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Impact of climate change on water balance components in Mediterranean rainfed olive orchards under tillage or cover crop soil management

María Teresa Rodríguez-Carretero (1), Ignacio J. Lorite (1), Margarita Ruiz-Ramos (2), Alessandro Dosio (3), and José A. Gómez (4)

(1) IFAPA-Centro Alameda del Obispo, Natural Resources Department, Córdoba, Spain , (2) Technical University of Madrid, Dpto de Produccion Vegetal: Fitotecnia, Madrid, Spain , (3) European Commission Joint Research Centre, Institute for Environment and Sustainability, Ispra, Italy, (4) Instituto de Agricultura Sostenible-CSIC, Córdoba, Spain

The rainfed olive orchards in Southern Spain constitute the main socioeconomic system of the Mediterranean Spanish agriculture. These systems have an elevated level of complexity and require the accurate characterization of crop, climate and soil components for a correct management. It is common the inclusion of cover crops (usually winter cereals or natural cover) intercalated between the olive rows in order to reduce water erosion. Saving limited available water requires specific management, mowing or killing these cover crops in early spring.
Thus, under the semi-arid conditions in Southern Spain the management of the cover crops in rainfed olive orchards is essential to avoid a severe impact to the olive orchards yield through depletion of soil water. In order to characterize this agricultural system, a complete water balance model has been developed, calibrated and validated for the semi-arid conditions of Southern Spain, called WABOL (Abazi et al., 2013).
In this complex and fragile system, the climate change constitutes a huge threat for its sustainability, currently limited by the availability of water resources, and its forecasted reduction for Mediterranean environments in Southern Spain.
The objective of this study was to simulate the impact of climate change on the different components of the water balance in these representative double cropping systems: transpiration of the olive orchard and cover crop, runoff, deep percolation and soil water content.
Four climatic scenarios from the FP6 European Project ENSEMBLES were first bias corrected for temperatures and precipitation (Dosio and Paruolo, 2011; Dosio et al., 2012) and, subsequently, used as inputs for the WABOL model for five olive orchard fields located in Southern Spain under different conditions of crop, climate, soils and management, in order to consider as much as possible of the variability detected in the Spanish olive orchards.
The first results indicate the significant effect of the cover crop on the transpiration of the olive orchard, indicating that a correct water and soil management is crucial for these systems especially under climate change conditions. Thus, a significant reduction of transpiration was detected when the cover crops were implanted. When the climatic conditions were more limited (reductions of around 21% for the annual precipitation and increases around 13% for reference evapotranspiration), the impact on olive orchards were critical, affecting seriously the profitability of the olive orchards.
In this context, cover crops can be considered as part of adaptation strategies. Further studies will be required for the determination of optimal species and varieties to be used as cover crops to reduce the impact of climate change on olive orchards under semi-arid conditions.

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