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Wildfire effects on soil lipid composition in burnt eucalypt stands, in north-central Portugal

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Wildfires can induce profound changes in the quality and quantity of soil organic matter (SOM) pools. Early detection of fire impacts on SOM pools is relevant for taking decision and planning of post-fire restoration actions, since SOM plays a key role in post-fire erosion risk and the recovery of fire-affected ecosystems. This work focuses on wildfire effects on the composition of lipids in the topsoil of eucalypt plantations, one of the prevailing and, at the same time, most fire-prone forest types in north-central Portugal. To this end, two neighbouring eucalypt plantations were sampled at 5 occasions with roughly 6-monthly intervals, starting immediately after a wildfire in August 2010 till August 2012. One of the study sites was located within the 2010-bunrt area and the other just outside it.

The air-dry soil samples were treated with a dichloromethane-methanol (3:1) mixture for Soxhlet extraction of the SOM's labile lipid fraction, as this fraction is particularly prone to undergo rapid and significant alterations by fire-induced heating. In turn, these alterations have elevated potential to be used as markers of direct fire effects on soil properties in general and, at the same time, as indicators of the recovery process during the so-called window-of-disturbance. The lipid compositions of the samples were determined by GC-MS.

The preliminary results of this study indicated that the soil lipid fraction of the upper soil layer (0-2 cm depth) decreased sharply due to the wildfire, and that this effect lasted for more than 24 months. Its contents in the different sampling periods varied between 2.4 and 5.7 % at the long-unburnt site as compared to 0.9 - 1.1 % at the burnt site. The main differences between the burnt and unburnt samples were found in the distribution patterns of alkyl compounds. Without exception, an accumulation of low molecular weight homologues was observed in the burnt samples, suggesting that fire led to thermal breakdown and cracking of long chain molecules. All, burnt and unburnt samples contained a homologous series of C18 – C35 n-alkanes, with maximum at C27 and C29. The results further suggested an enrichment in the burnt samples of homologues of low molecular weight (as evidenced by a decrease in average chain length) and of even-numbered homologues (as evidenced by a decrease in the Carbon Preference Index-CPI). Apparently, the wildfire also reduced the natural odd-to-even CPI of the n-alkane series. Saturated n-fatty acid bimodal series were detected in the range C14–C3, with a sharp first maximum at C16 and a second maximum at C24, indicating a strong contribution by epicuticular waxes from vascular plants. The n-fatty acid series distribution seemed a particularly good indicator of soil quality status and post-fire recovery, discerning significant seasonal variations in the lipid composition as well as a partial recovery of after 24 months after the wildfire.