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Carbon, Nitrogen and Fungal mycelium in the organic and in the mineral soil layers across a chronosequence of Stone pine Forest on Mount Vesuvius

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Forest ecosystems act as a substantial carbon sink and store about 20% of all soil C. The amount of organic matter sequestered in the soil is dependent on the quantity of plant litter delivered to the soil as well as to the extent of litter decomposition. Stone pine forests are common in the Mediterranean areas of southern Italy, were this tree has been largely used for afforestation of volcanic substrates on Mount Vesuvius. Nevertheless, very little is known about carbon accumulation in Stone pine soil as well as about soil organic matter turnover in the organic and in the mineral soil layers.

The aim of this study was to assess, along the whole soil profile, the concentration of C and N and the amount of fungal mycelium across a chronosequence encompassing a 36y, a 66y and a 96y old Stone pine forest within the National Park of Vesuvius. The chronosequence allows to estimate the changes with forest age in C and N concentration and the allocation of organic matter below-ground. The amount of fungal mycelium, particularly the active mycelium, at different depth along the soil profile is an indicator of the organic matter turn-over.

The forest stands had been implanted on the same type of parent material, i.e. on lava. The sandy mineral soil was 15 cm deep in the youngest forest and reached a maximum depth of 37 cm in the two older forests. Litter fall (2006–2009) steadily increased from the youngest to the oldest forest stand (3828, 6144 and 7831 Kg/ha/y, respectively) and was positively related to tree basal area.

C and N concentration in the organic soil layers (litter and humus) of the three stands did not change remarkably with forest age. In contrast, in the 0-15 cm mineral layer, C and N concentrations were about threefold higher in the 66y old compared to the 36y old forest stand. A further increase (by 2,4 for C and by 1,5 for N) was observed in the 96y old compared to the 66y old forest stand. In the deeper (15-37 cm) mineral soil of the two older forest stands, C concentration was 6 times higher and N concentration 3 times higher in the 96y old forest. The values of the C/N ratio decreased with depth in all stands; C/N values in the mineral soil, were higher in the oldest forest stand, consistently with the lower increase of N compared to C concentration. The results indicate that C and N accrual in the soil of the chronosequence derives from a combination of aboveground (mainly needle litter) and belowground (mainly roots) litter inputs whose different quality is mirrored by the different C/N ratio along the soil profile.

The amount of active fungal mycelium was related mainly to soil water content and was highest in the humus layer. Though the active mycelium was present all over the whole profile of both the older forest stands, even in the deepest layers, its amount decreased with depth likely due to resource shortage. When referred to soil organic matter, fungal mycelium was most abundant in the mineral soil layers from 5 to 15 cm where it constituted up to 11% and 7% of the organic matter, respectively in the 66y and the 96y old forest; in contrast in the organic soil layers fungal mycelium reached a maximum of 2 % of the organic matter. This suggests that organic matter turnover is more active in the upper mineral soil layers and decreases with depth and forest age favouring a major accumulation in the deepest layers of the oldest forest stand.