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# C-use efficiency and C-availability to soil microorganisms of abandoned arable land in the Nature Reserve (Kaluzhskie Zaseki, European Russia)

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Abandonment of agricultural lands leads to the changes of vegetation composition and microbial community functioning that may influence an amount of soil organic carbon stored and $CO_2$ efflux. Our research focuses on the assessment of soil organic carbon (Corg) content and its consumption efficiency by soil microorganisms at vegetation restoration on abandoned arable in the "Kaluzhskie Zaseki" Reserve. The arable land located inside the old-growth forest tract ($\geq$300 yrs.) was abandoned in the beginning of 1990s. Vegetation and soil were sampled at four transects ($\sim$75 m) from the forest (FR) to the border between forest and the abandoned arable land (ARB) towards its center (ARC). The list of plant species in three vegetation layers and their coverage of each site (100 m2, 5 plots) were compiled. Soil samples in each site were collected from 0-10 cm layer in October, 2012 (Albic Luvisols, totally 12). Soil Corg (dichromate oxidation), pHw, microbial biomass carbon (MBC, SIR-method) content and basal respiration (BR) rate were measured. Microbial metabolic quotient ($qCO_2$=BR/MBC), $qCO_2$/Corg and MBC/Corg ratios were calculated for assessment of microbial community features (specific soil microbial respiration, C-use efficiency and C-available, respectively). Quercus robur, Fraxinus excelsior, Tilia cordata, Ulmus glabra, Acer platanoides and A. campestre dominate in FR site. Betula pendula and B. pubescens with nemoral herbs were diagnosed for ARB, whereas birch with meadow grasses were found at ARC. Soil pH varied between 4.8 (ARC) and 5.5 (ARB), it was not significantly differ for studied sites. Corg and MBC ranged 1.1-2.1% and 213-655 $\mu$g C g-1, in FR it was averaged 1.5 and 1.7 times higher ($p<0.05$) than those in ARC. Soil BR was significantly decreased from FR to ARB and ARC with averaged 1.74, 1.09 and 0.93 $\mu$g $CO_2$-C g-1 soil h-1, respectively. The $qCO_2$ and MBC / Corg varied from 1.2 to 4.6 $\mu$g $CO_2$-C $mg^{-1}$ Cmic $h^{-1}$ and from 1.9 to 3.2%, whereas averaged values were similar for sites. Soil $qCO_2$ / Corg ratio in FR and ARB reached on average 168 and 176 mg $CO_2$-C $g^{-1}$ Cmic $h^{-1}$ (g Corg g-1 soil)-1, it was on 40% less compared to ARC. Thus, soil C-use efficiency by soil microorganisms declined along the transects, whereas C-availability was similar for studied sites. Soil organic carbon and microbial biomass contents, as well as microbial respiration rate remain lower compared to the old-growth forest even after 20 years of restoration abandoned arable land, and especially at more distance from the forest.

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