



Weed-cover versus weed-removal management in olive orchards: influence on the carbon balance at the ecosystem scale

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Agriculture plays an important role in the C budget at the global scale. Traditional practices based on soil tillage and applying herbicides to remove weeds have caused damage to soils and led to important losses of soil organic C and increased CO₂ emissions to the atmosphere. Changing trends from traditional agriculture to conservation agriculture practices may have an important role in both C and water budgets and the transformation of agriculture from C source to C sink.

The objective of this study was to analyse the effect of two treatments, weed removal by herbicides versus weed cover conservation, on the C balance in an irrigated olive orchard in SE Spain. Measurements of CO₂ exchange were made from October 2014 to September 2015 using two eddy covariance towers, one for each olive crop treatment. Results show that CO₂ fluxes at the ecosystem scale were similar in the two treatments during initial conditions, prior to weed growth in the soils without herbicide application (October). During the first week, daily net ecosystem exchange (NEE) was close to zero in both treatments, with values ranging from 1.06 to -0.41 g C m⁻² in the weed cover treatment, and from 0.76 to -0.69 g C m⁻² in the weed removal treatment. As weed growth increased, higher net CO₂ assimilation was found in the treatment with weed cover. In both treatments, maximum net CO₂ assimilation was found in March, with a monthly NEE of -72 and -28 g C m⁻² in the treatment with and without weed cover, respectively. In May, after the weeds were cut and left on the soil, a strong increase was observed in NEE in the treatment with weed cover due to decreased CO₂ assimilation and increased respiration compared to the treatment without weed cover. Therefore, soil chamber measurements showed average respiration rates of 2.57 and 1.57 μmol m⁻² s⁻² in the weed cover and weed removal treatment, respectively. Finally, the highest monthly NEE was registered during July, with both treatments showing a similar value of NEE (26 and 23 g C m⁻²). Regarding the annual balance, significant differences were found in NEE between both treatments. The weed cover treatment showed 1.6 times higher annual net C assimilation (-132 g C m⁻²) than the weed removal treatment (-83 g C m⁻²). These results highlight the importance of sustainable management practices in agriculture to strengthen the behavior of cropping systems as C sinks.