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The water balance of semi-arid orchards: implications for the application of cover crops

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Accelerated soil erosion is perceived as a major problem in orchards in semi-arid areas. The sparse canopy cover does not protect the soil in an effective way, so that soil material is lost from the field during intense rainfall. On shallow soils this may have a negative impact on long term orchard productivity. The application of cover crops appears a quite effective means against soil erosion. However, little is known about the effect of cover crops on the orchard water balance and productivity. In this paper we address a number of aspects that we think are crucial for the implementation of cover crops: climate, soil type, competition for water and orchard management. Each of them was studied from a water balance perspective. The results show that both climate and soil directly affect the soil water availability and hence the level of competition for water. A water balance study in Murcia, Spain and additional field data from the Mediterranean show that in dry areas (rainfall $<$ 400 mm) there is simply not enough water to enable the implementation of cover crops in rainfed orchards. However, in more humid areas like northern Italy and southern France (rainfall $>$ 650 mm) cover crops may be grown without a negative impact on productivity. An analysis of data on climate and orchard tree spacing from the Mediterranean shows that a general climatic threshold can be identified for the growth of cover crops. The data suggest that competition for water is not an issue at locations where the ratio between annual precipitation and reference evapotranspiration exceeds 0.6. Based on the water balance study in Murcia and available literature a number of management strategies can be proposed to adapt the application of cover crops to drier areas. The competition for water was addressed in more detail in a field experiment near Sevilla,

Spain. The experiment consists of a comparison of the soil moisture and water balance between a tillage and a cover crop treatment. The preliminary results show that the cover crop treatment increases the infiltration to the subsoil. After two large rainfalls, the cover crop treatment reached higher levels of soil moisture (39% on average) than the tillage treatment (25%) at a depth of 45 cm. Water balance simulations of the two treatments will be compared to the observed moisture content in order to assess the impact of the cover crop on the water availability to the trees.