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Applicability of Nature-Based Solution to shallow pyroclastic covers, an experimental study

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Nature-Based Solutions involve living natural materials for the protection, management or restoration of ecosystems and they can be applied in many contexts such as for restoring and sustainably managing wetlands, conserving forests, water restoration of drylands, green infrastructures in urban environments.
During last years, these materials are widely increasing the interests of scientific researchers and engineers for the design and the implementation of eco-engineering projects addressed to mitigate hillslope instability through the hydro-mechanical reinforcement of shallowest layers. In particular, plants or grasses can modify the soil response to hydrological stresses (rainfall/ evaporation) or improve its shear strength through roots action.
This experimental study is aimed to investigate the applicability of using vegetation as sustainable practice for improving hydro-mechanical stabilization of shallow pyroclastic soils, systematically affected by rainfall induced landslides. Graminae long root grasses have been planted in a 1D experimental column 2 meters high, filled with pyroclastic material and exposed to atmospheric conditions protected by a rainout shelter during the plant growth. In order to be sure that atmospheric conditions and water supply were suitable for the plant growth, during the first vegetative year both root length and height of foliage have been monthly monitored, showing a strong linear positive correlation. Despite hydrological stresses are the drivers of the triggering of shallow landslides, the change of soil water pressure causes the slope failure. Particularly in unsaturated shallow soil layers, rainfall infiltration induces a drop of soil suction that can lead to the failure. The soil column was instrumented with sensors at four different depths in order to monitor the variation of hydraulic variables due to hydrological stresses and both evapotranspiration and infiltration tests have been performed. An additional 1D column with only bare soil has been used as control.
From results comparison it is observed that these grass species can likely grow in pyroclastic soils within one year and that the presence of vegetation in soil changes its hydrological response mostly in the shallowest layers, where the interaction soil-atmosphere is higher. Root characteristics and diameters have been measured along depth after the experimental study for improving technical knowledge for further implementation in modelling problems.
These results at laboratory scale encourage to further laboratory and in situ investigations on the implementation of Nature-Based Solutions as living mitigation measures for shallow landslides.