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Alteration of soil properties by high intensity controlled burning in southern Spain

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Abstract

In the last few years, the use of fire to manage forest ecosystems has become more frequent in Europe. Fire has a great impact on the soil and therefore it is necessary to know how controlled burns affect this non-renewable resource, essential for life in forest ecosystems. This study assesses the alterations in the physic-chemical and biological indicators of the soil after a high-intensity controlled burn. A grid of 12 points, representative of 1.4 ha, was established on a hillside in Sierra Morena (Córdoba), with soil developed on sandstones, slates and lithostones. At each point, thermal sensors were placed, and soil samples were collected at two depths (0 - 2 and 2 - 5 cm), before burning, immediately after burning and eight months later (recovery). Soil pH, electrical conductivity, magnetic susceptibility, colour, nutrient content and / or availability and their spatial and time variations were analysed. Soil pH, the main driver for soil microorganisms, was substantially increased in the first centimetres of the soil (0 - 2 cm) immediately after burning up to > 2 units, and the increase was maintained one year after the burn. This may be of interest for forest management (plant species selection) and disease control and prevention. In addition, the high-intensity burn had a positive short-term effect on some of the soil properties, such as nutrient availability for plants, which was considerably increased. Available P increased in more than 30 mg kg^{-1} after the burn in the uppermost 2 cm of soil, and one year after the burn the amount of available P was still higher than before the burn. The magnitude of the alterations in soil indicators was spatially explained by the behaviour of the fire during the controlled burning. The burn also affected soil microorganisms so the intensity of the fire as well as the alterations on soil properties determined their behaviour. In conclusion, the possible immediate and short to medium term effects of burning on soil should be considered for a more holistic management of fire in forest ecosystems, as its functionality and capacity to provide ecosystem services is largely altered by these events as a function of their intensity.

Keywords: Prescribed fire, forest management , mycorrhiza , soil functionality

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