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Water Harvesting for Olive (*Olea europaea* L.) Trees in a Marginal Dry Area of Northwestern Syria

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Abstract

Olive production in marginal dry areas requires careful soil, water, and nutrient management. Farmers in the Khanasser Valley, Syria, developed their own water-harvesting technique by combining V-shaped bunds with up- and down-slope tillage furrows after examination of the semi-circular structures in a no-till water harvesting research site. The farmers cooperated with the researchers to investigate the effects of their new water harvesting technique in this dry environment (220 mm annual rainfall). Soil moisture content was monitored weekly during the first half of 2004. A control treatment without water harvesting structures was also monitored. Throughout the rainy season, soil moisture content in the rootzone of the trees with water harvesting structures was 4 to 15% higher than in the control. Almost all water gained by water harvesting was stored in the layers below 40-cm depth. This study showed that little labor investments by farmers can provide critical extra water needs to olive trees in dry, sloping lands.

Résumé

La culture d'olivier dans les zones sèches et marginales exige une attention particulière aux sols, ressources hydriques et nutriments. Les paysans dans la Vallée de Khanasser en Syrie ont développé un système de collection des eaux de ruissellement en construisant des structures de la forme V à partir sillons de labour. Ce système représente une modification du système de collection des eaux de ruissellement qui exige l'absence de labour. Les paysans ont coopéré avec les chercheurs pour investiguer les effets de leur système dans ce milieu sec (pluviométrie annuelle de 220 mm). Le contenu hydrique du sol a été suivi à raison d'une fois par semaine pendant la période janvier-juin 2004. Un traitement témoin sans structures de collection des eaux de ruissellement a été également étudié. Pendant toute la saison pluviale, le contenu hydrique du sol dans la zone racinaire des oliviers fournis des structures de collection des eaux de ruissellement a été 4-15% plus élevé que dans le cas du traitement témoin. Presque la totalité d'eau collectée a été retenue dans les couches plus profondes de 40 cm. Cette étude a montré qu'un petit investissement physique peut fournir des quantités supplémentaires d'eau exigées pour les oliviers cultivés dans les terres sèches et en pente.

Introduction

Olive is successfully grown under rainfed conditions in areas that receive more than 350 mm of annual rainfall (Tubeileh et al., 2004). In Syria, olive growing is expanding into marginal areas which receive low levels of rainfall or which consist of steeply sloping land. Low and erratic rainfall received in the these marginal dry areas is insufficient to support the crop, especially during the hot dry season, which lasts from May through to October and coincides with the tree's most active growth stages. In these marginal areas, where low-input agriculture prevails, improving tree water supply might help growers achieve sustainable olive production.

Rainwater harvesting is a traditional way of increasing the amount of water available to crops in dry environments. Water harvesting involves collecting and directing the water that falls on one area (the 'catchment' or 'contributing area') towards the crops grown on a smaller ('target') area (Critchley and Siegert, 1991). Water-harvesting techniques have particular relevance to dry hilly areas, because such areas have a high runoff potential and because it is difficult to use irrigation equipment on steep slopes. The objective of this study is to evaluate the effect of WH measures implemented on soil moisture content in a 5-year-old olive orchard in the Khanasser Valley, Syria.

Materials and Methods

Site description

Olive (*Olea europaea* cv. Zeiti) trees were planted in February 2000 in a west-facing sloping land in the village of Harbakiyeh (35.49°N; 37.29°E), Khanasser Valley, Syria. This valley is situated near the steppe, 80 km southeast of Aleppo, and is characterized by long, dry and hot summers with low relative humidity. Annual rainfall for the 2003/04 season (September to August) was 206 mm while long-term (1979–2005) average is 231 mm, received mostly between November and April. The small amount of rainfall received in the area is not evenly distributed over the rainy season, and the amounts received vary greatly from one year to another.

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The soil in the study area is a Lithic Xerothent (USDA Soil Survey Staff, 1975) with a loam texture in the first 15-cm layer and a clay loam texture in the deeper layers. Average available soil moisture content (volumetric) was 14-15%. This well-drained soil was less than one meter deep in the case of most of the trees studied, and did not exceed 135 cm in the best cases. The soil was low in organic matter, N, P, and K.

Treatments

In the beginning of the rainy season (November 2003), some olive growers constructed water harvesting structures by combining V-shaped bunds with up- and down-slope tillage furrows. This idea was inspired by a local water-harvesting research site in a non-tilled rocky field. The reason for the farmers' modification was to be able to control weeds by plowing while also harvesting runoff water. Eight trees were selected in the field of a female farmer that constructed water harvesting bunds in her field, the trees were randomly divided into trees with and without water harvesting bunds. Soil moisture content in the tree basin was monitored to a depth of 140 cm (in 20 cm increments) using a time-domain reflectometer (TDR) on a weekly basis during the period January through April 2004 and on a bi-weekly basis until late June.

Results

When readings started on January 31, some water harvesting has already been noticed and soil moisture content was higher in the water-harvesting treatment (Fig. 1). The major rainfall and water harvesting event occurred during the first week of February, with a total rainfall of 29.4 mm. With water-harvesting structures, soil moisture content in the tree basins increased by 40 mm compared with an increase of 27 mm for the treatment without water-harvesting structures. The difference in soil moisture content between the two treatments increased during the rainy month of February due to intense rainfall. During the week ending on February 21 (15.7 mm rainfall), soil moisture content increased by 14 and 10 mm respectively for the treatments ‘water harvesting’ and ‘no water harvesting’. Thereafter, in late spring and summer, the difference between the two treatments narrowed constantly and disappeared in June. Almost all gained water was stored in layers deeper than 40 cm (data not shown).

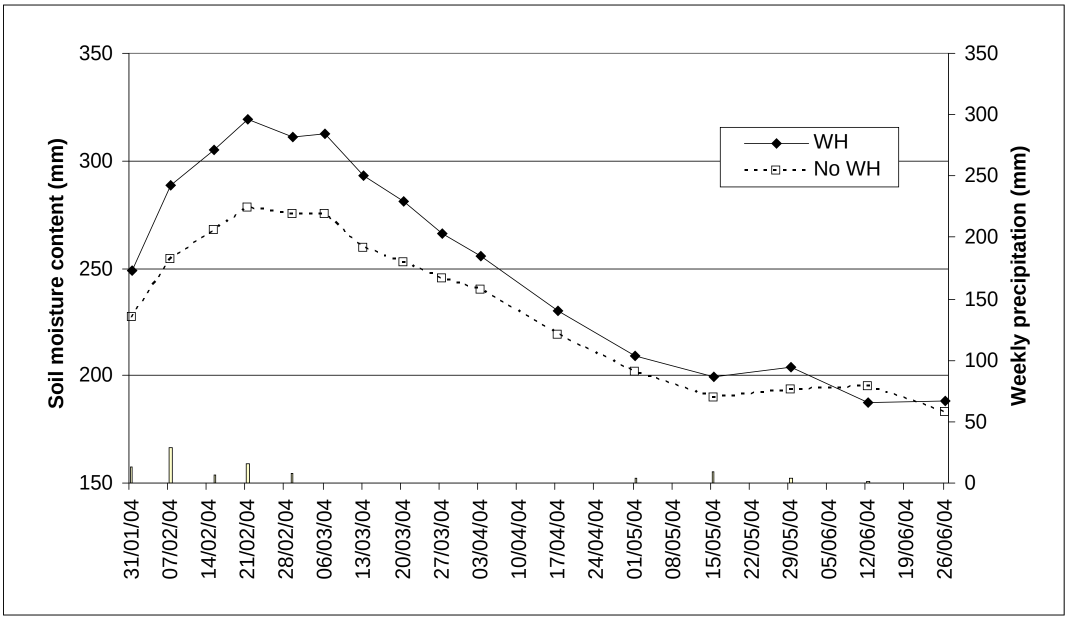

Fig. 1. Total moisture content in soil profiles of 140 cm measured in the tree basins for the treatment with water-harvesting structures (WH) and the control treatment without water-harvesting structures (No WH). Bars in the bottom represent weekly rainfall.

Discussion and Conclusions

The construction of water-harvesting structures increased soil moisture content throughout the rainy season until March. This effect is particularly important because it provides additional water for the crucial flowering stage (in April) and the vegetative growth shortly after. These results show that simple, low-cost measures can critically improve plant adaptation to harsh dry conditions. We are currently studying the effect of water harvesting on tree water relations.

Literature Cited

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