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# Advances in root reinforcement experiments

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Root reinforcement is considered in many situations an important effect of vegetation for slope stability. In the past 20 years many studies analyzed root reinforcement in laboratory and field experiments, as well as through modeling frameworks. Nearby the important contribution of roots to shear strength, roots are recognized to impart stabilization also through lateral (parallel to slope) redistribution of forces under tension. Lateral root reinforcement under tensile solicitations (such as in the upper part of a shallow landslide) was documented and discussed by some studies. The most common method adopted to measure lateral root reinforcement are pullout tests where roots (single or as bundle) are pulled out from a soil matrix. These conditions are indeed representative for the case where roots within the mass of a landslide slip out from the upper stable part of the slope (such in a tension crack). However, there is also the situation where roots anchored at the upper stable part of the slope slip out from the sliding soil mass. In this last case it is difficult to quantify root reinforcement and no study discussed this mechanism so far. The main objective of this study is to quantify the contribution of roots considering the two presented cases of lateral root reinforcement discussed above - roots slipping out from stable soil profile or sliding soil matrix from anchored roots-, and discuss the implication of the results for slope stability modeling.
We carried out a series of laboratory experiments for both roots pullout and soil sliding mechanisms using a tilting box with a bundle of 15 roots. Both Douglas (Pseudotsuga menziesii) roots and soil were collected from the study area in Sardinia (Italy), and reconstructed in laboratory, filling the root and soil layer by layer up to 0.4 meter thickness.
The results show that the ratio between pullout force and force transferred to the root during soil sliding range from 0.5 to 1. This results indicate that measured pullout force always overestimate the contribution of lateral root reinforcement activated in situations where soil slide from anchored roots. That result implies a comparison and calibration of the models used for the calculation of root reinforcement.