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Assessing NDWI as a Proxy for Vegetative Growth and Biomass Parameters in Olive Orchards Under Contrasting Water Regimes

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Presentation Overview

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Introduction



Portugal is the **4th largest** olive producer in Europe, with **approximately 380,000 hectares**, with the Alentejo region responsible for about **80%** of national production.



Portuguese olive growing has been evolving to meet the demands of international competitiveness and market quality standards.



In this context, monitoring vegetative growth and biomass of olive groves plays a key role in optimizing crop management practices.

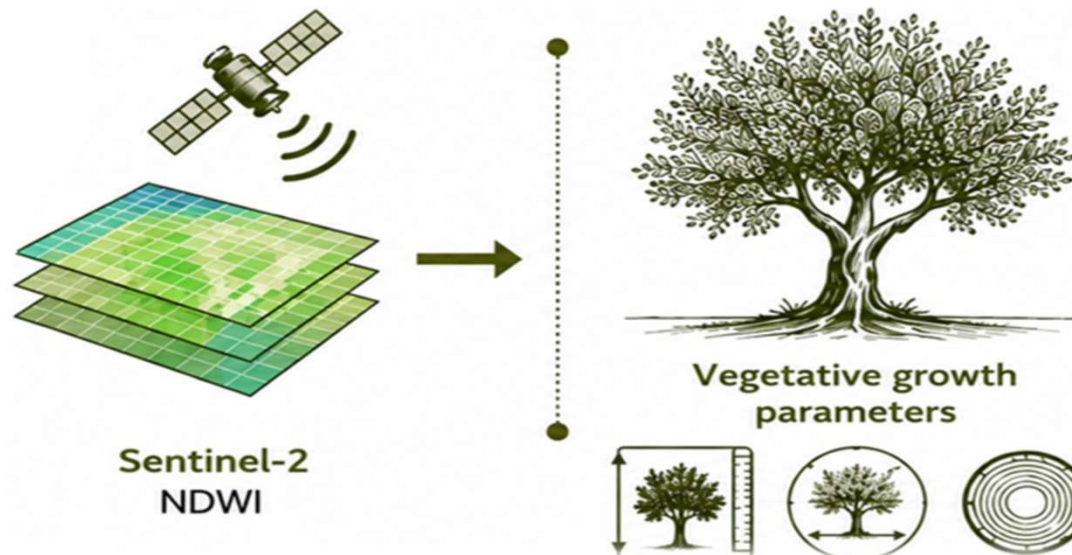


Spectral indices obtained through remote sensing, such as **NDWI (Normalized Difference Water Index)** derived from **Sentinel-2** satellite imagery, have demonstrated high potential as **non-destructive** tools for tracking water status and its direct impact on vegetative growth and biomass accumulation.

Objectives



The present study evaluates the relationship between the **NDWI**, vegetative growth, and biomass parameters in olive orchards managed under contrasting water regimes, establishing the index as an **indirect indicator** of the crop's water status.



Materials and Methods

STUDY INFORMATION

Location: INIAV, Experimental Olive Grove, Elvas, Portugal.

Study Period: Since 2024.

Olive Grove: Planted in 2015.



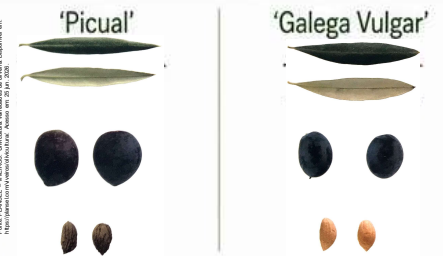
SATELLITE DATA



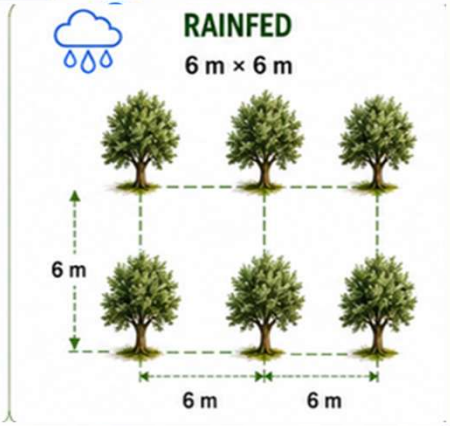
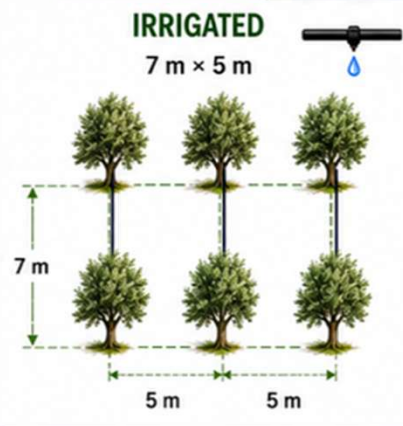
Sentinel-2 imagery (ESA)

NDWI data were obtained from Sentinel-2 satellite imagery.

CULTIVARS

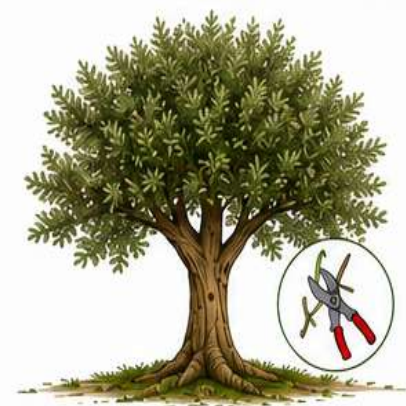


WATER REGIME



MANAGEMENT

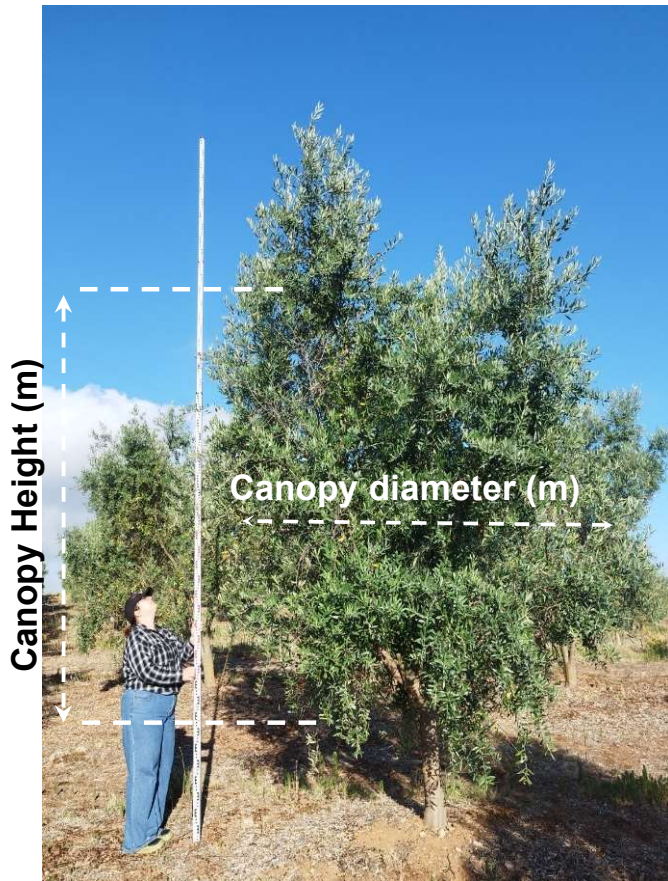
Annual fruiting pruning



The recommendations for Integrated Pest Management in olive cultivation (Mendes & Cavaco, 2017) and the Crop Fertilization Manual (Calouro, 2022) are followed.

Materials and Methods

1. Vegetative Measurements (Before Start of New Annual Cycle)



2. Derived Variables (Del Rio et al., 2005)

1 Canopy Surface (m²)

$$CS = \pi (H \times D_m)$$

Where:

CS = Canopy Surface Area (m²)

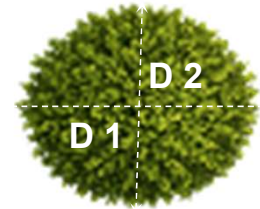
H = Canopy Height (m)

D_m = Mean Canopy Diameter (m)

$$D_m = \frac{D_1 + D_2}{2}$$

D_m is the mean canopy diameter, calculated from two perpendicular measurements of the canopy diameter.

Top View
(Example)



2 Canopy Volume (m³)

$$V = \frac{\pi (D_m \times D_m) \times H}{6}$$

Where:

V = Canopy Volume (m³)

H = Canopy Height (m)

D_m = Mean Canopy Diameter (m)

3 Trunk Cross-Sectional Area (cm²)

$$AST = \pi \left(\frac{P}{2\pi} \right)^2$$

Where:

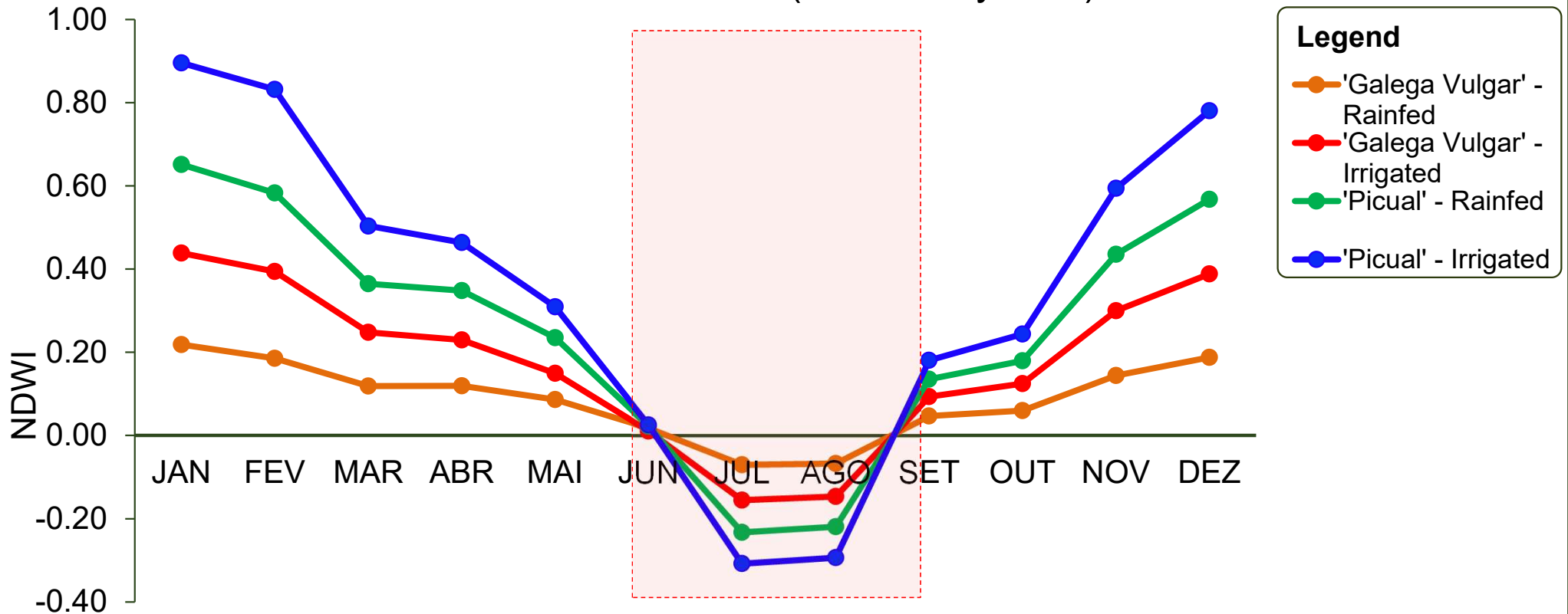
P = Circumference (cm)
(Measured around the trunk)

AST = Trunk cross-Sectional area (cm²)



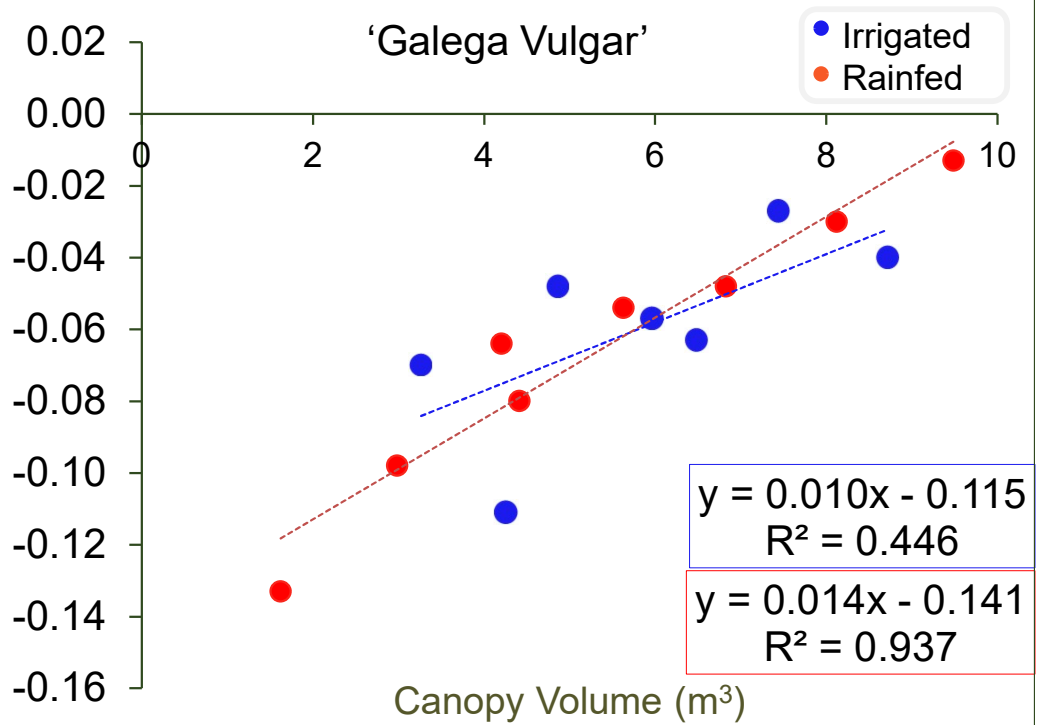
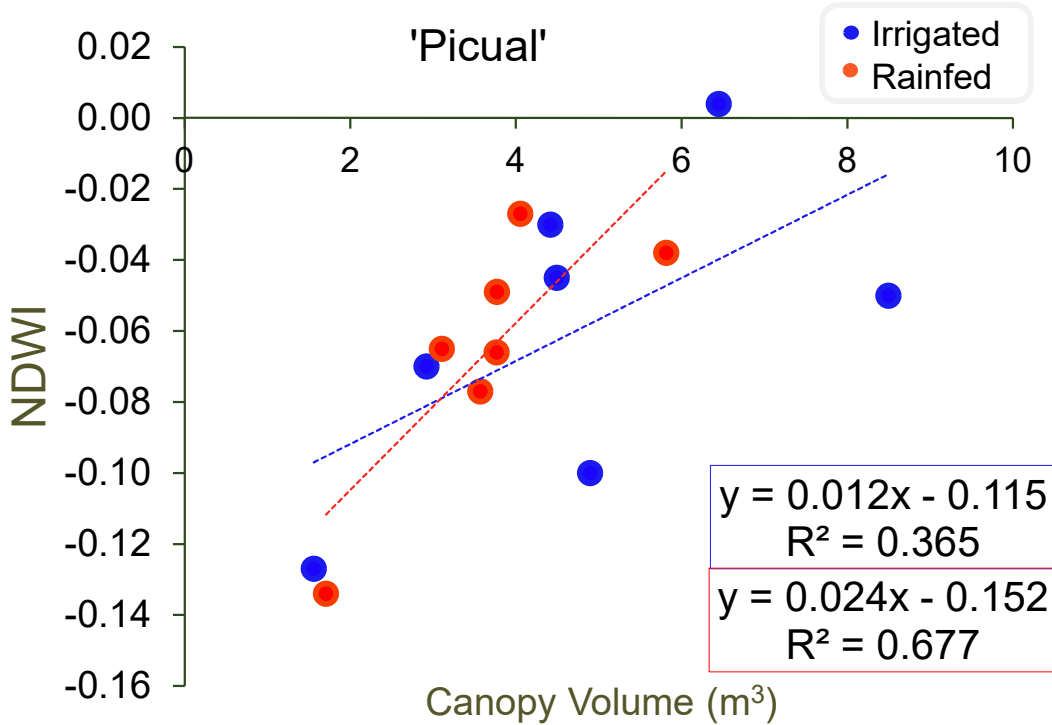
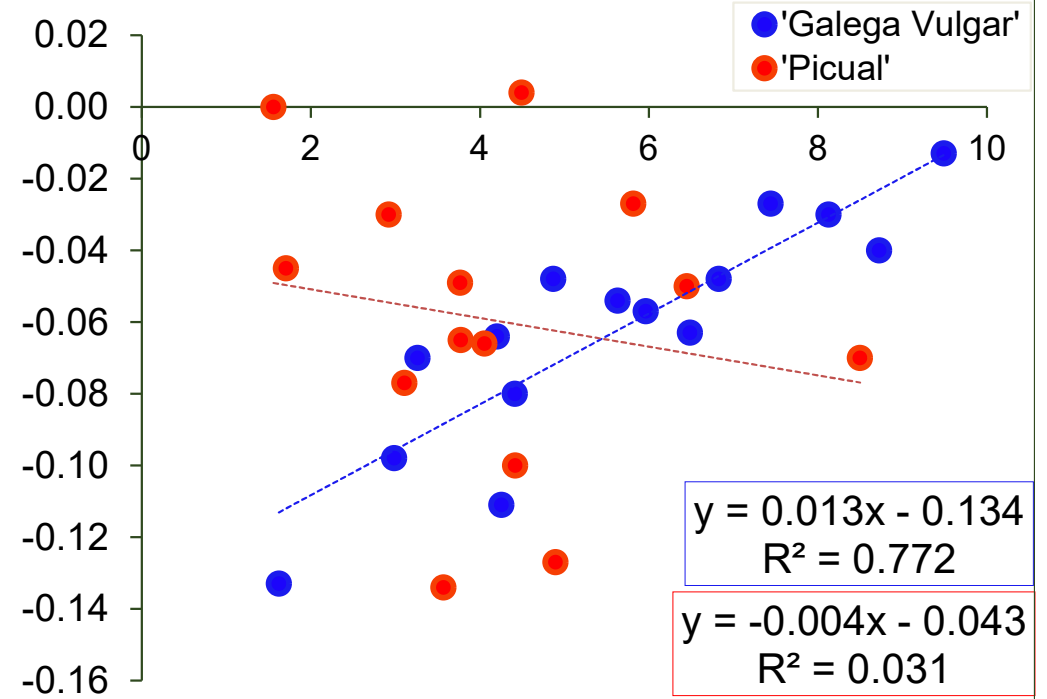
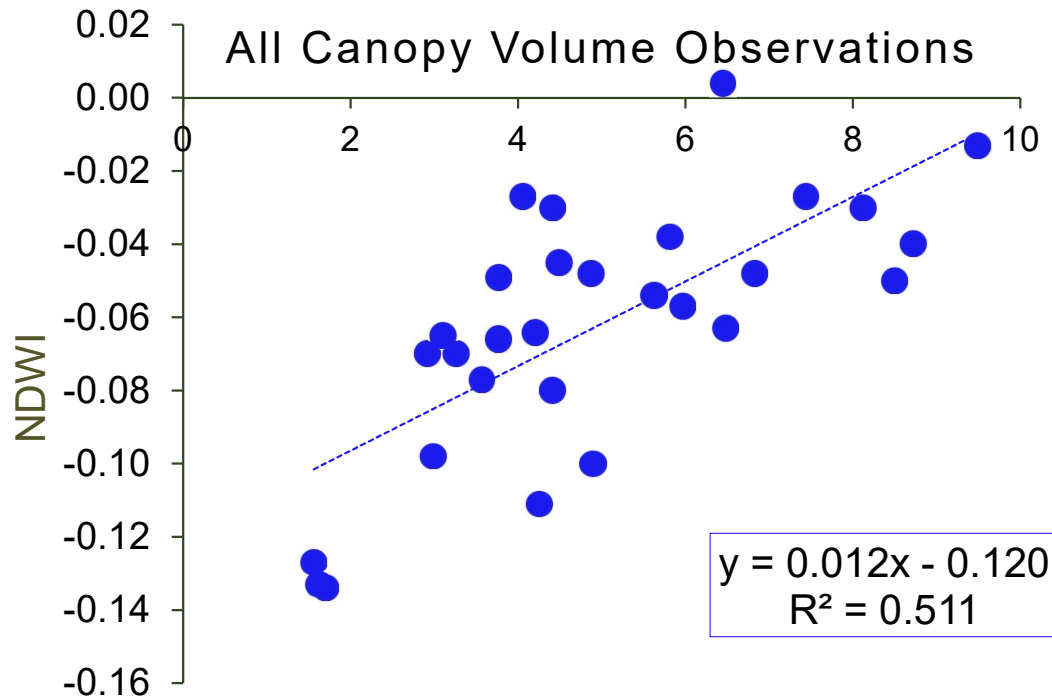
Results

Remote Sensing Data Sentinel – 2 (Satelite System)






Temporal trends in monthly mean NDWI values over the past five years (2020 – 2025).

Canopy Volume (m³) vs. NDWI (August)

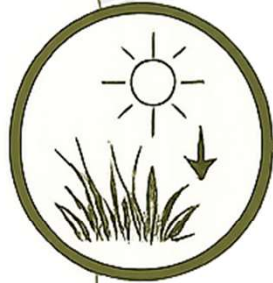


More Correlation (R^2) Values

 Orchard	 Cultivars	 Water Regimes	NDWI (August) vs.			
			Canopy Height (m)	Canopy Diameter (m)	Canopy Surface (m ²)	Trunk Cross-Sectional Area (cm ²)
Olive orchard	N/A	N/A	0.473	0.542	0.541	0.371
	'Galega Vulgar'	N/A	0.659	0.783	0.766	0.536
		Irrigated	0.222	0.469	0.391	0.343
		Rainfed	0.887	0.948	0.956	0.723
	'Picual'	N/A	0.674	0.404	0.556	0.35
		Irrigated	0.318	0.318	0.499	0.457
		Rainfed	0.668	0.668	0.745	0.365

Conclusions

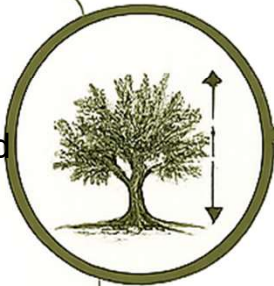
Summer conditions reduced herbaceous vegetation interference, allowing olive tree canopies to dominate the NDWI signal.



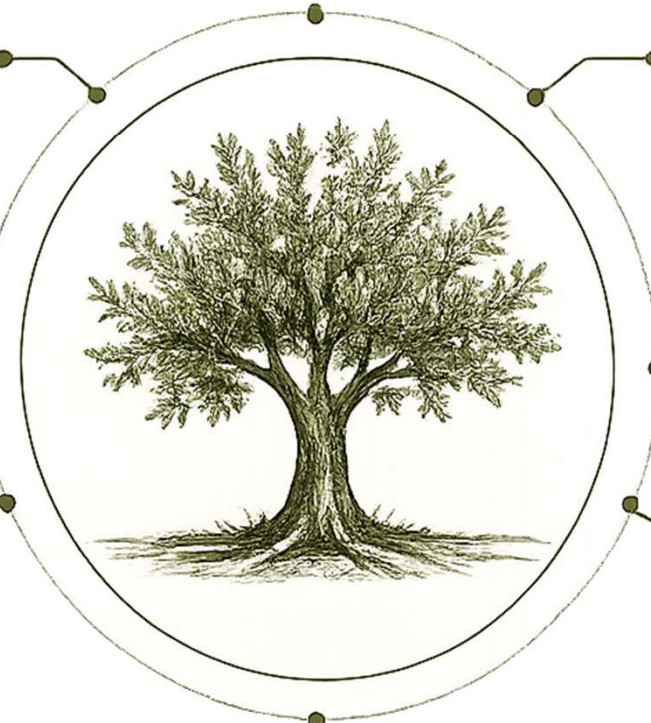
NDWI demonstrated strong potential as a non-destructive and indirect indicator for monitoring vegetative growth (biomass parameter) in olive orchards.



The strongest correlations were observed under rainfed conditions, particularly for the 'Galega Vulgar' cultivar.



The predictive capacity of NDWI varied according to cultivars and water regime, highlighting the importance of contextual interpretation in Mediterranean olive production systems.





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Thank you
for your attention

