

Leaf eco-physiological, nutritional and anatomical changes within the canopy of olive trees grown in a high-density plantation

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Leaf macronutrient (N, P, K, Ca and Mg) and pigment concentrations, leaf anatomy, photosynthesis rates and chlorophyll fluorescence parameters have been studied in different parts of the canopy of olive trees grown in a high density planting system. The experiment was carried out in Mornag (North of Tunisia; 36.42° North), in an *Olea europaea* (cv. Arbequina) orchard planted in 1999 with a density of 1250 trees ha⁻¹. Leaves were sampled from three canopy zones differing in light interception: a bottom layer (<1 m), a central one (1-2 m) and a top one (>2 m). Our results showed that light interception decreased significantly in the bottom part of the canopy when compared to the central and top layers. Regarding macronutrient concentrations, only leaf K and Ca concentrations varied significantly among the different layers of the canopy, being higher in the bottom part when compared to the central and top ones. Photosynthetic rates decreased significantly and progressively from the uppermost part of the canopy to the central and the lowest ones. Decreases were 39 and 62% in the central and lower parts of the canopy when compared to the top one. Leaf concentrations per area of neoxanthin, V+A+Z pigments pool, β-carotene and lutein were higher in the upper part of the canopy than in the central and the lowest layers. Furthermore, the de-epoxidized forms Z and A increased significantly in leaves from the uppermost part of the canopy when compared to the central and the lowest zones. Leaf anatomical characteristics varied significantly depending on the position into the canopy. The major changes were observed in the palisade and spongy parenchyma, which were reduced by 9-14% and 17-24% in the lowest part of the canopy when compared to the uppermost one. These results indicate that the different light levels entering into the olive tree canopy lead to leaf anatomical and photosynthetic changes characteristic of “sun-” or “shade-type” in the uppermost and lowest parts of the canopy. Consequently, the contribution of a single leaf or a population of leaves to the C balance in an olive tree grown under high-density plantation depends on their position into the canopy.

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