

# XVII HISPANO-PORTUGUESE INTERNATIONAL SYMPOSIUM ON WATER RELATIONS

PAMPLONA

FEBRUARY 25-27th, 2026



**XVII Spanish-Portuguese Symposium  
on Plant Water Relations**

*Water relations in plants to address current  
challenges for plants*

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### **Climate modulates the effect of thinning on the ecosystem water balance of continental holm oak woodlands**

Ana López-Ballesteros<sup>1,2,3\*</sup>, Arnaud Carrara<sup>4</sup>, José Javier Peguero-Pina<sup>1,2,3\*</sup>  
and Juan Pedro Ferrio<sup>35</sup>

\*Correspondence: [alopezb@cita-aragon.es](mailto:alopezb@cita-aragon.es)

<sup>1</sup>Departamento de Sistemas Agrícolas, Forestales y Medio Ambiente, Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA), Zaragoza, Spain

<sup>2</sup>Instituto Agroalimentario de Aragón -IA2- (CITA-Universidad de Zaragoza), Zaragoza, Spain

<sup>3</sup>Unidad de Suelos y Riegos, Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA), Estación Experimental Aula Dei (EEAD-CSIC), Zaragoza, Spain

<sup>4</sup> Mediterranean Center for Environmental Studies (CEAM), Valencia, (Spain)

<sup>5</sup>Estación Experimental de Aula Dei, Consejo Superior de Investigaciones Científicas (EEAD-CSIC), Zaragoza, Spain

#### **Abstract:** (about 2.000 words maximum)

Spanish forests constitute *ca.* 37% of the national territory and play a key role in several ecosystem services such as climate regulation, water filtration, and soil stabilization, among others. Holm oak woodlands represent the most extensive forest formation nationally, currently covering 15% of the national forest area. Beyond its geographical dominance, *Quercus ilex* dominated stands are also relevant as providers of acorns, timber and mycorrhizal fungi. Besides its ability to adjust the vegetative period to changing climatic conditions, holm oak woodlands have shown alarming signs of decline, with an increasing trend of defoliation and mortality episodes across the country over the last four decades. The main two drivers of this decline are the abandonment of traditional forest management together with climate change. The absence of forest management results in holm oak stands with high densities of slow-growing individuals competing intensely for water and nutrients, which, at the same time, increases the forest vulnerability to droughts and heatwaves.

In this context, there is an urgent need to identify strategies that safeguard the health and stability of these forests. Evidence indicates that selective thinning is a silvicultural practice that enhances the resilience of these systems by promoting holm oak growth



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and reducing resource competition. However, to date, no study has directly quantified the effect of this practice on the water balance at the ecosystem scale. To address this gap, in 2023 two eddy covariance flux measurement stations were established in holm oak stands with and without thinning in the Gúdar-Javalambre region (Teruel). This unique research infrastructure in Europe has enabled the collection of direct and continuous measurements of net ecosystem-atmosphere exchanges of CO<sub>2</sub>, water vapor, and energy in these forest stands for nearly three years.

In this work, we aim to evaluate the joint effects of thinning and climate variability on the water balance (WB) and water use efficiency (WUE) of continental holm oak woodlands over two hydrological years with contrasting climate. The first hydrological year (2023-2024) was much drier than the subsequent one (2024-2025), with SPEI12 values ranging from -2 to more than 2, respectively. Soil water potential measured at 35cm soil depth also showed clear differences between years, with minimum daily values reaching -4 and -1.8 kPa for each hydrological year. Preliminary results suggest that thinning subtly decreased the water loss via evapotranspiration (ET) regardless of the hydrological year, yielding to higher WB, defined as the difference between precipitation (P, mm) and ET (mm), compared to the unthinned site. In contrast, ecosystem-scale WUE, defined as the ratio between annual Gross Primary Productivity (GPP, g C m<sup>-2</sup>) and ET (mm), was higher in the unthinned site for both years. When focusing on the inter-annual change, in both sites we found lower WUE under the severe drought in 2023-2024, as compared to the recovery period in 2024-2025. Nevertheless, the two treatments differed in the magnitude of response: the thinned site showed a greater increase in WUE during the recovery year compared to the unthinned site. Overall, these results suggest that climate, and more specifically precipitation regime, can strongly influence the impact of forest management on plant water relations at stand scale.

**Keywords:** forest management, eddy covariance, evapotranspiration, climate change

**Funding:** This research was supported by i) grant RYC2023-043829-I funded by MCIN/AEI/10.13039/501100011033, European Union Next Generation EU/PRTR and FSE+, ii) grant PID2022-136478OB-C32 funded by MICIU/AEI/10.13039/501100011033 and “ERDF A way of making Europe”, iii) grant TED2021-129499A-I00 funded by MCIN/AEI/10.13039/501100011033 and European Union Next Generation EU/PRTR, and v) by Gobierno de Aragón S74\_23R research group.