

PROJECT TITLE: Nature-based slope reinforcement using vegetation – understanding root mechanics

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Project keywords: vegetation; plant root biomechanics; root reinforcement; nature-based solutions

Proposed start date: 3 June 2024

Project description:

Vegetation reinforces slopes against landslides and erosion. In order to predict how much, we need to understand the mechanical behaviour of plant roots first. Roots consist of soft tissue on the outside and more rigid tissue within its core – just like man-made composite materials such as climbing rope or cables. Their multi-material nature often results in unexpected mechanical behaviour.

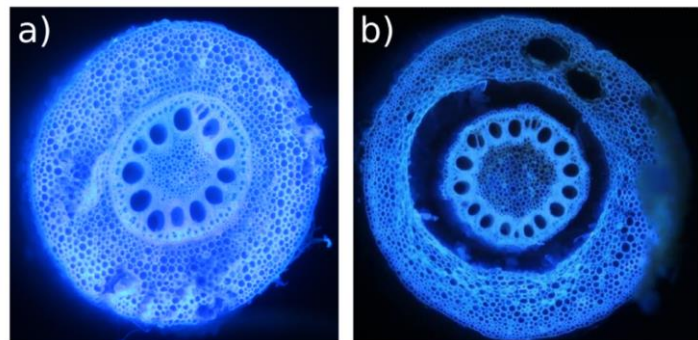


Figure 1 - Cross-section of a maize root before and after tensile failure. Note the differences in tissues, and the delamination between the inside and outside parts of the root after failure (Meijer et al., 2024).

You will conduct tensile strength experiments on real plant roots to collect evidence on their mechanical behaviour under tensile loading. You will learn to use time-lapse photography and digital image correlation (DIC) to transfer photographic data into real strain measurements. You will answer questions about the effects of differing cell tissues, root tortuosity and loading/unloading cycles on the mechanical behaviour of individual roots.

Your results will feed into a better understanding of how we can use vegetation as a sustainable, nature-based solution against riverbank erosion or instability of natural or man-made slopes.

Candidate requirements:

- *Essential:* an interest in conducting lab experiments + limited field sampling work.
- *Desirable:* some affinity with data analysis + coding (e.g. Python)

Background reading:

- Meijer, G. J., Lynch, J. P., Chimungu, J. G. & Loades, K. W. Root anatomy and biomechanical properties: improving predictions through root cortical and stele properties. *Plant and Soil* (2024). <https://doi.org/10.1007/s11104-024-06507-y>

Approximate Work Schedule in weeks (desk based/lab/report writing)

- Week 1: Background reading of relevant literature
- Week 2: Field sampling of plant roots on University of Bath campus
- Week 3-5: Laboratory experiments
- Week 6-7: Data analysis
- Week 8: Preparation of final report and poster