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Towards the development and evaluation of sustainable bioengineering measures on an erosion-prone slope

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Precipitation regimes, especially in the mid and high latitudes of the Northern hemisphere are expected to be modified as a result of the ongoing climate change. More frequent intense rain fall events during the summer seasons have distinct influences on erosional processes on slopes especially in Alpine areas. Heavy rainfall events are directly linked to the frequency and magnitude of mass movements. Higher erosion rates result in an increased natural and socio-economic damage potential, primarily in vegetation-free areas. Hence, soil bioengineering measures (e.g., hillside stabilization with living plants) gain more and more importance in order to prevent shallow mass movements and erosion on steep exposed slopes.

Particularly root-systems of shrubs and trees do play a key role in stabilizing the near subsurface material on slopes as well as in the regulation of the soil water budget. In contrast to technical constructions a ready to go method for quantifying the stabilizing effect of vegetation is still lacking and, therefore, it is difficult to quantify vegetation effects in a simple way. Thus, the main goal of our project is to demonstrate the possibilities and limitations of soil bioengineering measures on erosion-prone slopes and sliding surfaces to implement an aggregate-stability model. Consequently, the following questions arise:

(i) How is soil aggregate stability affected by the (fine)root development?
(ii) What is the role of mycorrhiza hereunder? Is inoculation of mycorrhizal fungi beneficial to soil bioengineering measures at erosion-prone hillsides?
(iii) Is there an impact on the soil water budget due to such measures?
(iv) Which parameters can be deduced from the results to generate an aggregate-stability model?

In May 2010, we established four new research plots at an erosion-prone talus slope (inclination: $\sim$43°; elevation 1220 m – 1360 m a.s.l.), located in the Arieschbach catchment area, Fideris/Eastern Swiss Alps. The slope, consisting of moraine and denudation-derived substratum, shows high geomorphic activity (e.g. debris flows, rill erosion). Two of the plots were stabilized with 1200 plants each. Additionally, mycorrhiza inoculum was added to one of these plots (INOQ Forst, 40ml/plant). Per running meter a mixture of eight transplants was planted in 15 rows of 10 m. The assortment included four saplings of Alnus and two of Salix as well as one further individuum of a tree (Acer, Betula, Fraxinus) and shrub species (e.g. Viburnum, Lonicera, Liguster). Finally, both plots were hand-seeded with an Alpine seed-mixture. The third plot already showed some pioneer vegetation and the fourth plot was vegetation-free. Furthermore, sites already stabilized between 1990 and 2006 serve as reference plots.

Preliminary results after the first vegetation period indicate that the plot, which was treated with mycorrhiza shows higher plant vitality. In September 2010 all plants were counted and measured. At that time, 700 plants survived the planting procedure at the mycorrhiza treated site, showing an average height of 23 cm; whereas only 462 (average plant height: 18 cm) survived at the non-inoculated site. Furthermore, first results are shown from leave samples, analysed in respect to their size, weight, water content, and C and major nutrient concentrations (N, P, K, Ca, Mg).