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# Plant litter biochemistry controls C partitioning into $CO_2$ and soil organic matter fractions

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Decaying plant material is the major source of soil organic carbon (SOC). Nevertheless, it still remains unclear how the biochemical composition of litter is affecting the formation of SOM. Thus, we aimed to disentangle the effect of plant litter composition on C transference into differently stabilized soil fractions. We did this by individually incubating 13C enriched Eucalyptus spp. organs (bark, leaves, twigs and roots) in topsoil (0–20 cm) of a sandy-clay loam (Haplic Ferralsol) from Paula Candido – Brazil (20º 52' S, 42º 58' E). Additionally, a soil sample without plant residue addition was incubated and used as a control. The samples were incubated at 80% of their water-holding capacity at 25 ºC. The molecular composition of the incubated plant organ material was characterized by solid-state 13C-CP/MAS-NMR spectroscopy. At the end of the incubation experiment (after 200 days), aliquots were taken and the SOM was physically fractionated using a combined density-particle size separation method. The total C content and the relative abundance of 13C ($\delta$ 13C) of each soil organic matter fraction were measured by IRMS, whereas the litter-C contribution for each SOM fraction was assessed using a two-end member isotope mixing model. No significant differences were observed for total SOC contents among the different treatments. Conversely, lower total SOC contents were observed for the control treatment without residue addition, indicating mineralization of inherited SOM along the incubation period. The partitioning of litter-derived C into SOM fractions and $CO_2$ indicates that leaf had higher proportion of C transferred to the total SOC, followed by roots, bark and twigs. The amount of carbon transferred to the mineral associated organic matter (MAOM) was as follows: leaves > bark > twigs > roots. Contrastingly, for the particulate organic matter (POM) the order was as follows: roots > bark > twigs = leaves. Contrasting NMR spectra demonstrate the significant effect of the biochemical composition of each plant organ in the fate of C in soil. Carbon from leaves was preferentially allocated to the MAOM fraction, and was more enriched in carboxyl and alkyl groups. Twigs, bark and roots, which were more enriched in O-Alkyl group, were preferentially respired or allocated into the POM fraction.