Carbon Sequestration Potential of Olive Tree Varieties under Contrasting Cultivation Conditions Assessed through Remote Sensing

Welida Keller[1*], Afonso da Ponte[1], Carla Inês[1*], Maria Catarina Manuelito[1], José Pragana[1], António Manuel Cordeiro[1] & José Marques da Silva[2*]

[1]Instituto Nacional de Investigação Agrária e Veterinária, I.P. (INIAV), UEIS Biotecnologia e Recursos Genéticos, Estrada de Gil Vaz – Apartado 6, 7350-404 Elvas, Portugal, *welida.keller@iniav.pt, *carla.ines@iniav.pt.
[2]MED – Mediterranean Institute for Agriculture, Environment and Development, CHANGE – Global Change and Sustainability Institute, Universidade de Évora, Pólo da Mitra, Apartado 94, 7006-554 Évora, Portugal, *jmsilva@uevora.pt; Agroinsider Lda (rafael@agroinsider.com).

INTRODUCTION

In the EUROACE region, the **"TID4AGRO — Advanced, Innovative, and Digital Technologies for the Agroindustrial Sector in EUROACE"** project promotes competitiveness and sustainability in the EUROACE by leveraging innovative digital technologies, aligned with low-carbon agriculture, climate resilience, and adaptation.

METHODOLOGY

This study aims to develop a remote sensing-based methodology to evaluate the carbon sequestration potential of two olive cultivars – **'Picual'** and **'Galega Vulgar'** – cultivated in intensive orchards under rainfed and irrigated conditions. Using Sentinel-2 imagery and the NDWI (Normalized Difference Water Index) and NDVI (Normalized Difference Vegetation Index), three monitoring sites were selected within the orchard (Fig. 1). During the winter dormancy, olive trees are systematically evaluated for traits related to vigour. Several measurements are taken, such as the height of the canopy and trunk, the canopy diameter, and the trunk perimeter (del Río et al. 2005). The calculation of trunk biomass in estimating the corresponding CO_2 sequestration follows the procedure described by Llarioni et al. (2013).

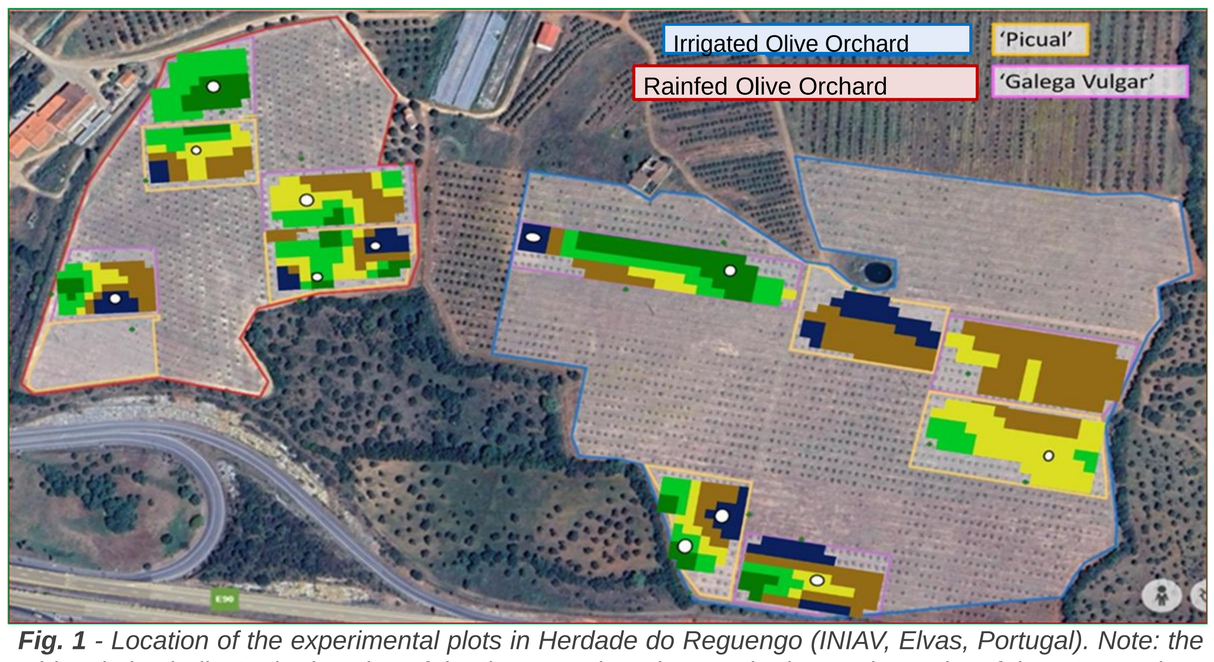

***Fig. 1** - Location of the experimental plots in Herdade do Reguengo (INIAV, Elvas, Portugal). Note: the white circles indicate the location of the three monitored trees; the increasing order of the NDWI values is from blue to yellow to green, which indicates an increase in leaf water content.*

RESULTS

Overall, vegetative growth was higher under irrigation. Across both water regimes, **'Galega Vulgar'** exhibited superior performance in the assessed traits, showing an increasing trend along the water gradient derived from satellite imagery. The strongest correlations were observed between NDVI in August and trunk volume (R^2 = 0.71, see Fig. 2), and between NDVI in August and trunk biomass (R^2 = 0.74, see Fig. 2) for **'Galega Vulgar'** under irrigation.

When considering only the main trunk under the same conditions, **'Galega Vulgar'** showed up to twice the carbon storage capacity compared to **'Picual'**. These findings highlight its potential role in climate mitigation strategies within agriculture.

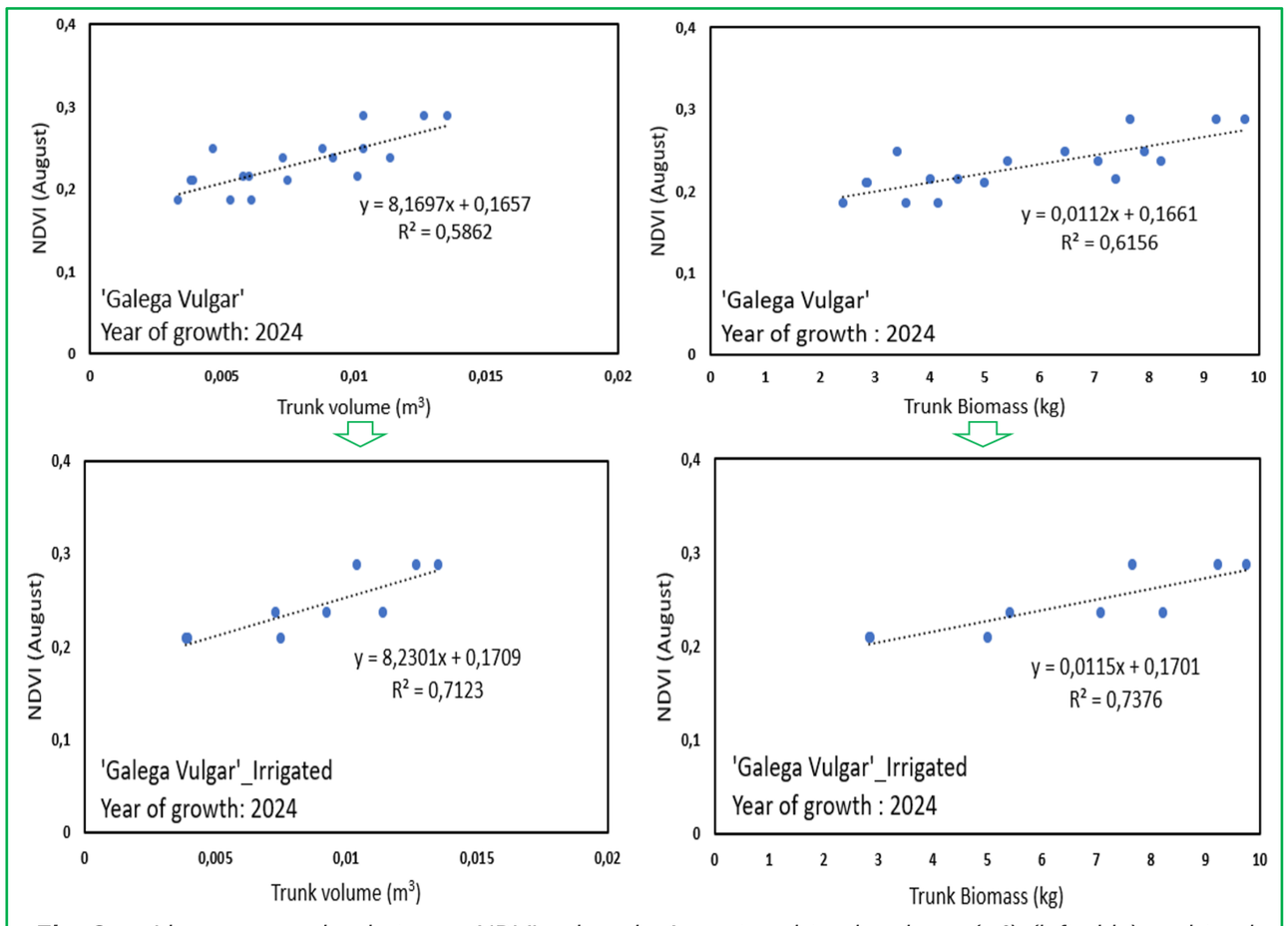

***Fig. 2** – Linear regression between NDVI values in August and trunk volume (m³) (left side) and trunk biomass (kg) (right side) of 'Galega Vulgar' olive trees. Note: the graphics below the arrows show the linear regression for olive trees under irrigated conditions only.*

CONSIDERATIONS

According to our primary data, irrigated olive groves can sequester higher levels of atmospheric carbon. Remote sensing appears to be a promising tool for non-destructive, large-scale assessments of carbon sequestration. Offering monetary rewards for this could incentivize even more efficient management practices across olive-growing areas.

References

del Río C., Caballero J.M., García-Fernandez M.D. (2005). Vigor. In: Rallo L., Barranco D., Caballero J.M., del Río C., Martín A., Tous J., Trujillo I. (Eds.), Variedades de Olivo en España. Mundi-Prensa, Spain, pp. 247–256.

Llarioni, L., Nasini, L., Brunori, A., & Proietti, P. (2013). Experimental measurement of the biomass of Olea europaea L. *African Journal of Biotechnology*, *12*(11), 1216-1222.

FUNDING

The project 0100_TID4AGRO_4_E is co-financed by the European Regional Development Fund (ERDF) through the INTERREG VI-A Spain-Portugal (POCTEP) 2021-2027 program of the European Commission.

https://tid4agro.eu/es/