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RESPONSE OF BLACK POPLAR (POPULUS NIGRA L.) TO HYDROGEOLOGICAL 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. 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 Pourret) were measured, planted in permeable bags with an irrigation system attached and randomly assigned to one of the 4 treatments.

   - **3.2.1 Treatments:**

     - T.1: Drag force
     - T.2: Sediment burial
     - T.3: Drag force + Burial
     - T.4: Control

     - 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 Pourret 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)

     - March: Planting
     - April: First harvest
     - May: Growing period
     - June: Treatments application
     - July: Second harvest
     - August: Final harvest & winching test
     - September: (T.1), (T.2), (T.3), (T.4)

   - **3.2.2 Morphological and biomechanical traits:**

     - Above-ground traits
       - Number of shoots
       - Max. plant height
       - Root collar diameter
       - Diameter at middle mature height
       - Tapering
       - Inflation of the main stem
       - Average leaf area
       - Specific leaf area
       - Above-ground dry mass
       - Frontal surface area
       - Pulling force
       - Flexibility

     - Below-ground traits
       - Initial diameter (cutting)
       - Initial weight (cutting)
       - N° first order roots
       - N° structural roots
       - N° basal, lateral and superficial roots
       - Root diameter
       - Insertion angle
       - Root length by diameter class
       - Max. and mean root length
       - Below-ground dry mass
       - N° ‘shear’ and ‘broken’ roots
       - Diameter of ‘shear’ and ‘broken’ roots

   - **Ratios**
     - **Drag Force + Burial**
     - **Root extraction**
     - **Shoot mass fraction**
     - **Elongation ratio**
     - **Shoot to root ratio**
     - Hydraulic conductivity
     - **Leaf area to root length ratio**
     - **Root weight**
     - **Roots extracted/remaining in the bag**

   - *** Traits from winching test**

3.3. 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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