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Mycorrhizal inoculation as a tool for sustainable bio-engineering measures in steep alpine environments? – Results of a three year field experiment

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Global warming is anticipated to result in an increase of heavy precipitation events. In vegetation-free, steep Alpine areas intense rain fall events have distinct influences on erosional processes on slopes. These processes and (shallow) mass movements are directly linked with torrential rain falls, and for this lead to high erosion rates in those regions, resulting in an increased natural and socio-economic damage potential.

For restoring and managing erosion-prone sites, bioengineering measures as a tool for hazard prevention gain more importance. Due to the rough environmental conditions, and hence, reduced germination capability and sprout vigour, it is difficult to establish a dense cover of pioneer vegetation. Thus, the question is what can be done to give planted saplings within bioengineering projects maximum support, to develop their above- and belowground structures to promote slope stabilization. Green-house and laboratory experiments have shown that mycorrhizal inoculum has a positive impact on plant development and soil structure, e.g. the formation of (stable) aggregates within several months. Based on these promising results, we intended to apply mycorrhizal inoculation in a field-experiment.

In May 2010, we established experimental plots at an erosion-prone talus slope (inclination: ~40 - 45 °; elevation 1220 – 1360 m a.s.l.), located in the Eastern Swiss Alps. The slope, consisting of moraine and denudation-derived substrate, shows high geomorphic activity (e.g. debris flows, rill erosion). Two slope areas, 10m wide and 32m long, were stabilized with 1200 plants each. Additionally, mycorrhiza inoculum (INOQ Forst, 40 ml/plant) was added to one of the two areas. Within the stabilized areas, a mixture of eight saplings was planted per running meter in 15 rows. The assortment included four saplings of green alder and two of purple willow, as well as one tree (maple, birch, ash) and shrub species (e.g. guelder rose, honeysuckle). Finally, both areas were hand-seeded with an Alpine seed-mixture. In addition, a third was selected but not treated, reflecting the natural conditions and serving as a control.

Next to analysing aboveground whole-plant traits (e.g. plant height, crown diameter, stem thickness) and leaf traits (e.g. specific leaf area, leaf size, leaf dry matter content, nitrogen and potassium analyses), we also focused on belowground properties. Undisturbed soil cores (0-20cm in depth) allow a determination of a aggregate stability coefficient, the aggregate-size development, as well as root traits (e.g. root length density, fine(root)diameter). Linear mixed-effect models and testing a posteriori contrasts permit a comparison between the different treatments.

Preliminary results indicate, that four months after stabilization plant mortality was high over the two treatments, but it was significantly less on the inoculated treatment. In general plant and leaf traits are showing, that plant vitality is higher at the mycorrhizal-treated plots. Examination of belowground properties yield surprising results; the non-inoculated treatment is showing higher aggregate stability coefficients and higher root length density, which is in contrast to laboratory results. Our contribution will highlight the results of the entire three year field experiment.