Enhancing Olive Orchard Management Through Proximal and Remote Sensing Technologies

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INTRODUCTION

The **"TID4AGRO — Advanced, Innovative, and Digital Technologies for the Agroindustrial Sector in EUROACE"** project aims to enhance the competitiveness and sustainability of the agri-food sector in the EUROACE region through the integration of innovative digital technologies.

As part of this initiative, non-destructive, plant-based measurements are being carried out using two proximal sensors (Fig. 1 and Fig. 2) in intensive olive orchards.

PROXIMAL SENSORS USED:

- **Porometer / Fluorometer LI-600 (**LI-COR®**)** → measures stomatal conductance and chlorophyll *a* fluorescence (Surano et al. 2022).

Fig. 1 *- Non-destructive measurements with the Porometer / Fluorometer LI-600 in olive tree (Olea europaea L.) leaves ('Galega Vulgar' and 'Picual' varieties), under irrigated and rainfed conditions*.

- **Dualex leaf clip (**Metos® by Pessl Instruments**)** → measures chlorophyll content, polyphenol indexes, and nitrogen balance índex (Alderotti et al. 2025).

Fig. 2 *- Non-destructive measurements with the Dualex leaf clip in olive tree (Olea europaea L.) leaves ('Galega Vulgar' and 'Picual' varieties), under irrigated and rainfed conditions .*

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.

MONITORING SITES and REMOTE SENSING:

Location: **Elvas** (Alentejo, Portugal)
Olive tree varieties: **'Galega Vulgar'** and **'Picual'**
Irrigation (and spacing) conditions: rainfed (5 m × 5 m); drip-irrigation (7 m × 5 m)

The NDWI (Normalized Difference Water Index) was remotely sensed by the satellite Sentinel-2 in order to produce maps for each variety plot. The NDWI enables us to assess drought conditions in the olive orchard and identify monitoring sites (Fig. 3) .

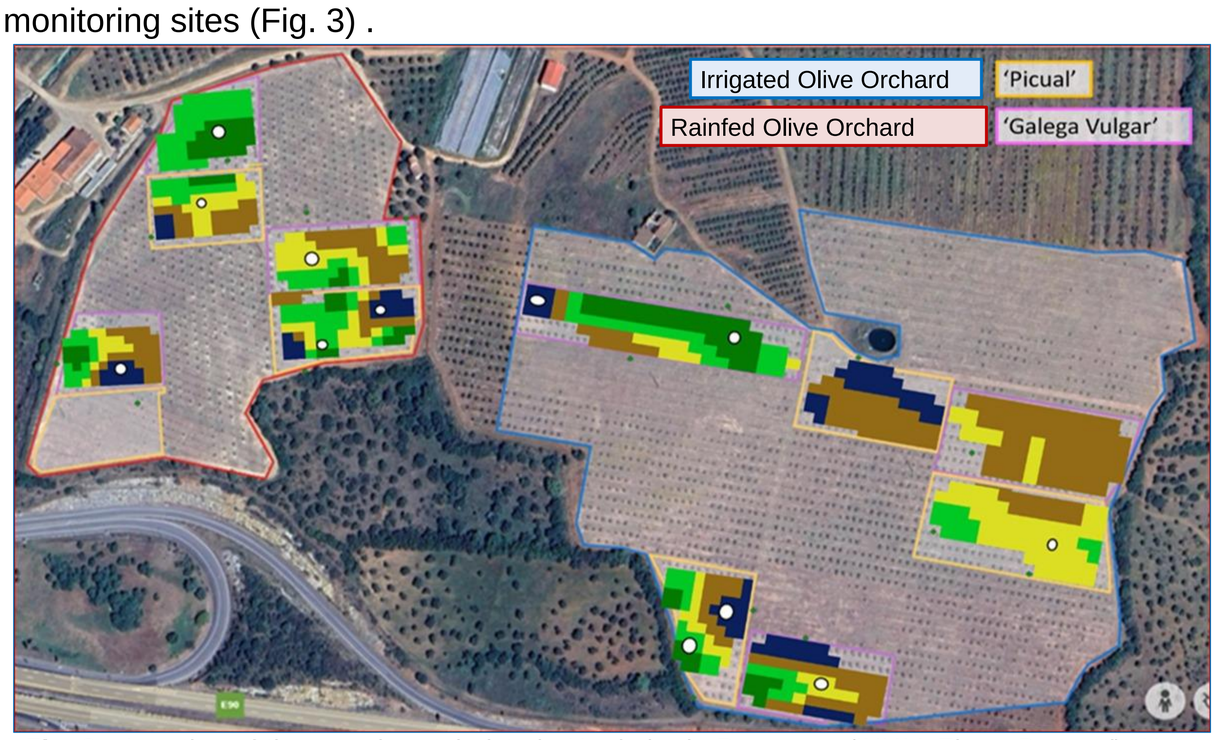

Fig. 3 *- Location of the experimental plots in Herdade do Reguengo (INIAV, Elvas, Portugal). Note: The white circles indicate the location of the three monitored trees; the increasing order of the NDWI values is from blue to yellow to green, which indicates an increase in leaf water content.*

While NDWI reflects vegetation water content, NDVI (Normalized Difference Vegetation Index) indicates vegetation density and health, based on the reflection and absorption of red and near-infrared light, which are associated with chlorophyll content and leaf structure.

EXPECTED RESULTS

To identify and validate consistent statistical correlations between field data obtained using proximal sensors (Porometer and Dualex) and spectral indices derived from Sentinel-2 (NDVI and NDWI). This is feasible because both data sources capture different manifestations of similar physiological parameters in plants. In the future, this could reduce the need for on-site measurements and optimize large-scale agricultural monitoring.

References

Alderotti, F., Piccolo, E. L., Brunetti, C., Stefano, G., Ugolini, T., Cecchi, L., Beccaluva, M., Renna, L., Detti, C., Ferrini, F., Nicese, F. & Gori, A. (2025). Cultivar-specific responses of young olive trees to water deficit: impacts on physiology, leaf anatomy, and fruit quality in 'Arbequina', 'Leccio del Corno' and 'Maurino'. *Plant Physiology and Biochemistry*, 110331.

Surano, A., Abou Kubaa, R., Nigro, F., Altamura, G., Losciale, P., Saponari, M., & Saldarelli, P. (2022). Susceptible and resistant olive cultivars show differential physiological response to Xylella fastidiosa infections. *Frontiers in Plant Science*, *13*, 968934.

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