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# Influence of sustainable irrigation regimes and agricultural practices on the soil $CO_2$ fluxes from olive groves in SE Spain

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Olive (Olea europaea) is the dominant agriculture plantation in Spain and its main product, olive oil, is vital to the economy of Mediterranean countries. Given the extensive surface dedicated to olive plantations, olive groves can potentially sequester large amounts of carbon and contribute to mitigate climate change. Their potential for carbon sequestration will, however, largely depend on the management and irrigation practices in the olive grove. Although soil respiration is the main path of C release from the terrestrial ecosystems to the atmosphere and a suitable indicator of soil health and fertility, the interaction of agricultural management practices with irrigation regimes on soil $CO_2$ fluxes have not been assessed yet.

Here we investigate the influence of the presence of herbaceous cover, use of artificial fertilizers and their interaction with the irrigation regime on the $CO_2$ emission from the soil to the atmosphere. For this, the three agricultural management treatments were established in replicated plots in an olive grove in the SE of Spain: presence of herbaceous cover ("H"), exclusion of herbaceous cover by using herbicides ("NH"), and exclusion of herbaceous cover along with addition of artificial fertilizers (0.55 kg m-2 year-1 of N, P, K solid fertilizer in the proportion 20:10:10, "NHF"). Within each management treatment, three irrigation regimes were also implemented in a randomized design: no-irrigation ("NO") or rain fed, full irrigation (224 l week-1 per olive tree, "MAX"), and a 50% restriction (112 l week-1 per olive tree, "MED"). Soil respiration was measured every 2-3 weeks at 1, 3, and 5 meters from each olive tree together with soil temperature and soil moisture in order to account for the spatial and seasonal variability over the year.

Soil respiration was higher when herbaceous cover was present compared to the herbaceous exclusion, whereas the addition of fertilizer did not exert any significant effect. Although the different irrigation regimes did affect soil moisture, soil $CO_2$ fluxes remained unaffected by the amount of water added. Soil moisture and temperature were actually reduced by the presence of herbaceous cover during the growing season, which suggests water competition between herbaceous plants and olives with counteracting effects on soil respiration values. Soil respiration showed high spatial heterogeneity, with values decreasing exponentially with the distance from the olive trees. These data highlight the need to account for their spatial and seasonal heterogeneity when estimating the contribution of soil respiration to atmospheric $CO_2$ emissions and the crucial role of the agricultural management on determining the carbon sequestration potential of soil from olive groves.