Reforestation monitoring in Palo Laziale Forest: functional assessment of three Mediterranean tree species in field and drought conditions

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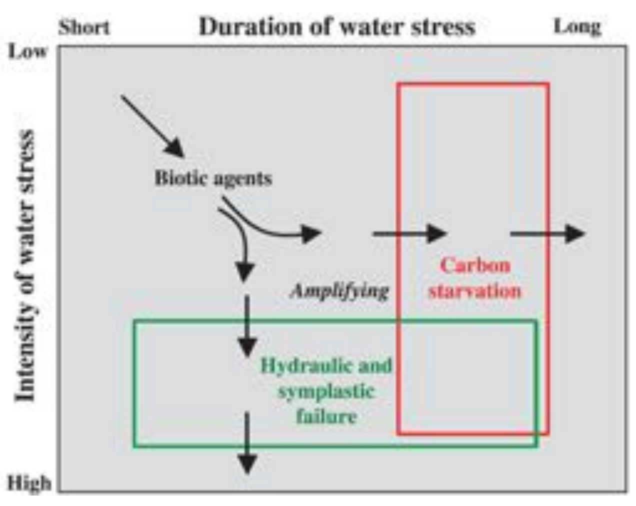
Introduction

Mediterranean forests encounter prolonged droughts that can hinder the growth and survival of tree species used in reforestation efforts in degraded areas.



McDowell et al. (2008)

Early-stage seedlings face high mortality risks due to their shallow roots and limited carbon storage.

Assessing species' carbon and water dynamics is essential for effective restoration planning.

The study aims to compare the functional and ecological strategies of three Mediterranean tree seedlings (*Quercus cerris, Quercus pubescens,* and *Fraxinus ornus*) of the same age and origin both in field in a reforestation site and potted subjected to experimental drought and well-watered conditions.

Materials and Methods

AREA OF STUDY:

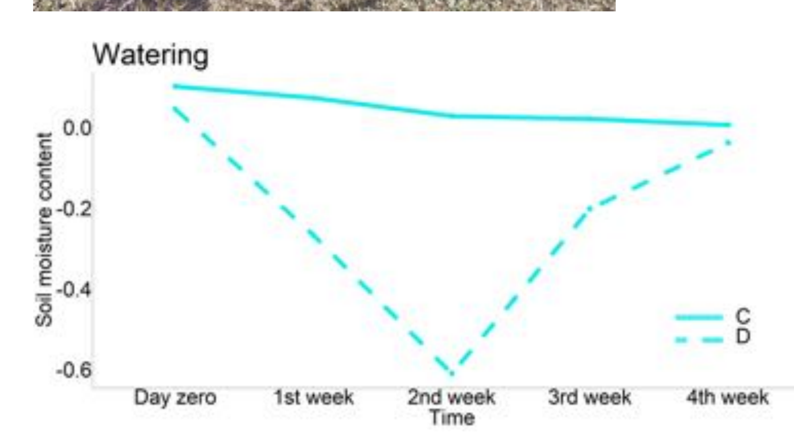
The study's area is Palo Laziale forest (SCI IT6030022), which is part of Natura 2000 network. The site is experiencing a forest decline due to lack of adequate management, increasing anthropization and worsening arid conditions.

As part of the European Life PRIMED project, around 2500 three-year-old native tree seedlings were planted in the area.

EXPERIMENTAL DESIGN:

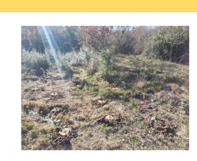
Species' leaf gas exchanges were measured in both experimental and field conditions using the portable photosynthesis system Ciras-2, along with key leaf traits associated with carbon economy and water status.

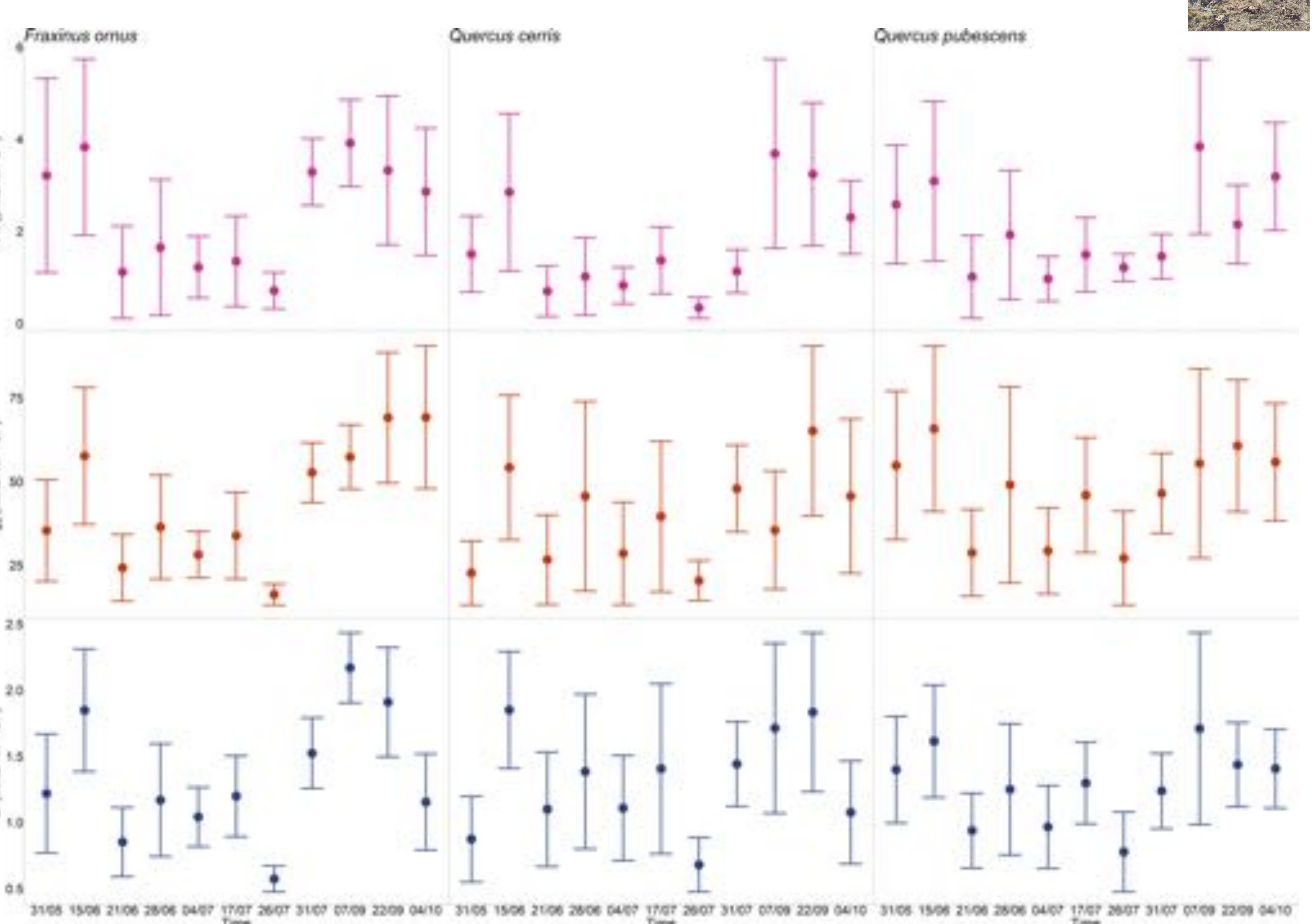
Measurements in the reforestation area (Palo Laziale Forest) were conducted between May and October 2023.



In June, a drought experiment was carried out in a botanical garden using seedlings of the same species, age, and origin as the plants observed in field. The traits were assessed in the "control" and "drought" groups, both during water withholding and subsequent recovery.

Results

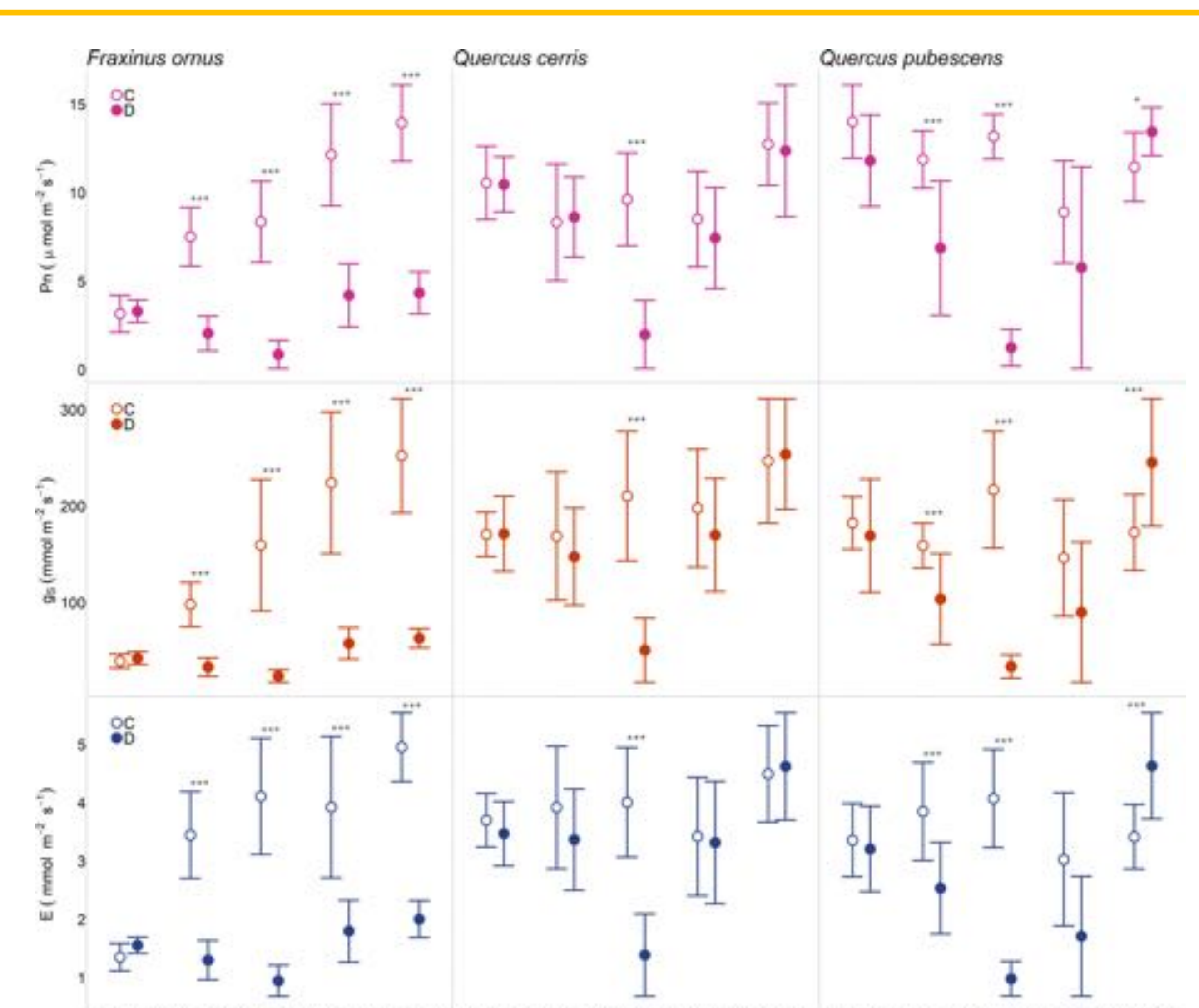




Mean and standard deviation of the leaf gas exchanges per each species and date. Pn (Net photosynthetic rate), g_s (Stomatal conductance), and E (transpiration rate). Site: Palo Laziale Forest.

	P PN	*P* GS	*P* E	*P* iWUE	*P* SLA	*P* LDMC	*P* RWC	*P* LAI
SPECIES								
QC-FO	0.000	0.000	0.000	0.000	0.698	0.004	0.446	0.000
QP-FO	0.206	0.000	0.123	0.995	0.020	0.001	0.128	0.000
QP-QC	0.000	0.979	0.007	0.000	0.152	0.866	0.755	0.000
MONTH								
JUNE-JULY	0.000	0.000	0.000	0.232				0.003
MAY-JULY	0.000	0.857	0.791	0.000	0.000	0.000	0.069	0.004
OCTOBER-JULY	0.000	0.000	0.318	0.000				
SEPTEMBER-JULY	0.000	0.000	0.000	0.000	0.984	0.710	0.992	0.491
MAY-JUNE	0.039	0.360	0.551	0.000				0.933
OCTOBER-JUNE	0.000	0.000	0.980	0.000				
SEPTEMBER-JUNE	0.000	0.000	0.000	0.000				0.000
OCTOBER-MAY	0.505	0.000	0.965	0.998				
SEPTEMBER-MAY	0.005	0.000	0.000	0.987	0.000	0.005	0.281	0.000
SEPTEMBER-OCTOBER	0.611	0.999	0.000	0.919				

Tukey HSD results for species and month effects on each dependent variable (PN: Net photosynthetic rate, GS: Stomatal conductance, E: transpiration rate, iWUE: intrinsic water use efficiency, SLA specific leaf area, LDMC: leaf dry matter content, RWC: relative water content, LAI: leaf area index). FO: *Fraxinus ornus*, QC: *Quercus cerris*, QP: *Quercus pubescens*. Site: Palo Laziale Forest.



Mean and standard deviation of the leaf gas exchanges per each species, treatment and date. C: control, D: drought treatment. Pn (Net photosynthetic rate), g_s (Stomatal conductance), and E (transpiration rate). Site: Rome's botanical garden.

	P PN	*P* GS	*P* E	*P* iWUE	*P* SLA	*P* LDMC	*P* RWC
TREATMENT							
C-D	0.000	0.000	0.000	0.000	0.188	0.884	0.199
SPECIES							
QC-FO	0.110	0.988	0.000	0.977	0.924	0.867	0.212
QP-FO	0.000	0.590	0.000	0.503	0.892	1.000	0.172
QP-QC	0.084	0.696	0.918	0.644	0.694	0.890	0.985

Tukey HSD results for species and treatment effects on each dependent variable (PN: Net photosynthetic rate, GS: Stomatal conductance, E: transpiration rate, iWUE: intrinsic water use efficiency, SLA specific leaf area, LDMC: leaf dry matter content, RWC: relative water content). C: control, D: drought treatment. FO: *Fraxinus ornus*, QC: *Quercus cerris*, QP: *Quercus pubescens*. Site: Rome's botanical garden.

Future developments

- Predict future leaf gas exchanges of *Q. cerris*, *Q. pubescens* and *F. ornus* using a biochemical model based on the equations of Farquhar et al. (1980);
- Investigate the mechanisms underlying species' mortality by analyzing and comparing non-structural carbohydrates in the leaf and wood tissues of both survived and dead plants.
- Predict drought-induced mortality of *Q. cerris*, *Q. pubescens* and *F. ornus.*