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Tomato root distribution, yield and fruit quality under subsurface drip irrigation

Rui M.A. Machado[1,3], Maria do Rosário, G. Oliveira[1] & Carlos A. M. Portas[2]
[1]*Depart. de Fitotecnia, Universidade de Évora, Apartado 94 7002-554 Évora, Portugal.* [2]*Instituto Superior de Agronomia, Tapada da Ajuda, 1349-017, Lisboa, Portugal.* [3]*Corresponding author**

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Abstract

Tomato rooting patterns were evaluated in a 2-year field trial where surface drip irrigation (R0) was compared with subsurface drip irrigation at 20 cm (RI) and 40 cm (RII) depths. Pot-transplanted plants of two processing tomato, 'Brigade' (C1) and 'H3044' (C2), were used. The behaviour of the root system in response to different irrigation treatments was evaluated through minirhizotrons installed between two plants, in proximity of the plant row. Root length intensity (L_a), length of root per unit of minirhizotron surface area (cm cm^{-2}) was measured at blooming stage and at harvest. For all sampling dates the depth of the drip irrigation tube, the cultivar and the interaction between treatments did not significantly influence L_a. However differences between irrigation treatments were observed as root distribution along the soil profile and a large concentration of roots at the depth of the irrigation tubes was found. For both surface and subsurface drip irrigation and for both cultivars most of the root system was concentrated in the top 40 cm of the soil profile, where root length density ranged between 0.5 and 1.5 cm cm^{-3}. Commercial yields (t ha^{-1}) were 87.6 and 114.2 (R0), 107.5 and 128.1 (RI), 105.0 and 124.8 (RII), for 1997 and 1998, respectively. Differences between the 2 years may be attributed to different climatic conditions. In the second year, although no significant differences were found among treatments, slightly higher values were observed with irrigation tubes at 20 cm depth. Fruit quality was not significantly affected by treatments or by the interaction between irrigation tube depth and cultivar.

Abbreviations: CI – 'Brigade'; CII – 'H3044'; DAP – days after planting; L_a – root length intensity; R0 – surface drip irrigation; RI – irrigation tube at 20 cm depth; RII – irrigation tube at 40 cm depth;

Introduction

Drip irrigation in processing tomato is a common technique in Portugal due to the Mediterranean climate, with dry and warm summers and high evapotranspiration rates throughout the growing season. These are conditions that make subsurface drip irrigation a suitable alternative to the surface system. With subsurface drip irrigation, evaporation from the topsoil is reduced and water runoff is negligible (Phene, 1991; Phene et al., 1992). In addition, with surface drip irrigation, roots grow preferentially around the emitter area (Oliveira et al., 1996), which in turn can contribute to improve water availability to the plants when using subsurface drip irrigation. The purpose of the present study was to compare surface *vs* subsurface drip irrigation (at two different depths) on the root distribution of two processing tomato cultivars. Knowledge of rooting patterns is essential to irrigation and fertiliser management and consequently to tomato yield and quality. Besides using minirhizotrons for root system analysis, trenches were opened perpendicularly to the plant row to examine the root distribution along the soil profile.

* FAX No: +351-266-711163. E-mail: rmam@uevora.pt