

Influence of *Quercus ilex* trees on herbaceous production and nutrient concentrations in southern Portugal.

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Abstract: In an open woodland in Portugal, the nature of interactions between *Quercus ilex* trees and herbaceous plants was assessed during 2 years by studying how manipulation of incident solar radiation, water and nutrient supply affect the herbaceous biomass and N, K, P, Ca, Mg, and Mn concentrations. Measurements were carried out in three environments consisting of (1) open grassland, (2) beneath the tree canopy, and (3) under artificial shade. Each of these environments was subjected to two regimes of fertilization and two water levels in a factorial design. The fertilizer treatment consisted of application of no fertilizer or a combination of 200 kg calcium ammonium nitrate ha⁻¹ (26% N) and 350 kg superphosphate ha⁻¹ (8% P), while the water-supply treatment consisted of either no irrigation or irrigation fortnightly from February 1 to April 30. Grasses showed significantly lower nutrient concentrations than forbs. However, nutrient concentrations of the whole herbaceous community were within the recommended ranges for cattle nutrition. A negative effect of shade on herbaceous biomass production was observed. The effect of watering on herbaceous biomass was less prominent than the effect of fertilization, irrespective of the environment, suggesting that *Q. ilex* does not compete for soil-water resources with herbaceous biomass in this ecosystem. Fertilization increased total biomass by 106%, 49%, and 97% in the open grassland, beneath the tree canopy, and under artificial shade, respectively. During the first and second year, fertilization increased herbaceous P concentrations by 24% and 83%, respectively, if compared with concentrations obtained at the unfertilized plots. Higher K and Mg concentrations were observed in herbaceous plants beneath the tree canopy than in the open areas, indicating a positive effect of trees on pasture quality. The positive and negative effects of trees on understory forage are discussed.