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Loss of available soil organic carbon from afforestation plots: effect of tree species composition and warming

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Afforestation with pure and mixed-species is an important strategy to improve soil organic carbon (SOC) stocks and restore degraded lands. However, what remains unclear is the stability of SOC to microbial degradation after afforestation and the effect of tree species composition. Moreover, it is important to reveal how sensitive the SOC in afforestation lands is to environmental changes, such as warming. To study the combined effects of warming and the tree species composition on decomposition of SOC by microorganisms and enzyme activities, soils were collected from the monocultural and mixtures of Silver birch (Betula Pendula) and European beech (Fagus Silvatica) (BangorDiversity, UK, 12 years since afforestation) and were incubated for 169 days at 0, 10, 20, 30 °C at 60 % of WHC. The field experiment is arranged into a completely randomized design with n=4. The CO_2 efflux was measured constantly, whereas activities of β-glucosidase, chitinase and acid phosphatase, and content of microbial biomass C (MBC) were obtained at the end of the incubation. Results showed that soil cumulative CO_2 efflux increased by 34.7–107% with the temperature. Potential enzyme activities were dependent on tree species composition. Warming, but not tree species exhibited a significant impact on the temperature sensitivity (Q10) of soil cumulative CO_2 efflux and enzyme activities. The greatest temperature sensitivity (Q_{10}) of total CO_2 efflux was found at 10–20 °C and was 2.0–2.1, but that of enzyme activities were found as 0.9–1.1 at 0–10 °C. These results suggest that warming has an asynchronous effect on the SOC decomposition and enzyme activity, and enzymes cannot account for the temperature sensitivity of soil respiration. Thus, thermal adaptations of SOC mineralization is independent of the adaptation of the enzyme pool.