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Key factors controlling microbial community response after a fire: importance of severity and recurrence

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Microorganisms play an important role in forest ecosystems, especially after fire when vegetation is destroyed and soil is bared. Fire severity and recurrence might be one of main factors controlling the microbial response after a wildfire but information about this topic is scarce. The aim of this study is to evaluate the influence of fire regimen (recurrence and severity) on soil microbial community structure by means of the analysis of phospholipid fatty acid (PLFA). The study was performed with unburned and burned samples collected from the top layer of a soil affected by a high severity fire (Laza, NW Spain) heated under laboratory conditions at different temperatures (50ºC, 75ºC, 100ºC, 125ºC, 150ºC, 175ºC, 200ºC, 300ºC) to simulate different fire intensities; the process was repeated after further soil recovery (1 month incubation) to simulate fire recurrence. The soil temperature was measured with thermocouples and used to calculate the degree-hours as estimation of the amount of heat supplied to the samples (fire severity). The PLFA analysis was used to estimate total biomass and the biomass of specific groups (bacteria, fungi, gram-positive bacteria and gram-negative bacteria) as well as microbial community structure (PLFA pattern) and PLFA data were analyzed by means of principal component analysis (PCA) in order to identify main factors determining microbial community structure. The results of PCA, performed with the whole PLFA data set, showed that first component explained 35% of variation and clearly allow us to differentiate unburned samples from the corresponding burned samples, while the second component, explaining 16% of variation, separated samples according the heating temperature. A marked impact of fire regimen on soil microorganisms was detected; the microbial community response varied depending on previous history of soil heating and the magnitude of changes in the PLFA pattern was related to the amount of heat supplied to the samples. Thus, wildfire was the main factor determining the microbial community structure followed, in less extent, by fire severity. The total biomass and the biomass of specifics microbial groups decreased notably as consequence of wildfire and minor changes were detected due to soil heating under laboratory conditions. The results clearly showed the usefulness of PLFA pattern combined with PCA to study the relationships between fire regimen (recurrence and severity) and associated direct and indirect changes in soil microorganisms. The data also indicated that degree-hours methodology rather than temperature is adequate for evaluating the impact of soil heating on microbial communities.

Keywords: wildfire, heating temperature, degree-hours, PLFA pattern, microbial biomass

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