

# Tree physiology response under different light environments in a Mediterranean *Quercus frainetto* forest exposed to dieback phenomena



**Enrica Nestola**  
CNR IRET Lecce

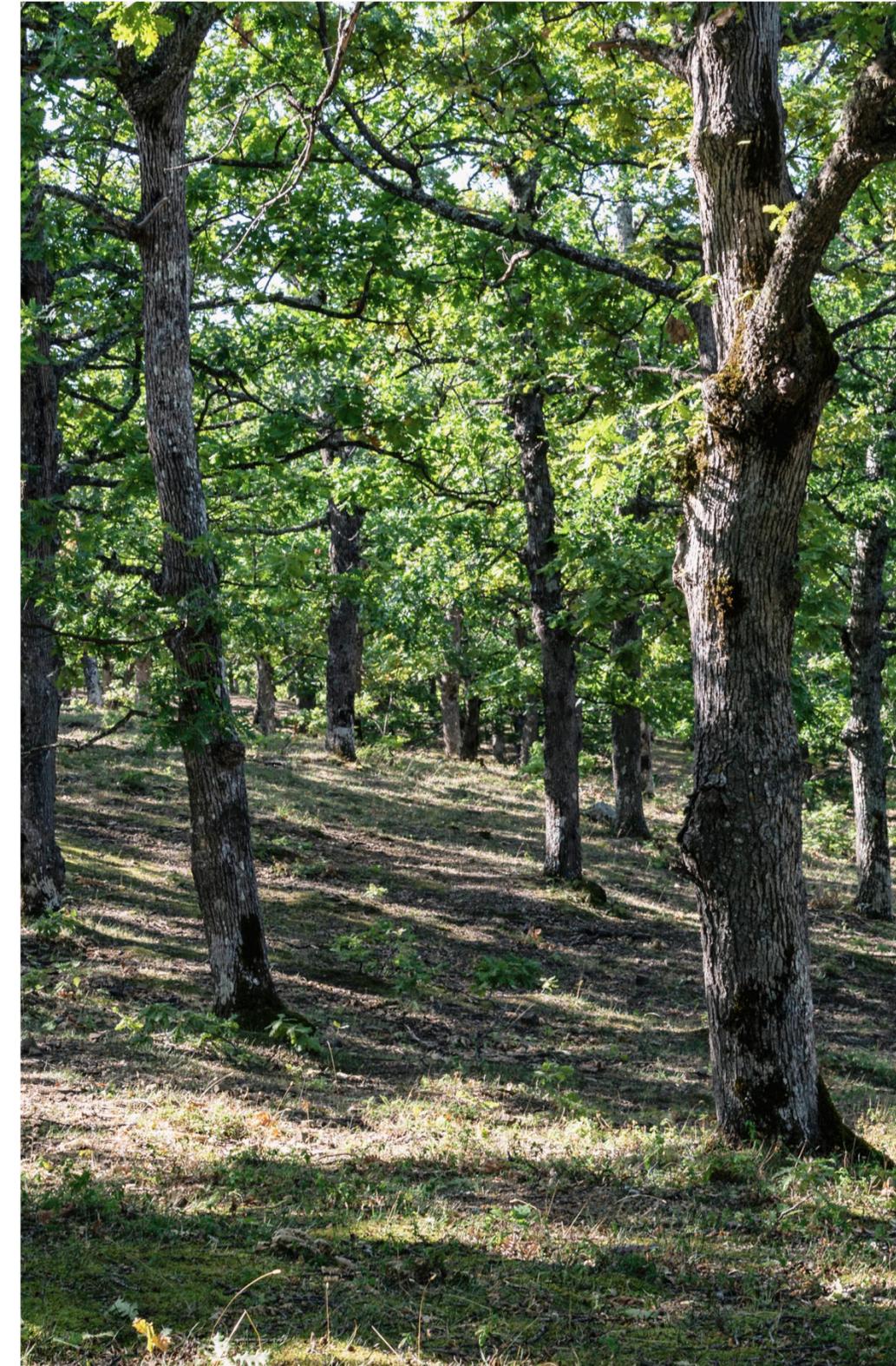
**Co-authors:** Fabrizio Pietrini, Emanuele Pallozzi, Gabriele Guidolotti, Loredana Caccavale, Carlo Calfapietra, Guido Masiello, Francesco Ripullone, Andrea Scartazza

 EXPERIMENTAL SITE

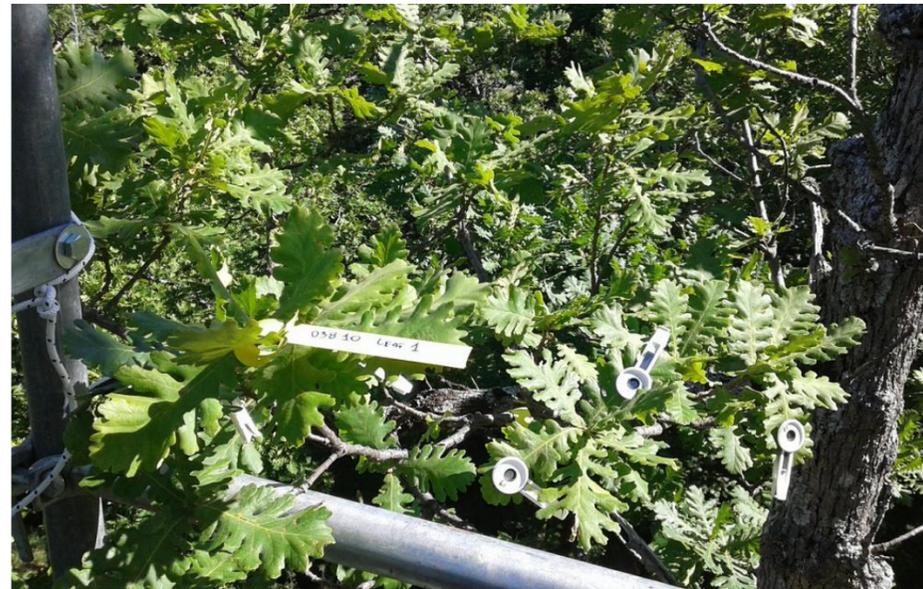
# A PURE Q. FRAINETTO FOREST LOCATED IN SOUTHERN ITALY

San Paolo Albanese forest site (40.02° N 16.34° E, 950-1050 m a.s.l.)  
located in the Pollino National Park

- frequent droughts in the past
- presence of declining of non-declining trees
- different light exposure



# SAMPLED LEAVES



## Declining trees (D)

Declining oaks were considered those with crown transparency >50%



## Non-declining trees (ND)

Non-declining oaks were considered those with crown transparency <50%



## METHODOLOGY

### DESTRUCTIVE TECHNIQUES

1) leaf structural traits

2) leaf pigment determinations

3) nitrogen concentration and  
carbon isotope composition

leaf level

### NON-DESTRUCTIVE TECHNIQUES

4) gas exchange measurements

5) chlorophyll (Chl) fluorescence  
measurements

6) optical measurements

## FIELD CAMPAIGN

Scaffold towers (9–12 meters high)  
No stress during the summer of 2020  
21st–22nd July 2020



RESEARCH QUESTION

WHICH ARE THE DIFFERENT  
ADAPTIVE STRATEGIES  
EMERGED  
IN RESPONSE TO VARYING LIGHT ENVIRONMENTS  
FOR THE TWO PLANT  
CATEGORIES?

# RESULTS

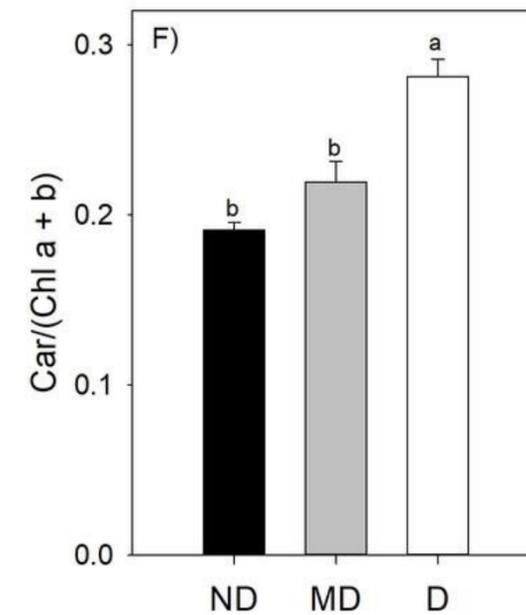
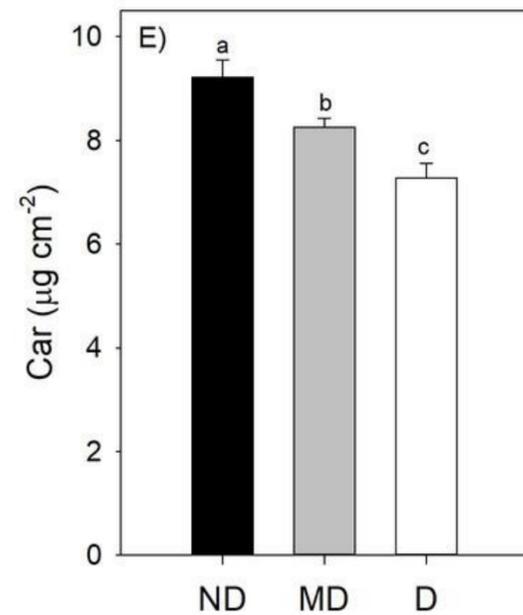
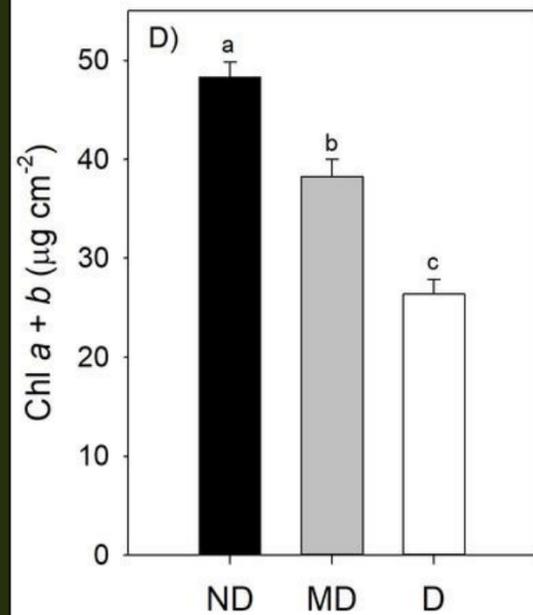
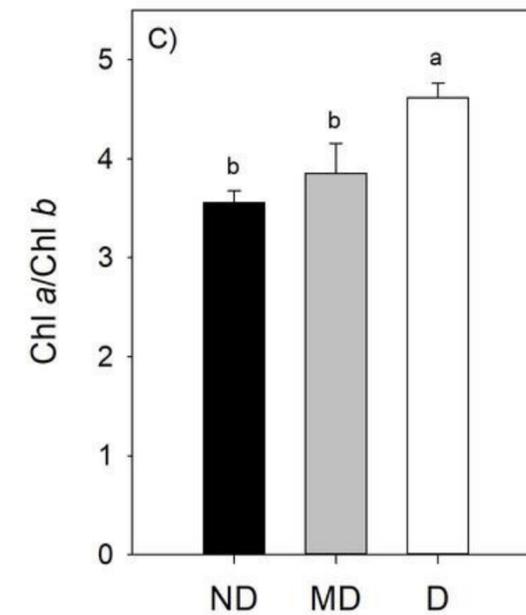
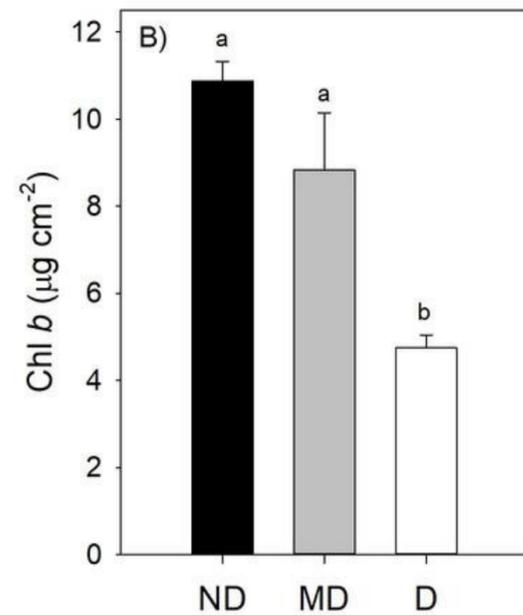
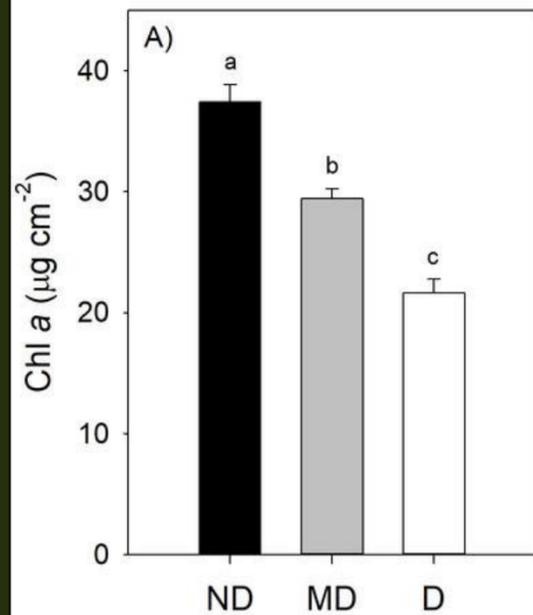
structural traits  
photosynthetic pigments  
carbon isotope composition

Rome, February 18<sup>th</sup>-19<sup>th</sup>, 2025



## Declining trees

## Non-declining trees



↑LMA  
↑DW  
↓N<sub>m</sub>  
↓C:N

↓LMA  
↓DW  
↑N<sub>m</sub>  
↑C:N

↓Chl tot  
↓Car  
↑Chl a/Chl b  
↑Car/ Chl tot

↑Chl tot  
↑Car  
↓Chl a/Chl b  
↓Car/Chl tot



**No significant differences**

δ<sup>13</sup>C of soluble sugars

C  
N<sub>a</sub>



similar  
WUE,  
PNUE

# RESULTS

Gas exchange measurements

Chl fluorescence measurements

CNR IRET Conference

Rome, February 18<sup>th</sup>-19<sup>th</sup>, 2025



**Declining trees**

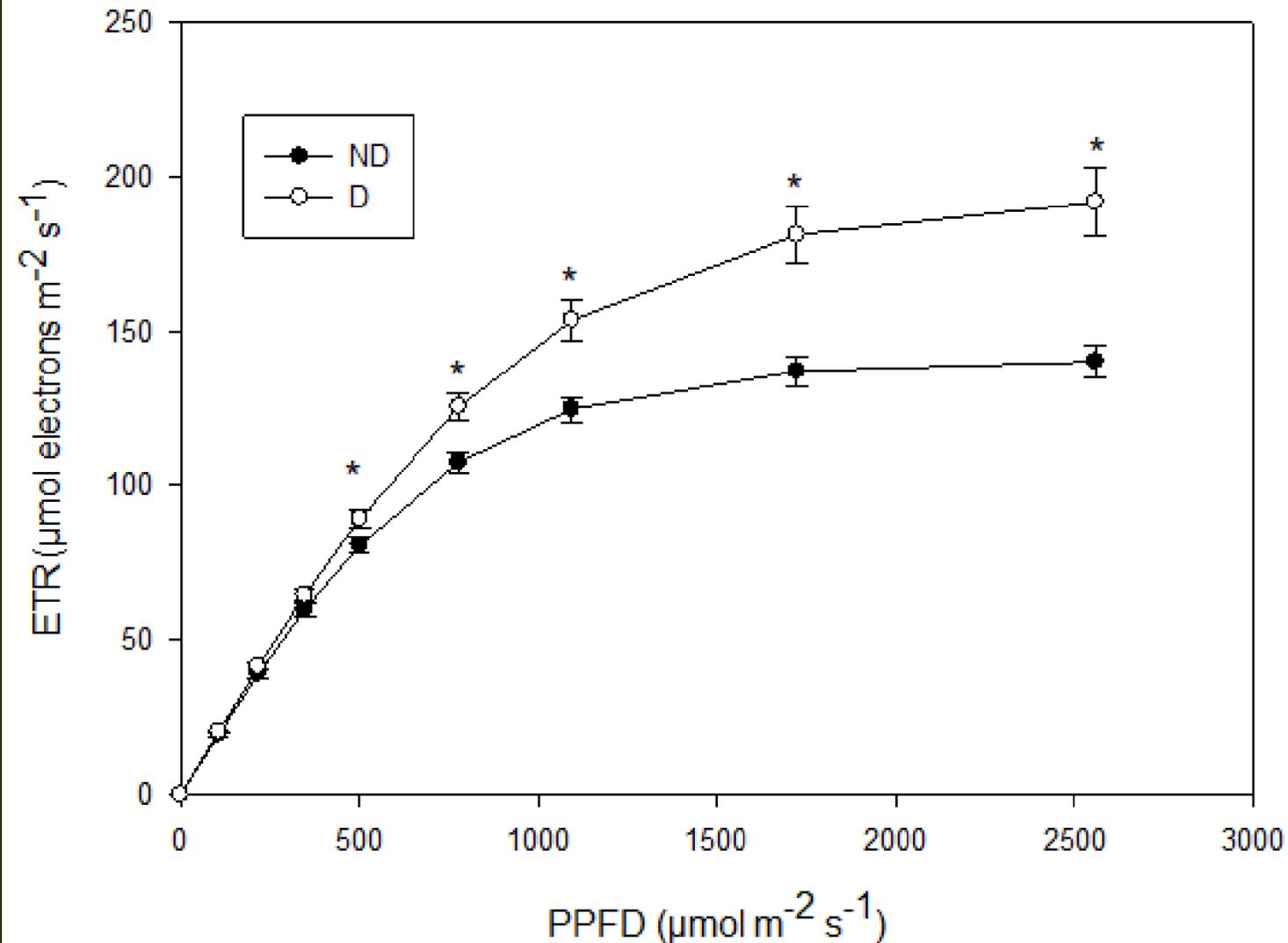
**Non-declining trees**

No significant differences

- A
- $A_{max}$
- $g_s$
- $C_i$
- E
- $PI_{ABS}$
- $\alpha$

- $\downarrow F_0$
- $\downarrow F_v/F_m$
- $\downarrow F_v/F_0$
- $\uparrow F_0/F_m$
- $\uparrow ETR_{max}$
- $\uparrow E_k$

- $\uparrow F_0 \rightarrow \uparrow Chl$
- $\uparrow F_v/F_m$
- $\uparrow F_v/F_0$
- $\downarrow F_0/F_m$
- $\downarrow ETR_{max}$
- $\uparrow E_k$



## Declining trees

## Non-declining trees



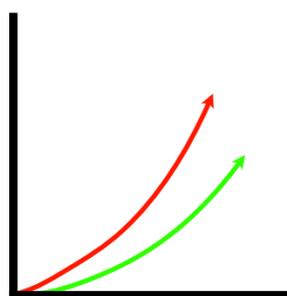
### visible region (400- 700 nm)

strong absorption of photosynthetic pigments

↑green ↓Chl and Car

↓green ↑Chl and Car

no difference for blue and red (saturation)



shift towards shorter  
wavelengths

### red edge region (690-740 nm)

transition from VIS (strong Chl absorption) to  
NIR (high reflectance)

shift towards longer  
wavelengths



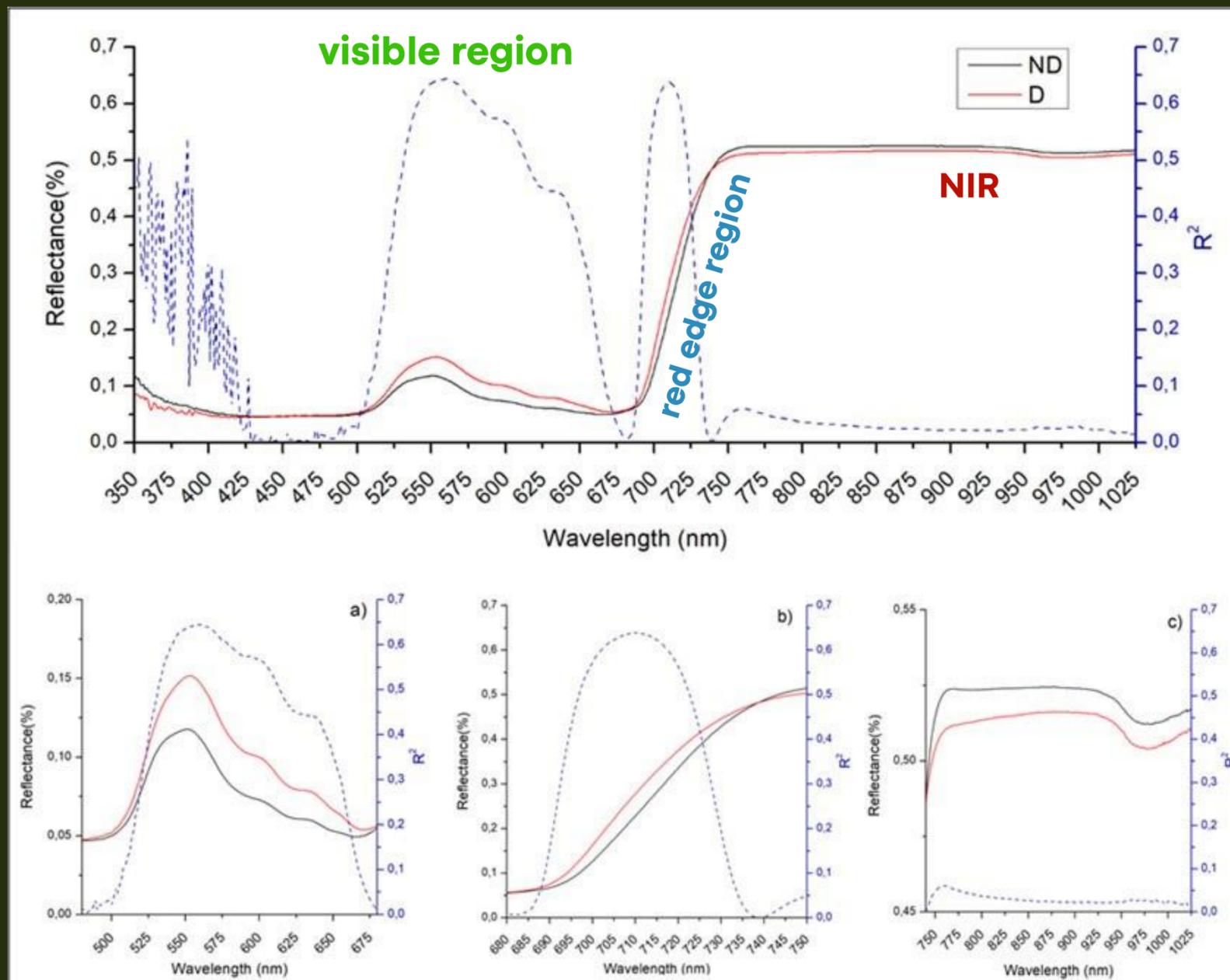
### near infrared region (700-1200 nm)

reflection of leaf structure

no difference for NIR region

## RESULTS

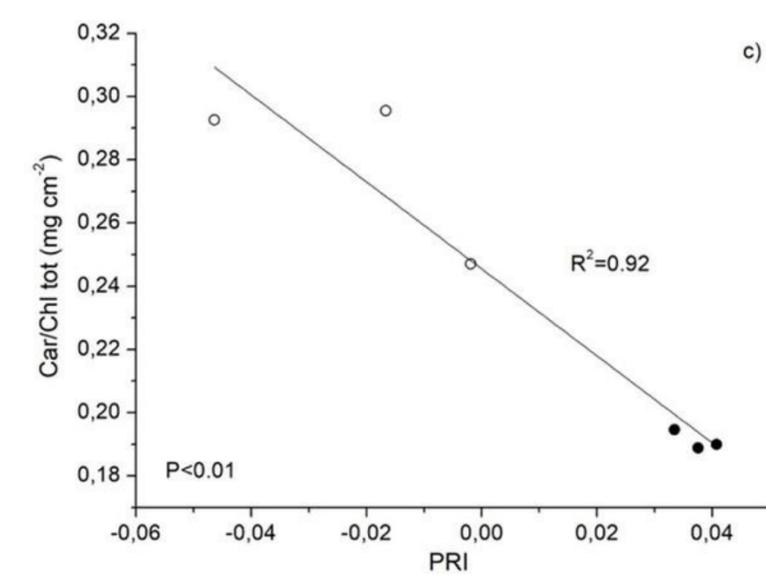
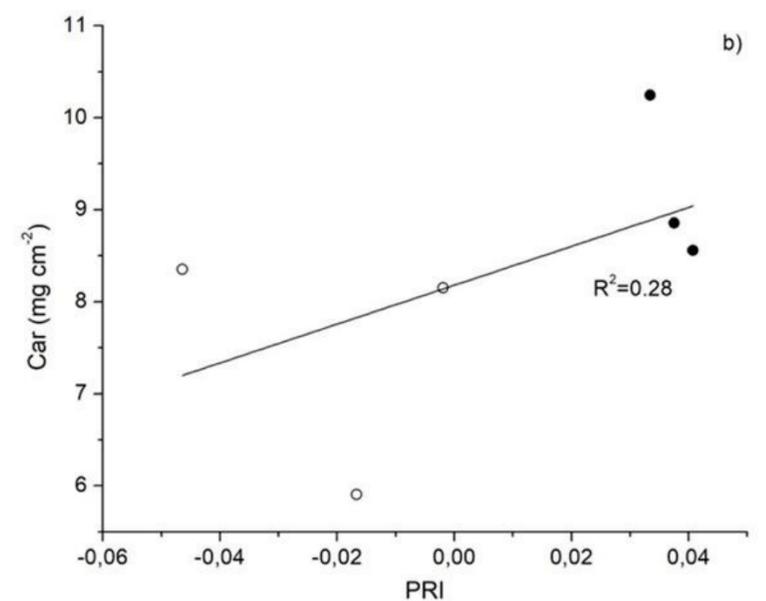
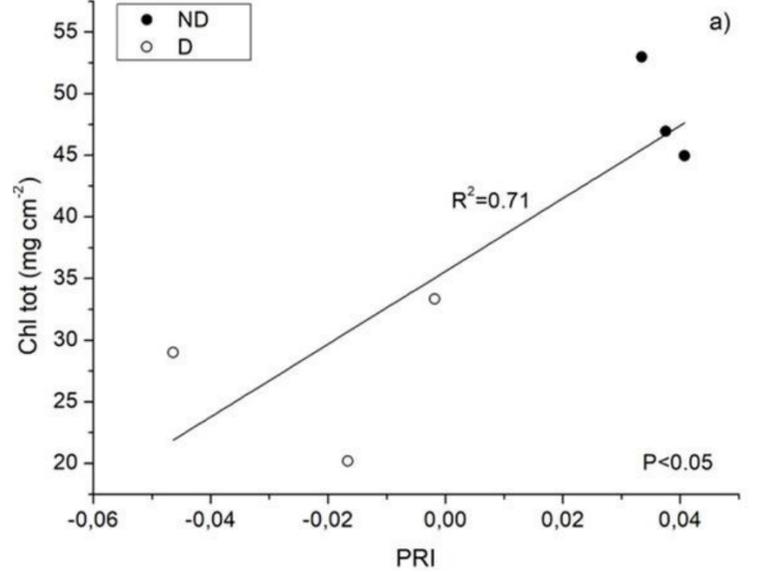
### Leaf spectral signature



significant difference in the **green** and **red edge**  
regions and no difference for **blue, red** and **NIR** regions

# RESULTS

## Photochemical Reflectance Index (PRI)



Rome, February 18<sup>th</sup>-19<sup>th</sup>, 2025



**Declining trees**

**Non-declining trees**

Significant relationship for PRI-Chl and PRI-Car/Chl tot  
No significant relationship for PRI-Car

- PRI as indicator of Chl and Car pools
- Comparison of PRI values between ND and D trees (constitutive response; ontogenetic adjustments)

## SUMMARY

- Declining trees showed traits similar to high light-adapted plants
- However, some parameters did not align with typical high light-adapted behaviour

## KEY FINDING

Despite higher  $ETR_{max}$  in declining trees, their  $A_{max}$  did not increase.

This suggests that excess electron transport is used to repair/dissipation processes, not photosynthesis.

Not a simple light-shade adaptation but different resource-use strategies between D and ND trees.





# Thank you!

**Authors:** Enrica Nestola, Fabrizio Petrini, Emanuele Pallozzi, Gabriele Guidolotti, Loredana Caccavale, Carlo Calfapietra, Guido Masiello, Francesco Ripullone, Andrea Scartazza

Institute of Research on Terrestrial Ecosystems (IRET), National Research Council (CNR)

School of Engineering, University of Basilicata

School of Agricultural, Forestry, Food, and Environmental Sciences, University of Basilicata

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