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Water saving in chufa cultivation using flat raised beds and drip irrigation

N Pascual-Seva, A. San Bautista, S. López-Galarza, J.V. Maroto, and B. Pascual
Departamento de Producción Vegetal. Universitat Politècnica de Valencia, Valencia, Spain (bpascual@prv.upv.es)

Chufa (Cyperus esculentus L. var. sativus), also known as tiger nut, is a typical crop in the Region of Valencia (Spain). Its tubers are used to produce a beverage called horchata. Chufa has been cultivated traditionally in ridges and furrow irrigated. Currently, the quality of water used is acceptable, there are no limitations on supply, and water is not expensive; therefore, large amounts of water are used. The European Water Framework Directive 2000/60 is based on the precautionary principle, considering preventive action for measures to be taken; thus, water use is an issue to improve. Moreover, drought periods are becoming more frequent and extended, and water is being diverted to other uses. In this two year study (2007-2008), we analysed how yield and irrigation water use efficiency (IWUE) are affected by two cultivation factors: planting strategy and irrigation system. Three planting strategies were analysed: ridges (R) and flat raised beds, with two (B2) and three (B3) plant rows along them, while two irrigation systems were compared, furrow (FI) and drip irrigation (DI). Within the beds, the effect of the position of the plant row was considered, differing among plants grown in the north (n), central (c), and south (s) rows. Distances between ridge and bed axes were 60, 80 and 120 cm for R, B2 and B3, respectively. Irrigation was based on the Volumetric Soil Water Content (VSWC), which was continuously monitored with capacitance sensors (ECH_2O EC-5 in FI and multidepth capacitance sensors C-Probe in DI). Each irrigation session started when the VSWC in R dropped to 60% and 80% of field capacity in FI and DI, respectively. Each DI session lasted 60 min in 2007; while in 2008 the installation was automated, stopping each session when the sum of the VSWC at 10, 20, and 30 cm soil depth reached its corresponding field capacity value. With both irrigation systems, beds were irrigated simultaneously with ridges and with the same irrigation duration. Plants from the different plant rows were sampled periodically and later fractionated into leaves, roots, and tubers, to examine the evolution of the different plant organs. The results showed that there were no differences among planting strategies in 2007; however, in 2008, R produced lower yields than the two types of beds. The interaction between the experimental years and the irrigation strategy did affect the yield significantly, obtaining higher yields with DI than with FI, which led to higher yields in 2007 than in 2008. Regarding the IWUE, DI gave the highest values, especially in 2008. Ridges led to the highest IWUE with DI, and the lowest IWUE with FI. When comparing the different planting lines, the highest yield was obtained in the southern row. It can be concluded that modifications to the planting strategy and the irrigation system within the traditional cultivation practices of the chufa crop would increase IWUE and lead to major water savings.