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Linking soil permeability and soil aggregate stability with root development: a pots experiment (preliminary results)

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Quantifying and monitoring the contribution of vegetation to the stability of the slopes is a key issue for implementing effective soil bioengineering measures. This topic is being widely investigated both from the hydrological and mechanical point of view. Nevertheless, due to the high variability of the biological components, we are still far from a comprehensive understanding of the role of plants in slope stabilization, especially if the different succession phases and the temporal development of vegetation is considered.
Graf et al., 2014, found within the scope of aggregate stability investigations that the root length per soil volume of alder specimen grown for 20 weeks under laboratory conditions is comparable to the one of 20 years old vegetation in the field. This means that already relatively short time scales can provide meaningful information at least for the first stage of colonization of soil bioengineering measures, which is also the most critical.
In the present study we analyzed the effect of root growth on two soil properties critical to evaluate the performance of vegetation in restoring and re-stabilizing slopes: permeability and soil aggregate stability. We set up a laboratory experiment in order to work under controlled conditions and limit as much as possible the natural variability.
Alnus incana was selected as the study species as it is widely used in restoration projects in the Alps, also because of its capacity to fix nitrogen and its symbiosis with both ecto and arbuscular mycorrhizal fungi.
After the first month of growth in germination pots, we planted one specimen each in big quasi cylindrical pots of 34 cm diameter and 35 cm height. The pots were filled with the soil fraction smaller than 10 mm coming from an oven dried moraine collected in a subalpine landslide area (Hexenrübi catchment, central Switzerland). The targeted dry unit weight was 16 kN/m3. The plants have been maintained at a daily temperature of 25°C and relative humidity of 75Four different growing periods have been distinguished (1, 2, 4 and 8 months). For each growing period 7 planted replicates have been set up, as well as 3 control pots with only bare soil treated the same way as the planted pots.
After each growing period, the soil permeability was measured by means of a falling head procedure (Bagarello and Iovino, 2010) directly in the pots. Furthermore, soil aggregate stability was determined on soil samples applying a wet sieving method (Graf and Frei, 2013). Subsequently, root systems were collected and analyzed using different image software (Smartroot and Winrhizo).
The permeability and soil aggregate stability values were finally linked with the root development stage and compared with field data coming from long-term stabilized slopes. Preliminary analysis reveals no significant influence of alder roots on both soil aggregate stability and hydraulic conductivity of soil after the one month growing period compared to the control. However, after two months we observed a decrease in the hydraulic conductivity values.