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Effects of different fire severity on soil biogeochemistry and related feedbacks on Quercus ilex L. ecophysiological status

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Abstract

Fire is a key factor in the composition and structure of Mediterranean ecosystems that modulate vegetation patterns through direct and indirect effects on below- and above-ground components. Although forest fires are a common disturbance, little is known about how fire severity affects soil fertility under certain plant species. This is an important issue given the increase in the severity of wildfires observed in regions such as the Mediterranean, possibly linked to land abandonment and climate change. The present study evaluates the short-term effect of fire severity on the biogeochemical properties of the soil beneath *Quercus ilex* L., a dominant tree in Mediterranean landscapes, and their relationship with the ecophysiological response of this species. To achieve this, soils were sampled under the cover of 30 *Q. ilex* and in 10 open interspaces, considering different levels of fire severity (high, low and unburned), immediately and 5 and 12 months after a fire that took place in Toledo (Spain) in 2019. Soil organic matter, CEC, pH, water repellence, ammonium, nitrate and rates of respiration, nitrification and mineralization of N were measured. Likewise, the ecophysiological status of the holm oaks (water stress, gas exchange and growth rates) were measured in tree resprouts. The results showed that, immediately after fire, soil fertility was significantly affected by the fire severity, but in a different way depending on the microsite. Thus, soils under *Q. ilex* cover burned with high severity suffered the higher changes (mainly related to N cycle and soil respiration), while soils properties of the interspaces hardly changed. This short-term effect of the wildfire disappeared in most of the soil study variables one year after fire. However, soil respiration rate or organic matter content did not recover during this time, especially at microsites under plant cover affected by high fire severity. One year after fire, the burned *Q. ilex* with high severity showed lower water stress and higher gas exchange and growth rates than those of low severity or unburned. The results corroborate the post-fire resilience of below- and above-ground components of this ecosystem, under high severity scenarios. However, there are non-recovered variables that should be monitored in the longer term. Thus, this study provides evidence that future alterations in the fire regime associated with an increase in fire severity could interact with different plant canopy microsites in Mediterranean ecosystems to change certain soil properties and plant

functionality.

Keywords: Fire severity, soil fertility, plant ecophysiology, soil spatial heterogeneity

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