MSc thesis topic announcement:

Uptake and transport functioning of roots across herbaceous plant life forms

Supervisors: Jana Duchoslavová, Joana Bergmann

Working Group: Sustainable Grassland Systems, RA2, located at Paulinenaue research station

Contact: jana.duchoslavova@zalf.de

Background:

All plants rely on the same basic resources such as light, water and mineral nutrients. Their diverse life history strategies to meet these basic demands have been described using functional traits as proxies of functions. Recently, an increasing attention has been paid to the parts of plants that are hidden belowground. As an analogy to carbon-acquiring leaves, fine roots acquire resources from the soil. However, acquisition is not the only function of roots as the acquired soil resources need to be transported to other plant parts, with the transport function becoming dominant in coarse roots. Although both acquisition and transport of resources belowground take place in roots, a single root segment cannot be optimised for both functions, because the characteristics that maximise transport work against those that maximise acquisition. Therefore, the balance between these two functions within a root system is an important trade-off that plants face.

The way plants deal with the acquisition vs. transport trade-off at a root-system level varies greatly depending on their growth form and evolutionary history, which implies different construction possibilities and constraints. Root segments are differentiated to primarily acquisitive or transportive functioning. Related differences in root anatomy and secondary development of tissues may gradually change with root order, as has been shown in trees. However, such patterns are highly species specific and, in general, much less is known about within-system variation of root functioning in herbs. In our project HiddenFun, we aim to fill this knowledge gap by studying herbs of different growth forms. Within herbs, non-clonals have a single connection between roots and aboveground parts while clonals spread laterally by belowground or near-ground horizontal rooting stems which may partly take over the transport function of roots. Such clonal growth form is found in more than 60% of herbaceous perennial species in Central Europe and across the angiosperm phylogenetic tree. The rooting stems provide an alternative way for horizontal transport of resources, and clonal plants use this transport pathway with substantial effects on their growth. Therefore, transport of belowground resources is linked to both root and clonal traits. In addition, long-distance root transport is reduced in plants with high lateral spread by horizontal rooting stems, as distal leaves are supported by adventitious roots growing in their proximity. Hence, presence of alternative clonal structures may affect the trade-off imposed on root systems, promoting an acquisitive function in clonal plants. In the HiddenFun project, we focus on mechanistic understanding of root functioning by measuring relevant traits in a well-designed set of species under comparable conditions.

Specific objectives:

The Master student will participate in collection of data from the main experiment of the HiddenFun project in September 2026. This experiment includes multiple herbaceous plant species with different clonal growth types which are grown in pots at Paulinenaue research station. Many functional traits will be measured on these plants following the harvest of the experiment, including nitrogen uptake rate, biomass allocation, fine root traits, mycorrhizal colonization, and root architectural and anatomical traits. The Master thesis project will focus on a subset of these traits and compare them across the studied species.

Methods:

During the intensive harvest phase planned for September 2026, roots of the plants will be washed, subsamples of fine roots will be scanned, and plant samples will be dried or fixed in ethanol for anatomical observations. Afterwards, the methods depend on root traits of interest for the Master thesis. They may include further scanning and image analyses for root architectural traits, dry biomass weighing to estimate biomass allocation, or histochemical staining of roots and microscopical observations.

Requirements:

- Interest in functional ecology
- Patience and precision
- Ability to communicate in English

Proposed schedule:

Task	Month				
	09/2026	10/2026	11/2026	12/2026	1/2027
Data collection					
Data analysis					
Writing					

Application:

Please send your application (in PDF format) including your CV and a short motivation letter by email with the subject line: **MasterThesis-HiddenFun-2026** to: **jana.duchoslavova@zalf.de**

When you apply, we collect and process your personal data in accordance with Articles 5 and 6 of the EU GDPR solely for the purpose of processing your application and for purposes that may arise from possible future employment at ZALF. Your data will be deleted after six months.