Geophysical Research Abstracts
Vol. 18, EGU2016-16490-1, 2016
EGU General Assembly 2016

Reduced tillage and cover crops as a strategy for mitigating atmospheric CO_2 increase through soil organic carbon sequestration in dry Mediterranean agroecosystems.

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The implementation of sustainable land management (SLM) practices in semiarid Mediterranean agroecosystems can be beneficial to maintain or enhance levels of soil organic carbon and mitigate current atmospheric CO_2 increase. In this study, we assess the effects of different tillage treatments (conventional tillage (CT), reduced tillage (RT), reduced tillage combined with green manure (RTG), and no tillage (NT)) on soil CO_2 efflux, aggregation and organic carbon stabilization in two semiarid organic rainfed almond (*Prunus dulcis* Mill., var. *Ferragnes*) orchards located in SE Spain

Soil CO_2 efflux, temperature and moisture were measured monthly between May 2012 and December 2014 (site 1), and between February 2013 and December 2014 (site 2). In site 1, soil CO_2 efflux rates were also measured immediately following winter and spring tillage operations. Aboveground biomass inputs were estimated at the end of the growing season in each tillage treatment. Soil samples (0-15 cm) were collected in the rows between the trees (n=4) in October 2012. Four aggregate size classes were distinguished by sieving (large and small macroaggregates, free microaggregates, and free silt plus clay fraction), and the microaggregates occluded within macroaggregates (SMm) were isolated.

Soil CO_2efflux rates in all tillage treatments varied significantly during the year, following changes during the autumn, winter and early spring, or changes in soil moisture during late spring and summer. Repeated measures analyses of variance revealed that there were no significant differences in soil CO_2 efflux between tillage treatments throughout the study period at both sites. Average annual values of C lost by soil respiration were slightly but not significantly higher under RT and RTG treatments (492 g C-CO_2 m^{-2} yr^{-1}) than under NT treatment (405 g C-CO_2 m^{-2} yr^{-1}) in site 1, while slightly but not significantly lower values were observed under RT and RTG treatments (468 and 439 g C-CO_2 m^{-2} yr^{-1}, respectively) than under CT treatment (399 g C-CO_2 m^{-2} yr^{-1}) in site 2. Tillage operations had a rapid but short-lived effect on soil CO_2 efflux rates, with no significant influence on the annual soil CO_2 emissions. The larger amounts of plant biomass incorporated into soil annually in the reduced tillage treatments compared to the conventional tillage treatment promoted soil aggregation and the physico-chemical soil organic carbon stabilization while soil CO_2 emissions did not significantly increase. According to our results, reduced-tillage is strongly recommended as a beneficial SLM strategy for mitigating atmospheric CO_2 increase through soil carbon sequestration and stabilization in semiarid Mediterranean agroecosystems.