
Changes in soil organic C and related biological properties after prescribed burning of shrublands for pasture restoration in the Central Pyrenees (NE-Spain)

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Prescribed burning has been recently readopted as a management practice in the Central Pyrenees (NE-Spain) to stop shrub encroachment processes and recover pasturelands. The immediate effects of prescribed burning on soil C stocks and related biological properties and their evolution in the short- to mid-term after burning were assessed. The study was conducted in three autumnal prescribed burnings in the municipalities of Buisán, Asín de Broto and Yebra de Basa. At each site, the topsoil Ah horizon was sampled at soil depths of 0-1, 1-2 and 2-3 cm immediately before and immediately after burning. Additionally, seasonal samplings were conducted every 6 months up to one year at the Asín and Yebra sites and up to 24 months at the Buisán site. The total soil organic C stock (SOCS) total N stock (NS), microbial biomass C (MBC), soil basal respiration (SR) and β -D-glucosidase activity were analyzed. The maximum temperatures recorded at the soil surface were 438 °C (Buisán), 595 °C (Yebra) and 768 °C (Asín). At the Buisán site, burning significantly decreased the SOCS (-52 %), NS (-44 %), MBC (-57 %), SR (-72 %) and glucosidase activity (-66 %) at 0-1 cm depth, whereas fire had no direct effects on the soil at the Asín and Yebra sites. The contrasting effects of burning on soil that were observed among sites were found to be related to differences in fire residence time. The prescribed fire at the Buisán site was conducted on a plain slope under slow winds (<8 km h⁻¹) at a burning rate of 0.64 ha h⁻¹, which produced greater impacts on the soil properties than the burnings at the Asín and Yebra sites, where fire spread rapidly (2.72 and 1.43 ha h⁻¹, respectively). At the Buisán site, the SOCS and NS recovered to the unburned values 24 months after burning. One year after burning, the SOCS at Asín were 60 % higher than those of the unburned soils at 0-1 cm depth. At all sampled sites a decreasing trend in soil biological activity in the short- and mid-term was also observed. From the results it can be concluded that: 1) the direct effects of burning on soil ranged from neutral to severe at the topsoil, which was related to the specific environmental conditions during the prescribed fires and 2) in the mid-term, the reduction in soil biological activity and the incorporation of ashes and charred plant remains led to an increase in soil organic carbon content in the burned soils.