STUDY OF ROOT DYNAMICS OF OLIVE TREES UNDER DRIP IRRIGATION AND DRY FARMING

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Abstract

A comparative study has been carried out on the root dynamics of table-olive trees in plants under drip-irrigation and under dry-farming. Results show different dynamics as well as different external aspects and activity periods of the roots for each case. *In situ* root observations has been made by the use of minirhizotrons.

1. Introduction

Olive trees cultivation in the Mediterranean countries has undergone a series of improvements in the last decades, particularly that of irrigation, mainly by localized methods. For this reason, studies on the water balance and plant water status under field conditions have since been necessary (Le Bourdelles, 1985; Michelakis and Vougioucalou, 1988; Moreno et al., 1988).

In Western Andalusia, and more so in the province of Seville, localized irrigation is widely used on table-olive crops. In these cases, the root system shows a particular distribution and dynamics (growth, periods of activity) according to the different degree of wetness of the soil in the zones around and below the plant.

In the present work an *in situ* comparative study on root dynamics has been done in both irrigated and non-irrigated (dry-farming) table-olive trees.

2. Material and methods

2.1. Site and plants

The experimental work has been carried out in the Aljarafe county, some 15 km SW of Seville city in two soil plots: one under drip irrigation and the other under dry farming. In both plots, the plants were 20-year-old 'Manzanillo' table-olive trees (*Olea europaea*, L.), at 7 x 7 m spacing.

2.2. Methods

Observation of the root systems and their evolution has been carried out by means of minirhizotrons installed in two different positions in respect to the tree as shown in figure 1. Minirhizotrons consisted of 74 mm-internal-diameter methacrylate transparent tubes closed at the end buried in the soil. The tubes were marked by circular grooves engraved all 10 cm were to refer root characteristics to the depth in the soil. 140 cm out of the total 200 cm of the tubes were buried in the soil at 45° inclination, to allow a 100 cm deep soil observational area.

The optical system used in the minirhizotrons consisted of a 2.20 m. long and of 4 mm inner diameter stainless steel tube, carrying at one end a lamp wired to a 12 V battery, through the stainless steel tube. The image was amplified by an optical enlarger device consisting of a PVC piece with a fixed frontal lens and a sliding eye-lens for focussing. Root density was calculated as by Upchurch and Ritchie (1983).

Soil water content was measured by neutron-moderation method.

3. Results and discussion

Root-density profiles corresponding to different dates within the experimental period, for each minirhizotron position and for each treatment (irrigated and non-irrigated trees) are presented in figure 2. Total soil water content for each minirhizotron position at the same dates as in figure 2, for 40-50 cm and 50-100 cm soil depth, are given in table 1.

Root-density profiles show an evolution related to the soil-water content. In irrigated trees, root development is larger in the zones affected by irrigation (position 1) and at 20-70 cm soil depth, with maxima at 40 and 60 cm depth (figure 2). In these zones, whitish, turgid roots forming a continuous system of recent formation are observed, giving evidence of a good living status, related to the convenient level of water content present in the whole profile, as shown in table 1. These results are in agreement with those found by Fernández et al.(1987, 1988) for this position and this depth. In the non-irrigated zone (position 2) of the same tree, soil-water content progressively decreases with time (table 1), being the cause of a very scarce root density from the beginning of the period, still diminishing as summer progresses. These roots present a suberized external surface and their activity is reduced to a much shorter period.

In non-irrigated trees, differences in root density also exist between positions 1 and 2, in this case not due to the effect of irrigation but to the different water content in the soil profile as a consequence of textural and structural characteristics. In position 1, seasonal changes of the root system has only been observed below 60-70 cm depth where the water content is high. Root density reachs its maximum in spring and early summer, decreasing afterwards as water content depletes. In position 2, dynamics of the root system is more evident due to higher water content between 50 and 100 cm soil depth as a consequence of the presence of silt in higher quantities than in other zones of the soil profile. In either of the two positions in non-irrigated trees, roots present a suberized surface and characteristics of adaptation to dry soil as evidenced by different root diameters according to changes of turgidity with time. Also, the period of activity is much shorter than in irrigated trees (position 1).

Summarizing, results show the existence of a more superficial and dynamical root system, concentrated in zones affected by irrigation, in irrigated than in non-irrigated trees.

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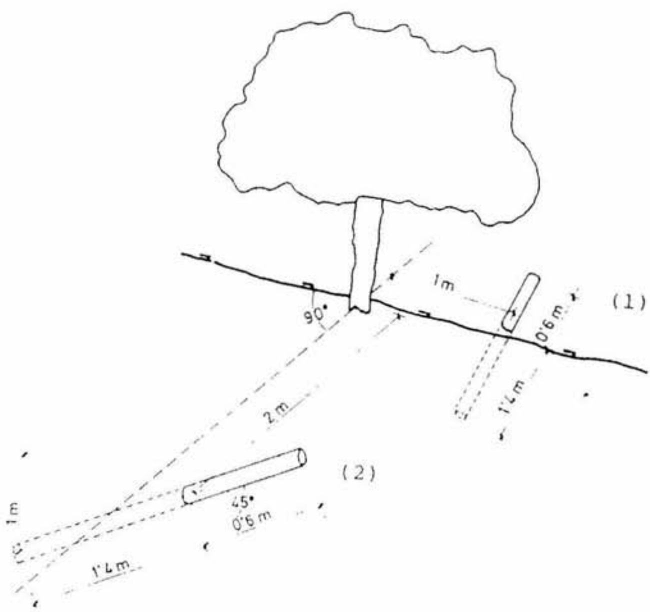

Figure 1 - Positions of minirhizotrons.

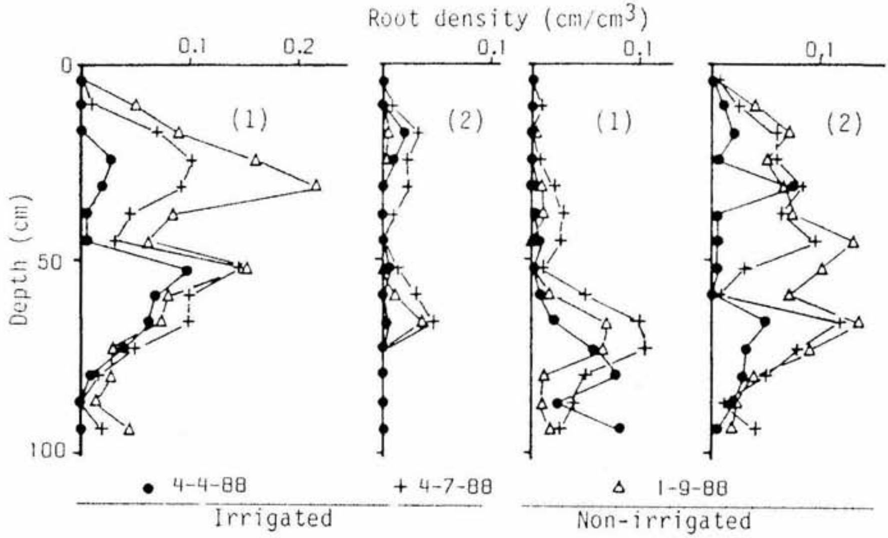

Figure 2 - Evolution of root density during the experimental period (1) mini-rhizotron position 1; (2) mini-rhizotron position 2.

Table 1 - Total water content (mm) in the 0-50 cm and 50-100 cm soil layers of irrigated and non-irrigated treatments.

	Irrigated				Non-irrigated			
	Position 1		Position 2		Position 1		Position 2	
Date	0-50	50-100	0-50	50-100	0-50	50-100	0-50	50-100
4 Jan 88	76.8	81.0	72.6	80.9	53.2	73.1	51.4	88.0
4 Jul 88	122.6	112.9	64.1	78.5	45.5	55.4	46.3	70.5
1 Sep 88	120.5	108.7	51.1	72.3	32.8	46.6	32.4	50.2