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# Land use and rainfall effect on soil $CO_2$ fluxes in a Mediterranean agroforestry system

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Soils are the largest C reservoir of terrestrial ecosystems and play an important role in regulating the concentration of $CO_2$ in the atmosphere. The exchange of $CO_2$ between the atmosphere and soil controls the balance of C in soils. The $CO_2$ fluxes may be influenced by climate conditions and land use and cover change especially in the upper soil organic layer. Understanding C dynamics is important for maintaining C stocks to sustain and improve soil quality and to enhance sink C capacity of soils.
This study focuses on the response of the $CO_2$ emitted to rainfall events from different land uses (i.e. forest, abandoned cultivated soils and winter cereal cultivated soils) in a representative Mediterranean agroforestry ecosystem in the central part of the Ebro basin, NE Spain (30T 4698723N 646424E).
A total of 30 measurement points with the same soil type (classified as Calcisols) were selected. Soil $CO_2$ flux was measured in situ using a portable EGM-4 $CO_2$ analyzer PPSystems connected to a dynamic chamber system (model CFX-1, PPSystems) weekly during autumn 2016. Eleven different rainfall events were measured at least 24 hours before (n=7) and after the rainfall event (n=4). Soil water content and temperature were measured at each sampling point within the first 5 cm. Soil samples were taken at the beginning of the experiment to determine soil organic carbon (SOC) content using a LECO RC-612. The mean SOC for forest, abandoned and cultivated soils were 2.5, 2.7 and 0.6 %, respectively.
The results indicated differences in soil $CO_2$ fluxes between land uses. The field measurements of $CO_2$ flux show that before cereal sowing the highest values were recorded in the abandoned soils varying from 56.1 to 171.9 mg $CO_2$-C m-2 h-1 whereas after cereal sowing the highest values were recorded in cultivated soils ranged between 37.8 and 116.2 mg $CO_2$-C m-2 h-1 indicating the agricultural impact on $CO_2$ fluxes. In cultivated soils, lower mean $CO_2$ fluxes were measured after direct seeding (60.8 mg $CO_2$-C m-2 h-1) than before (65.4 mg $CO_2$-C m-2 h-1). The mean of topsoil water content before rainfall events was 19.7% and after was 28.9%. Soil $CO_2$ fluxes increased on the following days after the rainfall event as the soil dried out but with lower emissions just after the events. This pattern was attributed to the control of soil moisture on microbial activity that affects $CO_2$ production via soil respiration.
$CO_2$ measurements from soil surface are useful to evaluate the potential for soil respiration and soil carbon dioxide production capacity under different land use and environmental conditions for a better understanding of C cycling.