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Deliverable D2.3

Database of relevant wood hydraulics traits for the GenRes collection

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1 Summary

This deliverable D2.3 gathers the FORGENIUS WP2 phenotypic data related to tree xylem hydraulics traits collected in the field during the first two years of the project. The datasets provided as part of this deliverable have been summarised to make it easier to read and use as relevant datasets of phenotypic properties for the EUFGIS database.

This deliverable applies to four species: *Populus nigra* and *Pinus pinaster* (characterized in 2021) and *Fagus sylvatica* and *Pinus sylvestris* (characterized in 2022). The data for 2023 and 2024 (*Quercus robur, Picea abies, Abies alba, Malus sylvestris, Pinus halepensis* and *Pinus pinea*) are being analysed and will be provided once all analyses are completed.

More than 2,000 measurements have been collected by the WP2 field team for Deliverable D2.3 in the first two years of this project. In practice, we sampled branches from the canopy top of 10 trees for each GCU, with the number of GCUs varying between 12 and 15 per species.

The deliverable outputs are the datasets (§ 3.2) and the associated metadata (§ 3.1). All the data are already available in the official FORGENIUS Repository (Microsoft Teams).

2 Introduction

Following the Field and Laboratory Protocols submitted as part of Milestone MS3 (sheet 9, 10 and 11 of the Protocol in MS3), we determined phenotypic variability in traits belonging to the leaf and stem hydraulics.

The data presented here refers to the following GCU sampled during 2021 and 2022.

Date of collectio n	Species	Number of GCUs	Total number of sampled trees
2021			
Spring	Populus nigra	15	150
Autumn	Pinus pinaster	12	120
2022			
Spring	Fagus sylvatica	15	150
Autumn	Pinus sylvestris	14	140

We initially planned to sample 15 GCUs per species. The slight reductions in sampling intensity for two species is explained by the initial difficulties to maintain the sampling schedule during Year 1 because of tiredness in the field team (12 instead of 15 sampled GCUs in *Pinus pinaster*) and the loss of samples during shipment following sampling in the field (one GCU in *Pinus sylvestris*).

Following collections, all sampled were shipped to the laboratories for further analysis. In detail, the measurements carried out for this Deliverable 2.3 cover the following spectrum of traits:





Trait spectrum	Symbol	Trait	Ecological significance
Hydraulics	Gmin	The leaf water conductance remaining after stomatal closure across all measured trees in the GCU.	Leaf residual (or minimum) vapour conductance for the apical leaves of 10 individual adult dominant/co-dominant trees sampled either inside or in the vicinity of the circular plot. During a severe drought, following the closure of the stomata, trees continue slowly to lose water through their surfaces (leaf epidermis, bark). A high residual conductance implies a high sensitivity to severe droughts because it favours desiccation. It is an index of drought susceptibility during extreme drought events. The values of xylem yulnerability
		at which 50% of the xylem capacity to conduct water to the leaves is lost across all measured trees in the GCU.	to embolism for the apical branches of 10 individual adult dominant/co-dominant trees sampled either inside or in the vicinity of a circular plot of 15m radius. When a tree is subjected to drought, its xylem is vulnerable to losing its capacity to conduct water to the leaves, i.e., its hydraulic conductivity, because of the formation of air emboli inside the xylem conduits.
	P12	The water potential at which 12% of the xylem capacity to conduct water to the leaves is lost across all measured trees in the GCU.	Like P50, P12 is an index of drought resistance of the xylem of stems. It is the water potential where the first air entry occurs in the xylem. It is calculated on the xylem vulnerability curve as the xylem water potential at PLC=12%.
	P88	The water potential at which 88% of the xylem capacity to conduct water to the leaves is lost across all measured trees in the GCU.	Like P50, P88 is an index of drought resistance of the xylem of stems. It is the water potential where the stem xylem is close to complete hydraulic failure. It is calculated on the xylem vulnerability curve as the xylem water potential at PLC=88%.





slope	Slope of the	The slope of the xylem
	vulnerability curve.	vulnerability curve, i.e., the sensitivity of PLC to changes in xylem water potential.
Kmax	Maximum specific hydraulic conductivity.	The efficiency of water transport of the stem xylem under saturated conditions, per unit of cross-sectional area and for a unit length of segment.

In the initial proposal, we also proposed to collect replicated samples from both the top and the bottom positions within each tree crown to account for different radiation conditions. This element of the project plan was discarded during later planning, in favour of standardising all sample collections to the top of the canopy of the dominant trees for each stand. This choice was justified by the need to maintain sample collection within the limit of the processing capabilities of the laboratories involved, while maximising the number of trees that could be sampled. The choice is also justified by the presence of significant differences in the level of illumination at the bottom of the canopy at each GCU, which would have made it very difficult to standardise the sampling by light levels.

The dataset is complete for all the variables reported above, with some occasional missing values.

Further details on the detailed sampling schedule, names and codes of the sampled GCU for each species can be found in Deliverable D2.1. Data collection was coordinated by the two teams at CREAF-Barcelona and INRAe-Avignone, with the help of the local partners to confirm the choice of the relevant GCUs, obtain the relevant permissions and identify the most suitable sampling areas. Local partners provided an essential support to the WP2 field team. All laboratory work relied on the field team crew who shipped or carried all samples to the three laboratories at INRAe (i.e., Avignone and Clermont-Ferrand (for Gmin), and Bordeaux (for vulnerability measurements on the cavitron), where these analyses were carried out.

3 Results

3.1 The data description file

The data description file reports the following information:

- The names of the people who conducted the measurements in the laboratory
- The times when the measurements were taken
- The country, species, GCU Code, Tree Code and tree id employed to identify individual samples.

The file contains also:

The name of each of the measured traits, the units employed and a short description of the variable.





Names, units and variable descriptions are consistent with those given in the (conceptual) dictionary employed to define and explain the meaning of all the measured variables, i.e., they correspond to the EUFGIS dataset contained in the online table: characterization-descriptors.xls constructed by the WP5 team (Milko Škofič and Marjana Westergren, WP5 leader).

The content of the data description file is also reported here for completeness:

Data measured and recorded by INRAe laboratories at Bordeaux (Sylvain Delzon), Clermont-Ferrand (Hervé Cochard) and Avignone (Nico Martin) during 2022 and 2023 # CURATED_DATA

P50 and S values were obtained using the Pammenter model of PLC curves using mean values of conductance per speed class Variable Units Description

variable	Units	Description
		Pressure inducing 50% PLC = air entry
P50	MPa	point
		Pressure inducing 12% PLC = air entry
P12	MPa	point
P88	MPa	Pressure inducing 88% PLC
		slope of the vulnerability curve at the
slope	% MPa-1	inflexion point
		maximum hydraulic conductivity
		measured with the cavitron (= ks, xylem-
Kmax	m² MPa-1 s-1	specific hydraulic conductivity)
Gmin	mmol m-2 s-1	mmol H2O /m2 one side leaf area /s





3.1 The dataset file

The dataset file consists of a number of columns, corresponding to the definitions given in the data description file, i.e., country, species, GCU Code, Tree Code, tree id, followed by the variable names.

The file 'deliverable D2.2.xlsx' containing the data description and the dataset is available in the official FORGENIUS Repository (Microsoft Teams). Data description and final dataset are given as separate sheets within the file.

4 Conclusions

The dataset provided here presents the first preliminary output related to the collection of the phenotypic measurements carried out for four of the ten species that will make up the final complete dataset of traits related to leaf and stem hydraulic traits.

5 Partners involved in the work

INRAe (Avignone, Clermont-Ferrand, Bordeaux), CREAF. All partners involved in field sampling and collection.

6 Annexes

None.