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ASH-DERIVED EFFECTS ON SOIL PARTICULATE ORGANIC MATTER AND NUTRIENTS FOLLOWING EXPERIMENTAL FIRE

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Abstract

After fires, the ground is covered by ash, which is important to the postfire environment because of its effect on hydrological behavior and its fertilizing properties. Ash-derived effects are difficult to assess in the field but can be measured by experimental burns in the laboratory. In this study, we analyzed the ash effects on soil organic matter (SOM) with focus on particulate organic matter (POM) after a laboratory burn intended to reproduce the conditions of prescribed burning as conducted in the southern Pyrenees (Spain). POM is a SOM fraction consisting of partially decomposed plant debris that is abundant in mountain soils and susceptible to both thermal and microbial degradation. Twenty-five undisturbed soil blocks were collected in a grassland encroached by the shrub *Echinospartum horridum* and managed by prescribed fire in Yebra de Basa (Huesca). Soil blocks were covered with plant material equal in amount and type to that observed in the field and were then subjected to different burning treatments (of short or long duration with low or high Intensity vs. control) using a blowtorch in an external combustion tunnel. Part of the blocks was separated for the analysis of immediate fire effects. For the other blocks, the ash cover was removed from one half of them and all were kept in a greenhouse irrigated daily for 5 months. Blocks were layered at 0-1 and 1-3 cm depths for analysis. Bulk soil was analyzed for total SOM and N and plant-available (Olsen) P. POM was separated by chemical dispersion and sieving and density fractionation using a $ZnCl_2$-sucrose solution (density of 1.6 g/cm^3). POM was quantified and analyzed for its fiber composition (by Van Soest method) and contents of major nutrients (N, P and K). The concentrations of nonparticulate organic matter (NPOM) and N were calculated. Burning produced immediate losses of up to 70% of SOM at 0-1 cm

that came in similar proportions from POM and NPOM despite POM was less abundant than NPOM in soil before fire. Burning altered the POM composition, removing cellulose, hemicellulose and nonstructural components thus leaving more refractory lignin-type components. These changes reverted after 5 months in soils devoid of ash, but were still apparent in ash-covered soils. Severe burning also produced an enrichment of the remaining POM in P and K and an increase in Olsen-P after 5 months. Our results suggest an intense POM mineralization after fire enhanced by the nutrients in ash.

Keywords: soil organic matter, prescribed fire, pastoral burns, laboratory burns