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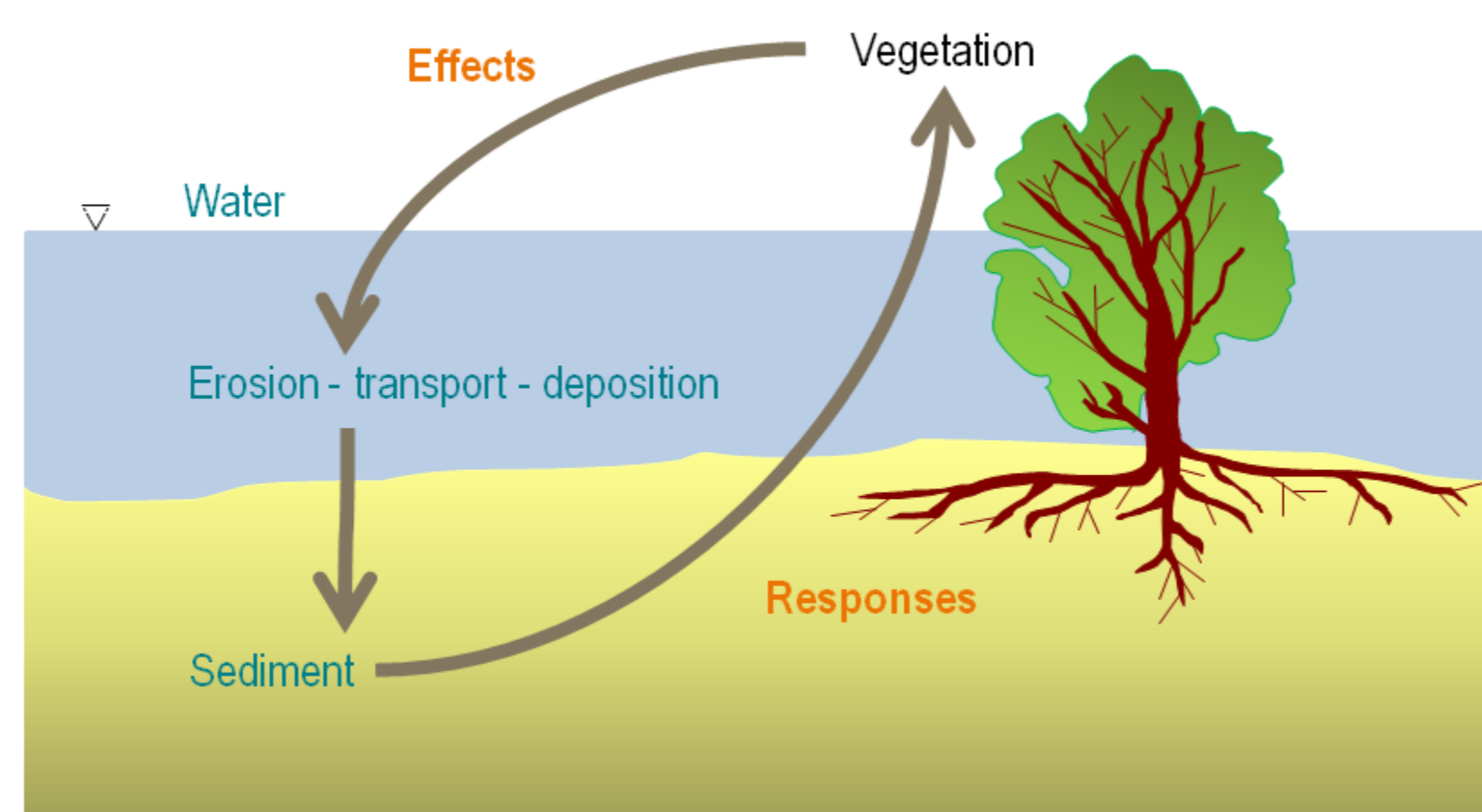


# RESPONSE OF BLACK POPLAR (*POPULUS NIGRA* L.) TO HYDROGEOMORPHOLOGICAL CONSTRAINTS: A SEMI-CONTROLLED *EX SITU* EXPERIMENT

Réponse du peuplier noir (*Populus nigra* L.) aux contraintes hydro-géomorphologiques : une expérimentation *ex situ* semi-contrôlée

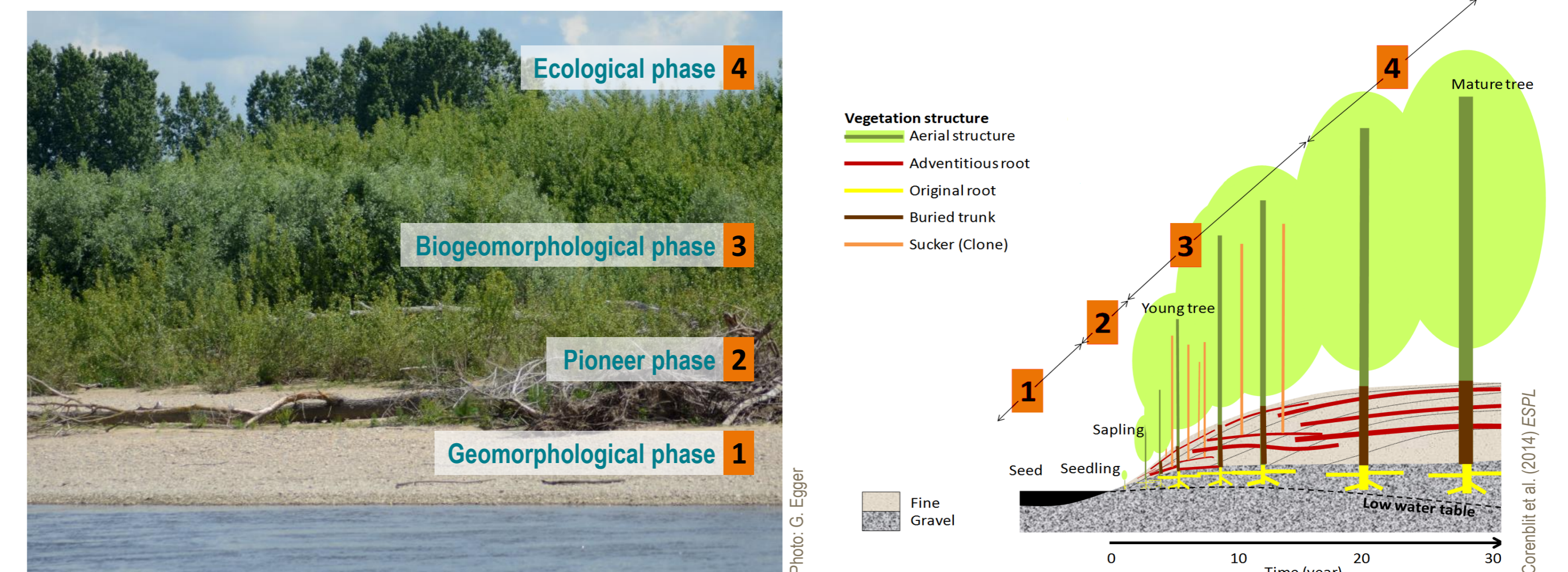
## 1 Evolutionary feedback between woody riparian species and hydrogeomorphological constraints

- Hydrogeomorphological factors (topography, flow and sediment transport regimes) control vegetation dynamics in riparian ecosystems → but vegetation also has an impact on these factors, which in turn causes an effect on the plant phenotype.
- Concepts:** 'ecosystems engineers' and 'positive niche construction'.
- At an evolutionary timescale, this **reciprocal interaction** has promoted the selection of certain **plant traits** to increase the persistence of woody riparian species within fluvial environments.



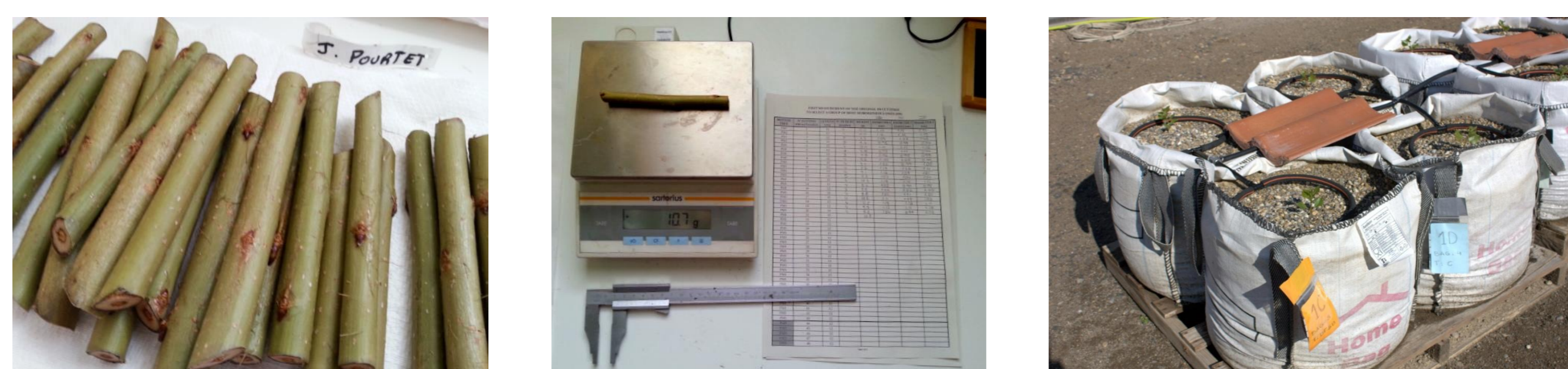
## 2 The biogeomorphological life cycle of black poplar (*Populus nigra* L.)

- Black poplar is a keystone ecosystem engineer species. Specific ranges of hydrogeomorphological conditions control the successive phases of its entire life cycle.
- Hypothesis:** the impact of poplars on the landform structure modulates its own growth performance, biomass and architecture until it reaches sexual maturity.

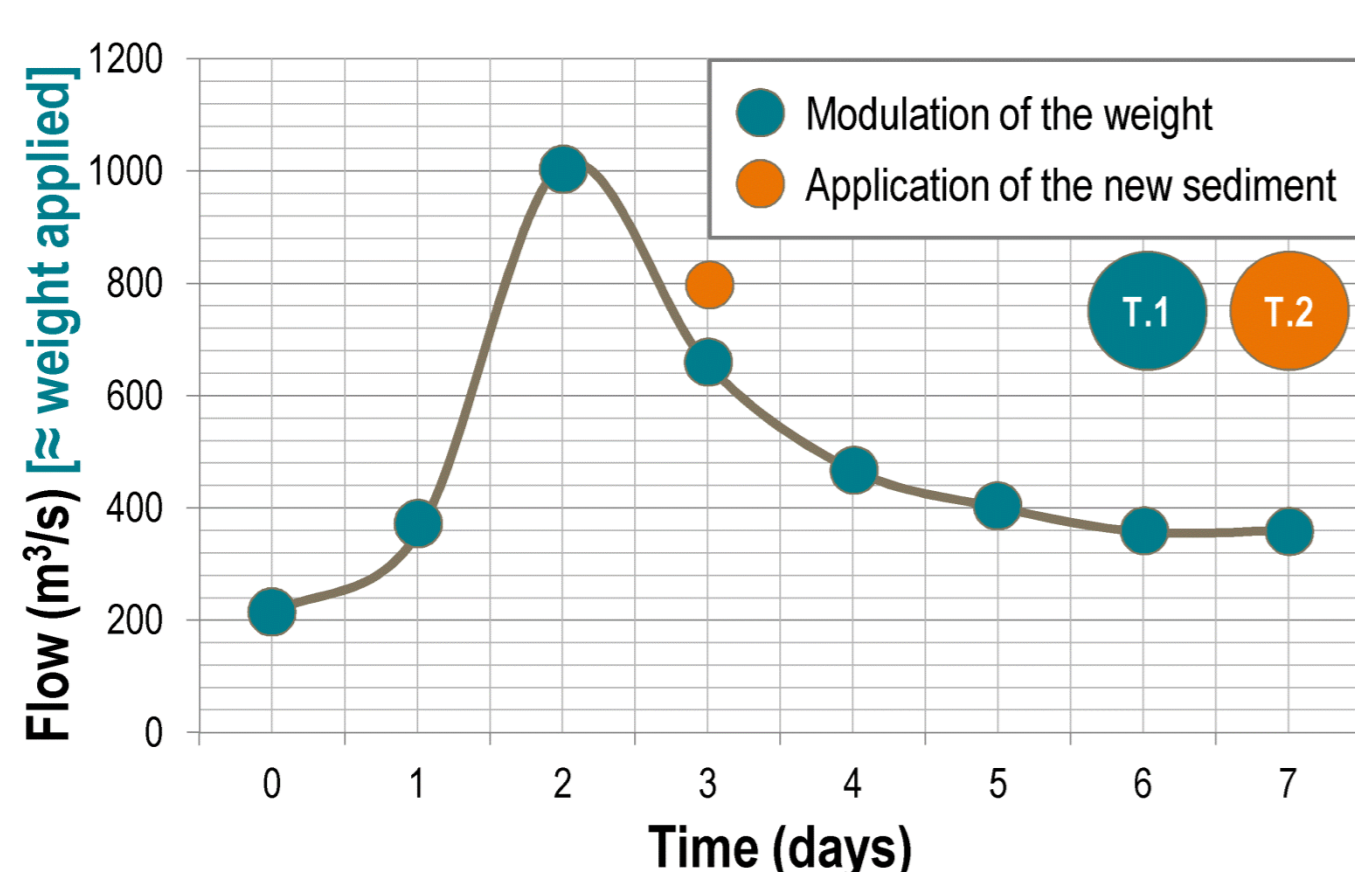
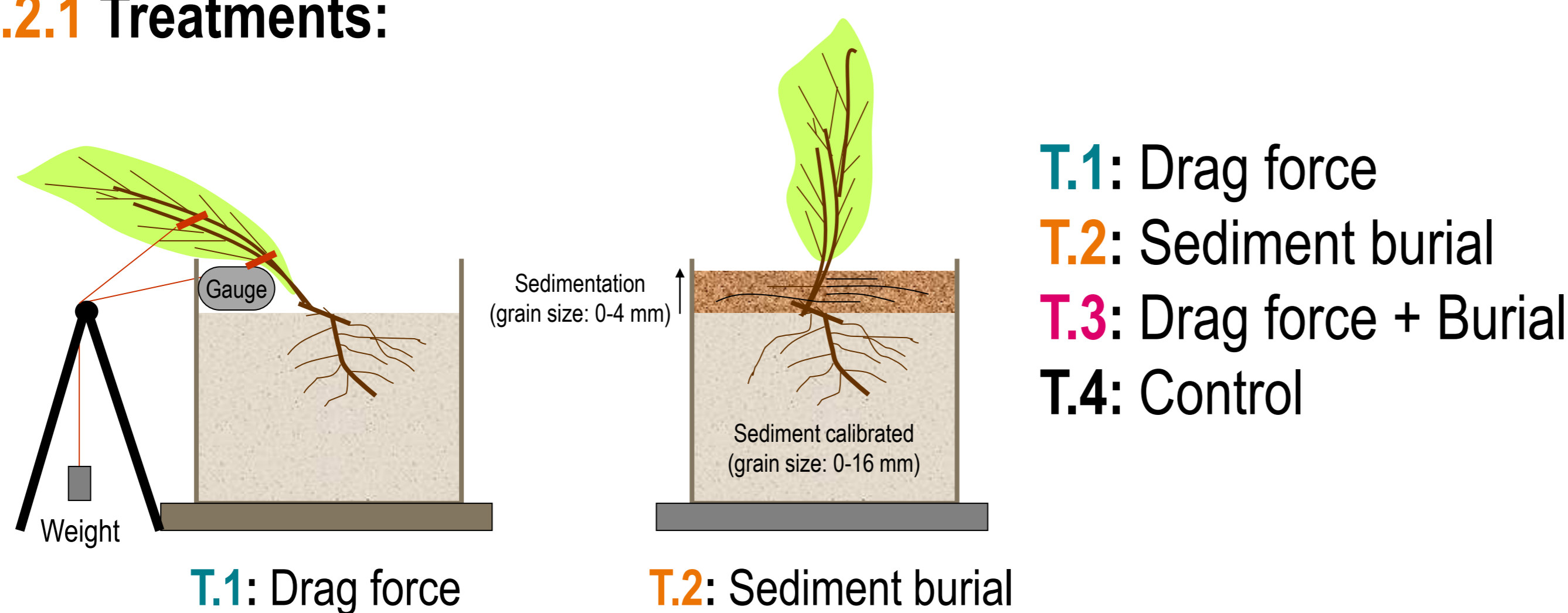


## 3 Semi-controlled *ex situ* experiment

- 3.1 Objective:** To quantify **key response functional traits** (morphological and biomechanical) of *Populus nigra* L. cuttings to simulated hydrogeomorphological constraints (**drag force** and **sediment burial**) as well as to dissociate the specific responses to them.
- 3.2 Experimental design:** 128 stem cuttings of *P. nigra* (variety Jean Pourtet) were measured, planted in permeable bags with an irrigation system attached and randomly assigned to one of the 4 treatments.



### 3.2.1 Treatments:



- The weight (T.1) will be modulated imitating the shape of an average hydrograph of a Spring flood in the Garonne River (where the clone Jean Pourtet comes from).
- The burial (T.2) will be applied during the recession limb of the curve.

- Temporal sequence** of expected above-ground and below-ground plant development according to the application of treatments. (Experimentation from March to Sept. 2015)



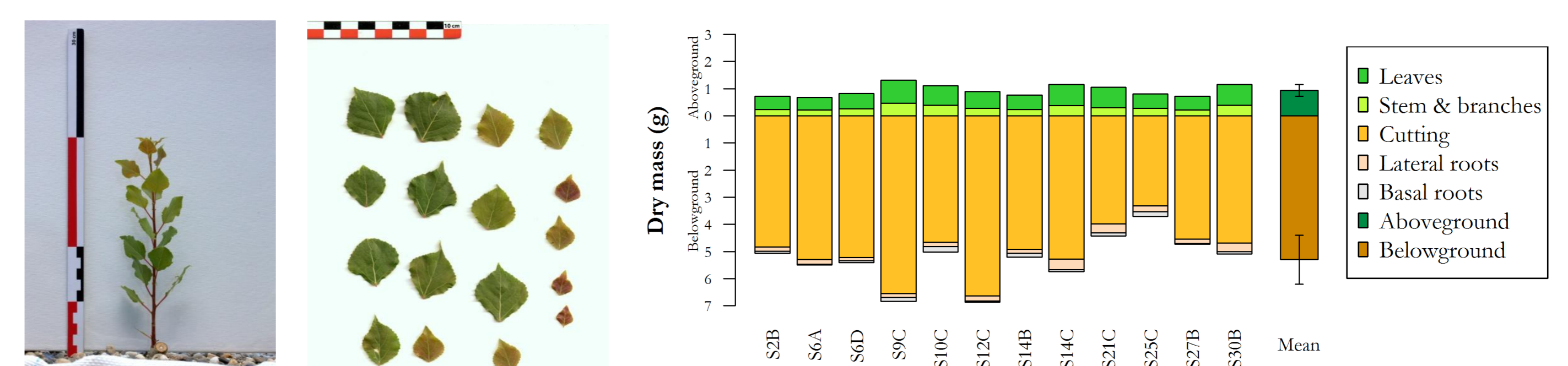
### 3.2.2 Morphological and biomechanical traits:

Above-ground traits	Below-ground traits	Ratios
<ul style="list-style-type: none"> <li>Number of shoots</li> <li>Max. plant height</li> <li>Root collar diameter</li> <li>Diameter at middle mature height</li> <li>Tapering</li> <li>Inclination of the main stem</li> <li>Average leaf area</li> <li>Specific leaf area</li> <li>Above-ground dry mass</li> <li>Frontal surface area</li> <li>Pulling force*</li> <li>Flexibility*</li> </ul>	<ul style="list-style-type: none"> <li>Initial diameter (cutting)</li> <li>Initial weight (cutting)</li> <li>N° first order roots</li> <li>N° structural roots</li> <li>N° basal, lateral and superficial roots</li> <li>Root diameter</li> <li>Insertion angle</li> <li>Root length by diameter class</li> <li>Max. and mean root length</li> <li>Below-ground dry mass</li> <li>N° 'shear' and 'broken' roots*</li> <li>Diameter of 'shear' and 'broken' roots*</li> </ul>	<ul style="list-style-type: none"> <li>Root mass fraction</li> <li>Shoot mass fraction</li> <li>Elongation ratio</li> <li>Shoot to root ratio</li> <li>Fine/structural roots</li> <li>Leaf area to root length ratio</li> <li>Root weight/n° of tips</li> <li>Roots extracted/remaining in the bag*</li> </ul>

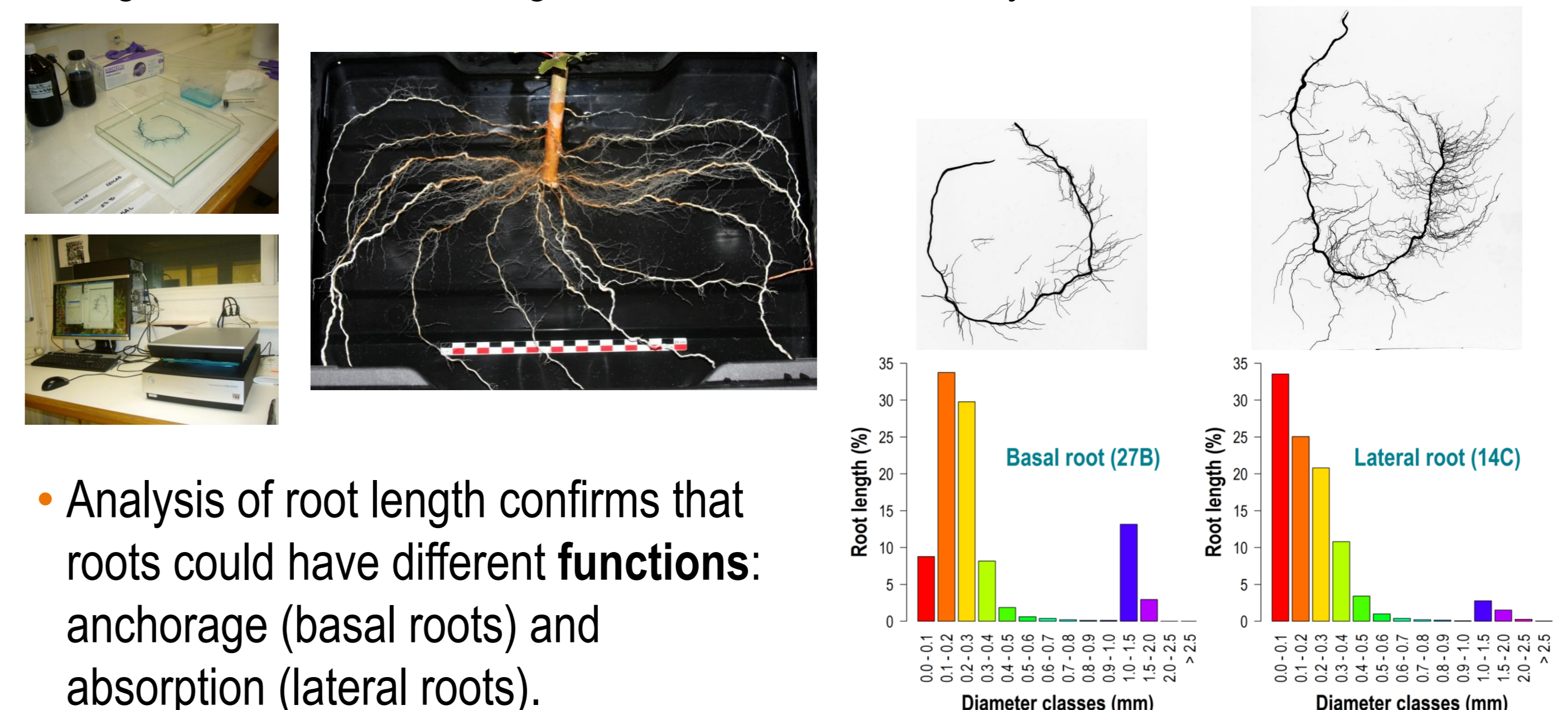
\* Traits from *winching test*.

### 3.2.3 Preliminary results: First partial harvest

- 12 plants** were destructively sampled to test the methodology of extraction, conservation and sub-sampling.



- The **growth is optimum** but some differences are evident depending on the original size of the cutting and the mother tree they come from.



- Analysis of root length confirms that roots could have different **functions**: anchorage (basal roots) and absorption (lateral roots).

The quantification of functional response traits of *P. nigra* will enhance our understanding of fundamental biogeomorphic interactions and its implication for the restoration of river systems.

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