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Improving the water use efficiency of olive trees growing in water harvesting systems

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Water is a primary limiting factor for agricultural development in many arid and semi-arid regions in which a runoff generation is a rather frequent event. If conveyed to dyke surrounded plots and ponded, runoff water can thereafter be used for tree production. One of the most promising runoff collection configurations is that of micro-catchments in which water is collected close to the area in which runoff was generated and stored in adjacent shallow pits. The objective of this work was to assess the effect of the geometry of runoff water collection area (shallow pit or trench) on direct evaporative water losses and on the water use efficiency of olive trees grown in them.

The study was conducted during the summer of 2013 and 2014. In this study regular micro-catchments with basins of 9 m2 (3 x 3 m) by 0.1 m deep were compared with trenches of one meter deep and one meter wide. Each configuration was replicated three times. One tree was planted in each shallow basin and the distance between trees in the 12 m long trench was four meters. Access tubes for neutron probes were installed in the micro-catchments and trenches (four and seven, respectively) to depths of 2.5 m. Soil water content in the soil profile was monitored periodically throughout drying periods in between simulated runoff events. Transpiration of the trees was estimated from half-hourly sap flow measurements using a Granier system. Total transpiration fluxes were computed for time intervals corresponding to consecutive soil water measurements. During the first year, a large runoff event was simulated by applying once four cubic meters to each plot; and in the second year the same volume of water was split into four applications, simulating a series of small runoff events. In both geometries, trees received the same amount of water per tree.

Evaporation from trenches and micro-catchments was estimated as the difference between evapotranspiration obtained computing the differences in total soil water content between two consecutive measurements and transpiration for this interval estimated from sap flow measurements.

In both years the evaporation from micro-catchments was significantly larger than that of trenches. The fractional loss due to evaporation from the total applied water for the second year for example, was 53% and 22% for micro-catchments and trenches, respectively. This indicates that a trench geometry reduces the amount of water lost to direct evaporation from the soil, and is thus more efficient in utilizing harvested runoff water.