Geophysical Research Abstracts
Vol. 17, EGU2015-9279-2, 2015
EGU General Assembly 2015

Does mycorrhizal inoculation benefit plant survival, plant development and small-scale soil fixation? Results from a perennial eco-engineering field experiment in the Swiss Alps.

Alexander Bast (1), Maria Grimm (1,2), Frank Graf (1,3), Roland Baumhauer (2), and Holger Gärtner (1)

(1) Swiss Federal Insitute for Forest, Snow and Landscape Research (WSL), Landscape Dynamics/Dendroecology, Birmensdorf, Switzerland (alexander.bast@wsl.ch), (2) University of Würzburg, Institute of Geography and Geology, Würzburg, Germany, (3) WSL Institute for Snow and Avalanche Research SLF, Davos Dorf, Switzerland

In mountain environments superficial slope failures on coarse grained, vegetation-free slopes are common processes and entail a certain risk for humans and socio-economic structures. Eco-engineering measures can be applied to mitigate slope instabilities. In this regard, limited plant survival and growth can be supported by mycorrhizal inoculation, which was successfully tested in laboratory studies. However, related studies on a field scale are lacking. Furthermore, mycorrhizae are known to enhance soil aggregation, which is linked to soil physics such as shear strength, and hence it is a useful indicator for near-surface soil/slope stability.
The overall objective of our contribution was to test whether mycorrhizal inoculation can be used to promote eco-engineering measures in steep alpine environments based on a five-year field experiment. We hypothesized that mycorrhizal inoculation (i) enhances soil aggregation, (ii) stimulate plant survival and fine root development, (iii) effects plant performance, (iv) the stimulated root development in turn influences aggregate stability, and (v) that climatic variations play a major role in fine-root development.
We established mycorrhizal and non-mycorrhizal treated eco-engineered research plots (hedge layers mainly consisting of Alnus spp. and Salix spp.) on a field experimental scale. The experimental site is in the eastern Swiss Alps at an erosion-prone slope where many environmental conditions can be seen as homogeneous. Soil aggregation, fine root development and plant survival was quantified at the end of four growing seasons (2010, ‘11, ‘12, ‘14). Additionally, growth properties of Alnus spp. and Salix spp. were measured and their biomass estimated. Meteorological conditions, soil temperature and soil water content were recorded.
(i) The introduced eco-engineering measures enhanced aggregate stability significantly. In contrast to published greenhouse and laboratory studies, mycorrhizal inoculation delayed soil aggregate stabilization relative to the non-inoculated site but resulted in a significantly higher aggregate stability compared to the control and the non-inoculated site at the end of the third growing season. (ii) Plant survival was significantly improved by the inoculation. Fine-root development was stimulated but not immediately. At the end of the third growing season, root length density tended to be higher and mean root diameter was significantly increased at the mycorrhizal treated site. (iii) Analyses on plant performance of Alnus and Salix demonstrated that the inoculated saplings achieved significantly higher survival rates. There was no treatment effect on plant growth properties except in 2010, where plant height and main stem diameter of Alnus was increased at the mycorrhizal treated site. The estimated total biomass of Alnus and Salix was higher at the mycorrhizal treated site. (iv) There was a positive correlation between root length density and aggregate stability, whereas roots < 0.5 mm were most influential on aggregate stability. (v) Interannual climatic variations seem to have a crucial influence on root development and, hence, on slope stability.
There is a temporal offset of two growing seasons between inoculation effects tested in greenhouse/laboratory and the presented field experiment. However, the application of a commercial mycorrhizal inoculum in eco-engineering measures is a beneficial promoter to mitigate slope instability and surface erosion but needs to be tested at other sites. The contribution is mainly based on Bast (2014) and was funded by the Wolfermann Nägeli Stiftung Zürich and the Swiss Federal Office for Environment (BAFU No.: 09.0027.PJ/I211-3446).

Bast, A. (2014): Mycorrhizal inoculation as a promoter for sustainable eco-engineering measures in steep alpine environments? Results of a three-year field experiment in the Arieschbach catchment, Fideris, eastern Swiss Alps. PhD Thesis. University of Berne: 149pp.