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Abiotic soil matrix, rather than microbial community composition, determines litter C cycling

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Microorganisms are the primary agents of litter decomposition in the detritusphere, and are considered potentially powerful levers for influencing soil biogeochemical transformation of plant C into soil organic matter (SOM). However, it remains unclear whether soil microbial activity is primarily constrained by the microbial community composition or by the abiotic soil habitat in which they live. We explored the relative importance of abiotic and biotic factors in litter carbon (C) cycling by reinoculating five sterilized agricultural soils from the Netherlands with six contrasting soil microbial communities from a gradient of land-use intensity. Admixing of subsurface horizons (representing older SOM) and the addition of synthetic ferrihydrite (as an iron oxide representative) were included as additional abiotic manipulations. 16S and ITS amplicon sequencing confirmed that the contrasting communities successfully colonized the sterilized soils and retained strong signatures of their source inoculum during a laboratory incubation of nine months. Nevertheless, basal respiration of SOM and the mineralization of isotopically (^{13}C) labelled litter (*Lolium perenne*) was overwhelmingly determined by the abiotic soil matrix, most notably the source soil and mixing of subsurface horizons. Ferrihydrite, in contrast, had little effect. These observations were extended by quantification of mineral nitrogen as well as ^{13}C incorporation into particulate and mineral-associated SOM fractions. The findings provide strong experimental support for the responsiveness of C cycling to soil abiotic habitat factors, irrespective of community structure.