

Hydrological behavior of a Vertisol under different soil management systems in a rain-fed olive orchard

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Soil water availability is a major subject in Mediterranean agricultural systems, mainly due to the limited and highly variable annual rainfall, high evaporative demand, and soil hydrological characteristics. The recent expansion of olive cultivation in the rolling-plains of the Guadalquivir valley, due to the higher profitability of new intensive olive orchards, expanded the presence of olive orchards on Vertisols, soils traditionally used for annual rain-fed crops. These soils have a high content of smectitic clays, which give them a high water storage capacity, and are characterized by vertical and deep shrinkage cracks in the dry season, associated to low soil moisture. Farmers make several tillage passes in these olive groves during the summer, in order to cover the cracks and thus reduce soil water loss by evaporation, which will impact especially in rain-fed in the next olive yield. This tillage practice involves removal of plant residues from the soil surface, as well as burying seeds produced by the plants, so this will remain bared at the beginning of the rainy season, when in the Mediterranean climate is frequent occurrence of high-intensity rainfall, which are ideal conditions for soil loss by water erosion, one of the most serious problems for the sustainability of olive cultivation in Andalusia.

Although there are some studies showing that water loss by evaporation from deep horizons of a vertic soil might be elevated (eg. Ritchie and Adams, 1974), the presence of plant residues on the soil surface drastically reduced soil water loss (eg Adams et al., 1969). Thus the aim of this study was to assess of soil moisture dynamics in a rain-fed olive orchard growing on a Vertisol under different soil management practices, in Andalusia (southern Spain). Four different soil management treatments were applied, which combined a cover crop (*Bromus rubens* L.) or bare soil throughout the year by applying herbicides, with tillage in summer to cover the cracks or non tillage. Results from the first experimental year showed that although, in the treatments of bare soil, the elimination of soil cracks resulted in lower soil water evaporation in summer compared to non tillage, water loss from soil in summer was even lower when cover crop residues were left on the soil surface, compensating water consumption by the cover crop during spring. As a result, the establishment of the cover crop (*B. rubens*) did not result in a penalty for productivity of the olive orchard.

These initial results support the use of cover crops in Vertisols (sown in autumn, and mowed at early spring leaving the residues on the soil surface) as an alternative to tillage during summer to cover the soil cracks. The use of cover crops in olive groves has a number of environmental benefits, such as reduce soil loss by erosion and enhance biodiversity. However, this study should be carried out for a longer period in order to generalize these first results.

References

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