but no influence of the soil type was observed. As expected, SOC contents decreased significantly with increasing soil depth. Tighter C/N ratios in deeper horizons suggest ongoing decomposition of soil organic matter (SOM). Total carbon pools analysis revealed a decline of the share of SOC on total carbon pool with increasing stand age and an increase in aboveground carbon in the vegetation ($r^2=0.88$). SOC accounted for 34-66 percent of the total carbon pool. In our study, the main determinants of SOC are soil type, soil depth and fine root content. Our results suggest that forest management (coppice with standards vs. high forest system) in deciduous forests in the northeastern lowlands of Austria has no decisive influence on soil carbon pools.